Freedom-to-Operate Standard Scan

AI Visual Inspection System (line-scan camera + CNN segmentation + reject actuator)

Case PATTI-FTO-SAMPLE-VIS · 2026-07-31 · Patti by Empryon

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The screening is sample-based: only the patents listed in the Search Log and Patents Reviewed sections were examined. Absence of a reference in this report does not mean no relevant patent exists.

Patent numbers, titles, assignees, dates and claims text are retrieved from public sources and each entry carries a link for independent verification. Relevance assessments and observations are AI-generated reasoning and may be wrong.

Consult a registered patent attorney before making any filing, launch, or freedom-to-operate decision.

1. Subject & Standardized Technical Features

Subject under screening (as confirmed by the requester):

An industrial visual inspection system for factory production lines. A line-scan camera continuously acquires images of products moving through the inspection station. A convolutional neural network performs pixel-level semantic segmentation on the captured images to detect and localize surface defects. Detections are graded against a confidence threshold, and confirmed defects trigger a pneumatic reject actuator that removes the defective part from the line, with results written back to the factory MES database. Target market: US.

Stated target market jurisdiction(s): US — deep-review slots are prioritized for patents enforceable there (WO/PCT next); out-of-jurisdiction documents reviewed after. Family members in the target jurisdiction are not resolved by this tier — check via each patent's link.

Feature	Name	Description (claim-comparable)
TF1	Line-scan image acquisition	A line-scan camera continuously captures images of products moving through an inspection station on a production line
TF2	Semantic segmentation defect detection	A convolutional neural network performs pixel-level semantic segmentation on captured images to detect and localize surface defects
TF3	Confidence threshold grading	Detected defects are graded against a confidence threshold to confirm valid defect detections
TF4	Automated pneumatic reject mechanism	Confirmed defects trigger a pneumatic reject actuator that physically removes the defective part from the production line
TF5	MES data integration	Inspection results are written back to the factory Manufacturing Execution System (MES) database

Standardized invention units (one-ruler semantic standardization — the same method is applied to each patent claim below):

Unit	Standardized essence	Limiting scope
F1	Continuous line-based optical image acquisition of moving objects at an inspection point	Image acquisition must be line-scan based (row-by-row capture); Products must be in motion relative to the camera; Acquisition occurs at a defined inspection station on a production line; Capture must be continuous/ongoing rather than single-shot
F2	Pixel-level deep learning based semantic segmentation for defect detection and localization	Detection must be at pixel-level granularity (semantic segmentation), not merely bounding-box or whole-image classification; Neural network must be convolutional in nature; Defects detected are surface defects on products; Both detection (presence) and localization (spatial extent) of defects must be achieved simultaneously
F3	Confidence-based filtering/validation of detected defects to reduce false positives	A quantitative confidence measure must be associated with each detected defect;

		A threshold-based comparison must be used as the validation criterion; Only detections meeting/exceeding the threshold are confirmed as valid defects
F4	Automated physical removal of confirmed defective parts using pneumatic actuation triggered by inspection results	Actuation mechanism must be pneumatic; Triggering must be automated and conditioned on confirmed defect detection (from F3); Removal must be a physical separation of the part from the line, not merely a flag or alert
F5	Automated data feedback/integration of inspection outcomes into a factory-level manufacturing execution system	Target system must be a Manufacturing Execution System (MES) at the factory level; Data transfer must involve writing/storing inspection results, not merely displaying them locally; Integration must be with a database associated with the MES

2. Methodology & Screening Funnel (auditable)

Real patent-database search via Google Patents index. Funnel: 236 unique hits searched → 236 relevance-screened (every hit) → 111 flagged as potentially relevant → 40 claims-reviewed in depth (every one with actual claims text) · 6 flagged hits had unretrievable claims and did not consume review slots (listed below). 125 screened out as low-relevance/irrelevant. Every patent cited below originates from these searches — none are AI-generated.

Query	Hits	Source
line-scan camera convolutional neural network defect segmentation production line	40	searchapi
pixel-level semantic segmentation surface defect detection inspection system	40	searchapi
automated visual inspection pneumatic reject actuator defective part removal	40	searchapi
machine vision defect detection confidence threshold MES database integration	40	searchapi
deep learning surface defect inspection industrial production line reject mechanism	40	searchapi
CNN based semantic segmentation quality inspection manufacturing system	40	searchapi

Flagged and prioritized, but claims text could not be retrieved automatically — these did NOT consume deep-review slots (replacements were pulled from the flagged list); review manually via the links:

Patent	Title	Screen relevance
JP3492509B2	Surface defect inspection apparatus and fluorescent magnetic particle ...	HIGH
JP7568727B2	System and method for AI visual inspection	HIGH

JP4016381B2	Surface defect inspection equipment	HIGH
KR20080001592A	Semiconductor device marking and vision inspection device	MEDIUM
JP2012531598A	Apparatus and method for inspecting defects in discrete low-rigidity ...	MEDIUM
JP2010217117A	Device and method for defect inspection	MEDIUM

Flagged but not deep-reviewed (over the disclosed review cap of this tier) — listed for transparency; consider a higher tier or manual review:

Patent	Title	Screen relevance
CN118261878A	Photovoltaic module evaluation method and system based on AI visual detection ...	MEDIUM
CN113744297A	A kind of MRI superconducting wire braided layer surface defect detection ...	MEDIUM
CN119379701B	Shaving board quality detection method and system based on image recognition	MEDIUM
CN114377997B	Rod sorting device and method based on COMS and hyperspectral camera	MEDIUM
JP2000237996A	Working and transporting device for molded article	MEDIUM
CN120741467B	Door plate, frame and paint detection method and system based on machine vision	MEDIUM
CN109378279B	Wafer inspection method and wafer inspection system	MEDIUM
CN111402225B	A Method for Folding Misdetection Defects in Cloth	MEDIUM
CN113030108A	Coating defect detection system and method based on machine vision	MEDIUM
CN116563238A	Cloth surface image flaw detection method based on multi-source heterogeneous ...	MEDIUM
JP2013190386A	Defect inspection device	MEDIUM
TW202223740A	Automatic inspection system and operation method thereof including a machine ...	MEDIUM
CN113838034B	Quick detection method for surface defects of candy package based on machine ...	MEDIUM
CN121073982A	Hard board micro-defect online diagnosis method and system based on deep ...	MEDIUM
CN115908301A	A defect detection method, device and storage medium based on enhanced input	MEDIUM
JP7730307B2	Product Inspection System	MEDIUM
CN113643224B	Defect detection method and device based on semi-supervised learning	MEDIUM

KR102943258B1	Vision Inspection Process System for Automated Precision-Machined Parts ...	MEDIUM
CN121365905A	Detection method and system of pharmaceutical production line based on visual ...	MEDIUM
CN117450950A	Press-type ballpoint pen entire pen appearance inspection system and inspection ...	MEDIUM
CN119470434A	A visual inspection method for electromagnetic wires	MEDIUM
CN115993362A	Industrial product testing system and testing method	MEDIUM
CN118710035B	Real-time monitoring method, system and storage medium for electroplating ...	MEDIUM
CN115330713A	Cathode plate detection method based on machine vision, server and readable ...	MEDIUM
JP2004333223A	Defect inspection method and device	MEDIUM
CN118209561B	Coil stock detection method and system	MEDIUM
JP2007292477A	Water stain inspection device and inspection method for transparent film	MEDIUM
CN111833303B	Product detection method, device, electronic equipment and storage medium	MEDIUM
CN107369155A	A kind of cloth surface defect detection method and its system based on machine ...	MEDIUM
CN119831966A	PCB production line defect detection system and method based on image ...	MEDIUM
CN106000904B	A kind of house refuse Automated Sorting System	MEDIUM
TW202107074A	An image classification system	MEDIUM
CN120609826A	A system and method for detecting the full appearance of terminal blocks based ...	MEDIUM
KR102707760B1	Frequency domain enhancement of low SNR flat residue/stain defects for ...	MEDIUM
CN119810100B	A persimmon quality detection method and system based on machine vision	MEDIUM
CN113393426A	Method for detecting surface defects of rolled steel plate	MEDIUM
JP3339128B2	Defect inspection method and apparatus used for its implementation	MEDIUM
CN107123114A	A kind of cloth defect inspection method and device based on machine learning	MEDIUM
KR950704679A	Process and device for inspecting transparent material	MEDIUM

CN114235837A	LED packaging surface defect detection method, device, medium and equipment ...	MEDIUM
CN115298809A	Inspection system	MEDIUM
JPH08327561A	Device for inspecting continuous sheet-shaped object for defect	MEDIUM
CN120490126A	Visual detection device and detection method for surface defects of metal foil	MEDIUM
JP2000088765A	Inspection apparatus for flaw on plane	MEDIUM
CN120922439A	Electronic cigarette packaging box detection equipment and electronic cigarette ...	MEDIUM
CN115205209A	A Weakly Supervised Learning-Based Detection Method for Monochrome Cloth ...	MEDIUM
CN120510344A	Plastic packaging bag flaw visual detection method and system	MEDIUM
CN118096751B	Injection molded parts appearance defect detection method, device, electronic ...	MEDIUM
CN114693621A	Vision-based automatic cloth inspecting method for white ultra-fine denier ...	MEDIUM
JPH08101130A	Surface flaw inspecting device	MEDIUM
CN120355909A	Method for processing digital images of fabric in output from textile machine	MEDIUM
JP2007108125A	Inspection device of foreign matter or flaw of transparent sheetlike article ...	MEDIUM
CN111951249A	Visual detection method of mobile phone light guide plate defects based on ...	MEDIUM
JP2006226801A	Inspection device for glass substrate, and inspection method of glass substrate	MEDIUM
TWI872322B	Systems and methods for classifying manufacturing defects	MEDIUM
CN110570393A	A method for detecting defects in the window area of mobile phone glass cover ...	MEDIUM
JP5592635B2	Determination device, determination method, and computer program	MEDIUM
CN114170226B	Linen detection method and device based on image enhancement and convolutional ...	MEDIUM
CN116993668A	Bearing surface defect visual detection method based on improved YOLOv7	MEDIUM
CN119741698A	Polyurethane roller defect detection method and related equipment	MEDIUM
CN113610848A	Digital cloth processing system, cloth flaw	MEDIUM

	detection method, device and medium	
KR20230122916A	Method and apparatus for generating a deep learning model to detect defects on ...	MEDIUM
CN217332186U	Wooden board AI visual defect detection device	MEDIUM
CN112102224A	Cloth defect identification method based on deep convolutional neural network	MEDIUM
JP3135075B2	Appearance inspection method and apparatus, magnetic head inspection method and ...	MEDIUM

This is a screening funnel, not an exhaustive legal clearance search.

3. Patents Reviewed (claims-level)

⚠ **AI REASONING — MAY BE WRONG.** The relevance grades, overlap points and distinguishing points below are AI analysis of the actual claims text. Verify each patent via its link before relying on any statement.

3.1 US11941799B2 — Machine-learning based camera image triggering for quality assurance inspection processes

Assignee: Elementary Robotics Inc · Published: 2024-03-26 · Status: Active · exp. 2041-06-07 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's initial step of 'receiving a feed of images of objects passing in front of an inspection camera module' broadly reads on the invention's line-scan camera continuously capturing images of products moving through an inspection station.
- Claim 8 recites 'generating, using at least one machine learning model, a mask that indicates, via a probability on a per pixel basis, a likely location of an object within each image,' and claim 9 specifies this model is a CNN trained on per-pixel labeled data — this broad, generic language for per-pixel/probabilistic object localization via CNN could be read to encompass the invention's CNN-based pixel-level semantic segmentation, since the claim does not limit the 'object' being localized to a whole product versus a defect region.
- Claim 10's binarization of the CNN mask output to indicate detected pixel locations is a generic post-processing step that could overlap with any thresholding/confirmation step applied to a segmentation network's pixel-probability output, including the invention's confidence-threshold grading of detected defect regions.

Appears to differ (AI reasoning):

- Claim 1 requires 'assigning instance identifiers to each object' and then 'identifying, for each object using the corresponding instance identifier, a single image from among a plurality of candidate images in which the object is optimally represented' — a multi-frame object-tracking and best-frame-selection scheme. The invention as described performs continuous per-image defect segmentation without any described instance-ID tracking across multiple candidate images or selection of a single optimal frame per object.
- Claim 1 further requires 'providing the identified images to a consuming application... for quality assurance analysis' — i.e., the claimed system outputs selected raw images for downstream QA analysis, whereas the invention's pipeline itself performs the QA (defect) analysis at the segmentation stage; the claim's specific triggering/selection-then-handoff architecture is not indicated as present in the invention.

- Claims 17-21 require centroid-based trajectory estimation, trajectory-based stopping of tracking, and filtering images by object size/trajectory — none of these instance-tracking/trajectory mechanisms are described as part of the invention's continuous line-scan defect detection.
- Claim 12-16 require determining motion between adjacent images via a CNN producing an optical-flow-like vector field — the invention description does not mention any motion/optical-flow estimation step.
- The claims as a whole are directed to selecting an optimal single frame per tracked object from a continuous feed for later QA analysis, not to performing the defect detection, confidence grading, physical rejection, or MES logging steps that are central to the invention; these downstream invention elements (confidence threshold grading, pneumatic reject actuation, MES integration) are not recited in the claims and therefore are not addressed by this patent's claim set.

Note: This patent's claims center on a machine-learning-driven frame-triggering method: detecting object presence in a continuous image feed, tracking objects via instance IDs/trajectories, and selecting a single 'optimally represented' image per object to hand off for external QA analysis. The invention instead describes a full inline inspection pipeline (line-scan capture, CNN-based pixel-level defect segmentation, confidence thresholding, pneumatic rejection, and MES logging). There is potential overlap in the generic image-feed-from-inspection-camera language and in the broad CNN/per-pixel mask generation language of claims 8-10, which could be read broadly enough to cover a segmentation network's pixel-probability outputs regardless of whether the 'object' is a whole part or a defect. However, the claims' core inventive elements — instance identification, multi-image comparison, trajectory-based tracking/filtering, and selection of a single best frame for external analysis — do not appear to be present in the invention as described, which instead performs continuous per-frame defect analysis without a described frame-selection/triggering stage. This is an informational screening note only, not a legal or infringement conclusion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap claim regarding claims 8-10 stretches the claim language: claim 9 specifies the CNN is 'trained using a dataset with per pixel labels indicating locations of salient objects,' which in context (per claim 1 and abstract) refers to detecting whether an object (the whole part) is present, not defect regions; characterizing this as plausibly covering defect-region segmentation is a speculative/overstated reading not clearly supported by the patent text, though the note does hedge with 'could be read to encompass' and 'broad language,' which mitigates but does not eliminate the overstatement.
- The distinguishing point stating that claim 1's frame-selection/hand-off architecture 'is not indicated as present in the invention' and describing the invention's segmentation as happening in place of that architecture is a legitimate distinguishing feature (invention lacks instance tracking/frame selection), so this is properly reasoned architecture-difference distinguishing, not wrong-direction reasoning by itself.
- The statement that 'downstream invention elements (confidence threshold grading, pneumatic reject actuation, MES integration) are not recited in the claims and therefore are not addressed by this patent's claim set' is reasoning in the wrong direction for FTO purposes: the fact that the claims do not recite these limitations does not mean the invention avoids infringement — broader claims lacking these limitations are actually more likely to read on the invention, not less. This is a wrong-direction logic issue that should be flagged as such rather than presented as a clean distinguishing point.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
E1: Acquisition of a feed of images of moving objects at an inspection point via a camera module, objects conveyed automatically past the camera	F1	**PARTIAL**	The claim requires a 'feed of images' of objects conveyed past a camera, which is a broader genus encompassing frame-based or continuous capture; F1 requires specifically line-

			scan (row-by-row) continuous acquisition. The claim does not specify the image feed is line-scan based, so the correspondence is only partial pending clarification of image feed type, and the invention's line-scan limitation is narrower than the broad 'feed of images' language.
E2: Machine-learning-based detection of object presence within an image	—	**NO COUNTERPART**	This element concerns detecting whether an object (the item to be inspected) is present in the frame at all, which is a distinct function from F2's defect detection/segmentation on the surface of an already-identified object; the invention's units do not disclose an object-presence detection step prior to defect analysis.
E3: Assignment of unique instance identifiers to detected objects for tracking across images	—	**NO COUNTERPART**	None of the invention units (F1-F5) describe assigning instance identifiers to track individual objects across a sequence of images; the invention's F2 performs pixel-level defect segmentation but does not track object instances via identifiers.
E4: Selection of a single optimal representative image per tracked object instance from multiple candidate images	—	**NO COUNTERPART**	The invention units describe continuous line-scan acquisition (F1) and per-pixel defect detection (F2) but contain no step of selecting a single best-quality image of an object from among multiple candidates; this optimal-frame-selection function has no counterpart.
E5: Output/provision of the selected optimal image to a downstream process for quality assurance analysis	F5	**CANNOT ASSESS**	The invention's F5 involves feeding inspection outcomes to a factory MES database, whereas the claim element concerns providing a selected raw image to a

			downstream analysis process; it is unclear from the given standardized units whether the invention performs any equivalent image-forwarding step prior to defect analysis, so correspondence cannot be assessed with confidence.

All-elements note: Not every claim element found a counterpart in the invention's standardized units. Element E1 (image feed acquisition) only partially corresponds because the claim's broad image-feed language does not specify the line-scan capture required by F1. Elements E2 (object-presence detection), E3 (instance identifier assignment), and E4 (single optimal image selection per object) appear to lack any counterpart among the disclosed invention units, which instead focus on pixel-level defect segmentation, confidence filtering, pneumatic removal, and MES integration rather than object tracking and best-frame selection. Element E5 could not be reliably assessed against the invention's units due to differing described functions.

Equivalents caution: For E1, the claim's generic 'feed of images' language versus the invention's specific line-scan continuous acquisition could arguably be viewed as an insubstantial difference if line-scan capture is understood as one common species of image-feed acquisition, though this remains uncertain without further disclosure; users should exercise doctrine-of-equivalents caution here.

3.2 US11954846B2 — Explainability and complementary information for camera-based quality assurance inspection processes

Assignee: Elementary Robotics Inc · Published: 2024-04-09 · Status: Active · exp. 2041-10-19 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 recites 'receiving data derived from a feed of images of a plurality of objects passing in front of an inspection camera module' — this broad language could encompass the invention's line-scan camera continuously imaging products moving through an inspection station.
- Claims 10-11 recite an anomaly detector that determines on a pixel-by-pixel basis whether attributes of the object are anomalous, using one or more convolutional neural networks — this is conceptually similar to the invention's CNN-based pixel-level semantic segmentation defect detection, though the specific mechanism (anomaly scoring vs. semantic segmentation classification) differs and should be treated as a potential equivalents overlap rather than an exact match.
- Claim 5 references overlay images 'only generated when the quality assurance metrics are above a defined threshold' — broadly analogous in concept to the invention's confidence-threshold grading of detected defects, though applied to a different downstream function (overlay generation vs. reject confirmation).
- Claim 8 recites that received data may be derived from a video feed of a manufacturing production line for the objects, which overlaps generically with the invention's production-line inspection context.

Appears to differ (AI reasoning):

- Claim 1 (and claim 17, 19) requires generating 'overlay images characterizing the quality assurance metrics' and 'combining the overlay images with the corresponding image... to generate an enhanced image' — the invention as described does not appear to include any overlay-image generation or image-enhancement step; it performs detection, threshold grading, and rejection rather than producing enhanced/annotated images.
- Claims 1, 17 require that the image analysis inspection tools be 'containerized,' with containers encapsulating software code, runtime requirements, dependencies, and metadata — the

invention's CNN-based detection is not described as being implemented via containerized inspection tools.

- Claim 19 requires overlay images that 'visualize why the... machine learning model generated the corresponding quality assurance metrics' with pixel-level color/transparency values tied to contribution level (an explainability visualization) — the invention's confidence-threshold grading does not appear to involve any such explainability overlay output.
- Claims 1, 17, 19 require 'providing the enhanced images to a consuming application or process for quality assurance analysis' — the invention's downstream actions (pneumatic reject actuation, MES data write-back) are different outputs and do not correspond to provision of an enhanced/overlay image product.

Note: This patent's claims center on a video-processing pipeline that produces explainability/quality overlay images combined with the original object image via containerized inspection tools, culminating in an enhanced image delivered to a consuming application. The invention instead centers on CNN-based semantic segmentation for defect localization, confidence-based grading, and a physical pneumatic rejection plus MES integration workflow. There is generic overlap in the image-capture-from-a-production-line and CNN/anomaly-detection concepts (claims 1, 8, 10-11), which should be flagged given the broad claim language, but the claims' core distinguishing requirements — overlay image generation, image enhancement/combination, containerized tooling, and explainability visualization — do not appear to be present in the described invention based on the provided feature list. This is an informational screening note only, not a legal or infringement conclusion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement regarding claim 1's 'inspection camera module' generically capturing images is reasonably supported, but the note does not flag that claim 1 also requires containerized tools, overlay generation, and enhanced image output as limiting elements narrowing the claim — this omission is addressed later, so it is only a minor sequencing issue.
- The claim 5 comparison ('overlay images only generated when quality assurance metrics are above a defined threshold') is stretched: claim 5's threshold gates whether an overlay image is generated at all, not a defect-confirmation/grading mechanism analogous to the invention's confidence threshold for defect validity; characterizing this as 'broadly analogous' overstates the conceptual similarity beyond what the claim text supports.
- The claim 8 overlap point is trivial/generic (video feed from a manufacturing line) and is presented as a substantive overlap without qualifying its weakness relative to the claim's other mandatory limitations (containerization, overlay generation) that are absent from the invention — bordering on overstatement but disclosed elsewhere in the note.
- The distinguishing points reference correctly that the invention lacks overlay-image generation, containerized tooling, explainability visualization, and enhanced-image provision, which is faithful since claims 1, 17, and 19 explicitly require these elements as claim limitations (not merely absent optional features), so this is proper narrowing logic rather than wrong-direction reasoning.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.a: Acquisition of an image feed of objects moving past a camera at an inspection point, with data received into a processing pipeline	F1	**CORRESPONDS**	Claim recites receiving image feed data of objects passing in front of an inspection camera, i.e., objects in motion relative to a camera at an inspection point; this genus of image feed acquisition covers F1's continuous line-based (line-

			scan) acquisition as a species, though claim 1 does not itself require line-scan capture.
1.b: Generation of quality metrics for each object via one or more software-containerized analysis tools operating on the image data	F2	**PARTIAL**	F2 requires pixel-level semantic segmentation via a convolutional neural network for simultaneous surface-defect detection and localization; claim 1 broadly requires only 'containerized image analysis inspection tools' generating 'quality assurance metrics' without specifying pixel-level segmentation, CNN architecture, or simultaneous detection/localization—dependent claims 10-11 add pixel-by-pixel anomaly detection and CNNs, but claim 1 itself is broader/different in character (containerization is not required by F2, and F2's pixel-level/CNN specifics are not required by claim 1).
1.c: Creation of a visual overlay representing the computed quality metrics	—	**NO COUNTERPART**	None of the invention units F1-F5 involve generating an overlay image characterizing metrics; the invention's outputs are confidence-based validation (F3) and downstream actuation/data feedback (F4, F5), not visual overlay generation, so this claim element appears to lack a counterpart in the described invention.
1.d: Merging the generated overlay with the original object image to produce a composite enhanced image	—	**NO COUNTERPART**	The invention units do not describe combining an overlay with the original image to form an enhanced image; this appears absent from the invention as described.
1.e: Delivery of the enhanced (overlay-combined) image output to a downstream consumer for further quality analysis	F5	**PARTIAL**	F5 requires automated writing of inspection outcome data into a factory-level MES database, a specific downstream

			integration; the claim element broadly provides 'enhanced images' (not raw inspection outcome data) to an unspecified 'consuming application or process,' which is an adjacent but different implementation (image-based delivery to an unspecified consumer versus data-record integration with an MES database) rather than a genus covering F5's species.

All-elements note: Two of the five claim elements (generating overlay images characterizing quality metrics, and combining the overlay with the object image to form an enhanced image) appear to lack a counterpart in the described invention units, which instead center on line-scan acquisition, pixel-level CNN-based segmentation, confidence-thresholding, pneumatic removal, and MES data integration rather than overlay-image generation or enhanced-image compositing. The remaining elements (image feed acquisition; containerized analysis tool generating metrics; providing enhanced images to a consumer) find at least partial counterparts, though the containerized-tools and consumer-delivery elements differ from the invention's specific pixel-level/CNN detection and MES-database integration approaches.

Equivalents caution: For element 1.b (containerized image analysis tools generating quality metrics vs. F2's pixel-level CNN semantic segmentation), the difference is substantive rather than insubstantial, since containerization and generic 'quality assurance metrics' do not inherently require pixel-level segmentation or CNN architecture, so an equivalents argument appears weak. For element 1.e (providing enhanced images to a consuming application/process vs. F5's automated writing of inspection results to an MES database), the difference between image-based output delivery and structured data integration into a factory MES is also likely substantive rather than insubstantial, given the distinct technical mechanisms (image transmission versus database writing) involved.

3.3 US12243216B2 — System and method for AI visual inspection

Assignee: Musashi Ai North America Inc · Published: 2025-03-04 · Status: Active · exp. 2041-10-25 · Relevance: HIGH · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1/8/12 recite a camera acquiring image data of an article under inspection — broadly encompasses the invention's line-scan camera continuously imaging products on a production line
- Claim 1/8/12's 'machine-learning based object detection model' generating defect data (class, location, confidence level) is a broad/generic limitation that appears to read on the invention's CNN-based semantic segmentation model, which localizes and classifies defects with a confidence score
- Claim 1/8/12's requirement that the defect detection model perform multiclass classification into three or more classes including at least two defect types may overlap with the invention's semantic segmentation defect detection if it distinguishes multiple defect types
- The 'confidence level' element in defect data (claims 1/8/12) potentially overlaps with the invention's confidence threshold grading step used to confirm valid detections
- Claim 7/10/13/14's tracking of a defect across consecutive frames to confirm a 'true detection' before sending defect data is conceptually analogous to the invention's confidence threshold grading step, and may be read broadly to encompass it as an equivalent confirmation mechanism

- Claim 1/8/12's PLC device receiving defect data broadly encompasses the invention's downstream control logic that triggers the pneumatic reject actuator, since a PLC is a common controller for actuating pneumatic ejectors in production lines

Appears to differ (AI reasoning):

- Claims 1, 8, and 12 require a PLC device as the recipient of defect data; the invention description does not explicitly identify a PLC as the controller for the reject mechanism, though this may be an implementation detail rather than a true absence
- No claim requires a pneumatic reject actuator specifically; claims 16-19 recite alternative unacceptable-defect responses (stop inspection command, alarm command, continue with counter update, or article-identifier capture/storage) — since these are alternative dependent limitations, the invention's pneumatic reject mechanism does not appear required by independent claims 1/8/12, but could potentially fall under a broader unclaimed embodiment; no independent claim recites a generic 'automated removal/reject actuator' limitation that the invention must satisfy

Note: This is an informational screening note based solely on the verbatim claims of US12243216B2, not a legal or infringement opinion. Independent claims 1, 8, and 12 use broad/generic language (camera, ML-based object detection model producing class/location/confidence, PLC receiving defect data) that appears capable of encompassing the invention's line-scan camera, CNN-based semantic segmentation, and confidence-threshold confirmation architecture — these represent potential overlap areas requiring closer claim-construction and equivalents analysis, particularly around whether semantic segmentation qualifies as 'multiclass classification' object detection and whether confidence-threshold grading is equivalent to consecutive-frame tracking confirmation (claims 7/10/13/14). Dependent claims involving robotic arm movement, article rotation/stitching, article-identifier capture, and specific PLC response actions (alarm, stop, counter) are narrower and do not appear required by the invention, but since they are dependent limitations they do not affect the overlap risk from the independent claims. No claim explicitly recites a pneumatic actuator or MES integration, so these specific invention features are not directly addressed by the claim language, though this alone does not establish a difference from the broader independent claims. Recommend detailed claim-chart analysis and file-history review by qualified patent counsel.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing point about the PLC not being explicitly identified as the reject-mechanism controller is framed to imply this weakens overlap, but the note appropriately hedges by calling it an implementation detail rather than a true absence — borderline but largely acceptable since it does not conclude non-infringement solely on that basis.
- The distinguishing point regarding claims 16-19 and the absence of a 'pneumatic reject actuator' limitation in independent claims 1/8/12 risks wrong-direction FTO reasoning: the note correctly notes that independent claims are broader and not limited to the dependent claims' specific responses, and explicitly states this does not establish a difference — this is handled correctly, but the initial framing 'the invention's pneumatic reject mechanism does not appear required by independent claims 1/8/12' could be misread as a distinguishing feature when the opposite (broader claim = greater overlap risk) is true; the note's final summary correctly clarifies this, but the standalone bullet is ambiguously worded and borderline wrong-direction.
- The statement that 'No claim explicitly recites a pneumatic actuator or MES integration... though this alone does not establish a difference' is correctly self-corrected, but its placement under 'Distinguishing points' is somewhat contradictory to the hedge and could overstate a distinction that the note itself says doesn't hold.
- The claim that a PLC 'is a common controller for actuating pneumatic ejectors in production lines' is an inference not directly supported by the patent text (claims/abstract do not mention pneumatic actuators at all), so this is an extrapolation beyond the provided evidence, though flagged as a plausible/common industry fact rather than a fabricated patent limitation.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention	Mapping	Basis

	counterpart		
1.a: Optical image acquisition of an article under inspection via a camera	F1	**PARTIAL**	Claim 1 broadly requires a camera acquiring image data of an article, with no requirement that the camera be line-scan based, that the article be in continuous motion, or that acquisition be continuous rather than single-shot at a defined inspection station; F1 requires continuous line-based (row-by-row) scanning of moving objects at an inspection point. The claim's generic camera element is broader/different in kind from F1's specific continuous line-scan motion-based acquisition, so this is an adjacent but not fully coextensive implementation.
1.b: Machine-learning based object detection model that receives image data and outputs data describing a detected defect (presence/type), executed on a computing device	F2	**PARTIAL**	F2 requires pixel-level semantic segmentation via a convolutional neural network for simultaneous detection and localization of surface defects. Claim 1 recites a machine-learning based 'object detection model' generating defect data including a defect class and defect location, which is consistent with bounding-box/object-detection style output rather than necessarily pixel-level semantic segmentation, and does not specify a convolutional architecture. The claim element is an adjacent detection paradigm (object detection) rather than a genus that necessarily encompasses pixel-level segmentation.
1.c: Defect data comprising classification, location, and confidence level, with multiclass classification into three or more classes including at least two defect types	F3	**PARTIAL**	F3 requires a quantitative confidence measure with threshold-based comparison used as validation criterion, such that only detections meeting/exceeding the threshold are confirmed as

			valid. Claim 1 recites that defect data includes a confidence level but does not recite any threshold-based comparison or validation/confirmation step using that confidence level within claim 1 itself; it merely specifies the confidence level is part of the output data structure. This is an adjacent but narrower disclosure than F3's active filtering step.
1.d: A control device receiving defect data from the detection computing device for downstream action	—	**NO COUNTERPART**	Claim 1 requires only that the PLC receive defect data; it does not recite pneumatic actuation, physical removal of defective parts, or any MES/database integration. Neither F4 (pneumatic removal) nor F5 (MES data feedback) appears to have a counterpart within claim 1, as claim 1 stops at data reception by the PLC without specifying any downstream physical or informational action.

All-elements note: Three of claim 1's elements (camera acquisition, ML-based detection model, and defect data with confidence level/multiclass classification) find only partially corresponding counterparts in the invention's standardized units F1, F2, and F3 respectively, reflecting differences in specificity (e.g., generic camera vs. continuous line-scan acquisition; object detection vs. pixel-level segmentation; confidence-level data field vs. active threshold-based validation). The PLC-receiving element does not appear to have a counterpart tied to F4 (pneumatic removal) or F5 (MES integration), as claim 1 does not recite any action taken by the PLC beyond receiving defect data — this element appears to be a potential distinguishing point from the invention's F4/F5 units, which require physical removal and MES data feedback respectively.

Equivalents caution: For element 1.a, a skilled reader might consider whether a generic camera limited by dependent claims or context could plausibly perform line-scan continuous acquisition, but as claimed the difference in acquisition modality (single/multi-shot generic camera vs. continuous line-scan) could be viewed as more than insubstantial given F1's explicit motion and continuity limits. For element 1.b, the difference between object detection (bounding-box/class+location) and pixel-level semantic segmentation is a recognized technical distinction in the art (spatial granularity of output), so this difference may not be readily viewed as insubstantial. For element 1.c, the absence of an explicit threshold-comparison/validation step in claim 1, versus F3's required threshold-based confirmation, could plausibly be viewed as an insubstantial difference if such comparison is understood to be implicit in typical confidence-level usage, but this is not certain from claim language alone.

3.4 US11051991B2 — Systems and methods for inspecting absorbent articles on a converting line

Assignee: Procter and Gamble Co · Published: 2021-07-06 · Status: Active · exp. 2038-05-31 · Relevance: MEDIUM · [verify on Google Patents ↗]

Potential overlap (AI reasoning):

- Claim 1 recites a generic "sensor" providing images to a controller for CNN-based defect identification, which is broad enough to potentially read on the invention's line-scan camera image acquisition feeding a CNN semantic segmentation model.
- Claim 1's CNN "inspection algorithm" that identifies defects by analyzing images is broader/generic and could encompass the invention's pixel-level semantic segmentation defect detection network as a species of the claimed CNN-based identification.
- Claim 1 (and claims 8/15 via claim 11/17) recite "rejecting absorbent articles that correspond with identified first defects/characteristics," a broad rejection step that could encompass the invention's automated pneumatic reject actuator as one possible implementation of the claimed generic reject action.
- Dependent claims 3-5, 7, 12, and 18 broadly enumerate defect types (holes, missing components, misplacement, deformation) that are generic defect categories potentially overlapping with types of surface defects the invention's segmentation network could detect.

Appears to differ (AI reasoning):

- Claim 1, 8, and 15 each require a specific converting-line process step of "cutting the substrate into discrete absorbent articles" as part of the inspection workflow; the invention as described is a generic production-line inspection station with no described substrate-cutting/converting step, so this claim limitation does not appear to be met.
- Claims 1, 8, and 15 require creation of a training database comprising a first group of images/signals with a defect and a second group without the defect, used with a training algorithm to generate CNN parameters as an explicit claimed method step; the invention description does not describe this database-creation/training methodology as part of its claimed process.
- Claim 6 narrows the articles to "diapers" and the overall claim set is directed to "absorbent articles" specifically; the invention is described as a generic production-line product inspection system with no indication the products are absorbent articles/diapers, which may place it outside the claimed subject matter if this limitation is deemed essential.
- The invention's confidence-threshold grading step and MES database write-back are additional features not recited in the claims; while such additions cannot avoid a claim, note that the patent's claims contain no corresponding limitation on confidence grading or MES integration, so no overlap analysis applies there.

Note: This is an informational screening note only, not a legal or infringement opinion. The patent's claims are directed to absorbent-article converting-line inspection with an explicit substrate-cutting step and CNN training-database methodology, both largely absent from the invention description. Core overlap centers on the generic use of a sensor + CNN-based defect identification + rejection action, which are broadly claimed and could read on analogous elements of the invention; however, the domain-specific substrate-cutting/absorbent-article limitations present a potentially significant distinguishing feature. Full claim charting against complete invention documentation and file history would be needed for a definitive assessment.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement about dependent claims 3-5, 7, 12, and 18 enumerating generic defect types is reasonable but somewhat overstated since these are narrowing dependent claims tied back to the substrate-cutting independent claims, not standalone generic claims — framing them as broad overlap risk without noting they inherit all independent claim limitations (including cutting) is slightly misleading.
- The distinguishing point about the invention lacking a 'confidence-threshold grading' or 'MES integration' limitation in the claims is a wrong-direction FTO argument: the claims being silent on these invention-specific features does not distinguish the invention from the claims — if anything, a claim that does not require confidence grading or MES write-back is broader and more likely to read on the invention, not less likely. The note's phrasing ('no corresponding limitation... so no overlap analysis applies') downplays this in a way that could mislead a reader into treating absence of a limitation as favorable, when unclaimed additional features generally do not avoid infringement of an otherwise-met claim.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
E1: Assembly of a labeled training dataset of images distinguishing defective from non-defective articles	—	NO COUNTERPART	The invention units (F1-F5) describe a runtime inspection/rejection/feedback pipeline but include no disclosed step of creating or curating a labeled training image database; this is a training-data-preparation step not addressed by the invention's standardized units.
E2: Training a convolutional neural network on labeled data to derive an inspection model	—	NO COUNTERPART	F2 specifies a convolutional-network-based pixel-level segmentation detector but the invention units describe only the deployed detection function (F2), not a training/model-generation process step; the training procedure itself is not part of the disclosed invention units.
E3: Provision of an image sensor and a controller executing the inspection algorithm	F1, F2	CORRESPONDS	F1 requires continuous line-based optical image acquisition (a sensor) and F2 requires a CNN-based detection algorithm (executed by a controller), matching the broadly recited sensor/controller elements.
E4: Moving substrate past a sensor during production and transmitting captured images to a processing controller	F1	CORRESPONDS	F1's requirement of continuous line-scan image acquisition of moving products at an inspection point on a production line corresponds to advancing a substrate and creating/communicating images during the converting process; the claim's generic 'images' genus covers F1's line-scan species.
E5: Detecting and identifying defects in captured images via an algorithmic analysis	F2	CORRESPONDS	F2's pixel-level CNN-based semantic segmentation for defect detection and localization is a species falling within the broader

			claim genus of 'identifying first defects by analyzing the images with the inspection algorithm.'
E6: Physically dividing a continuous substrate into individual discrete product units	—	**NO COUNTERPART**	None of the invention's standardized units (F1-F5) disclose a substrate-cutting/singulation step; the invention units concern acquisition, detection, validation, removal, and MES feedback, not converting the web into discrete units.
E7: Automated removal of articles identified as defective from the production line	F3, F4	**PARTIAL**	The claim's generic 'rejecting' based on identified defects broadly corresponds to F4's automated physical removal step, but F4 additionally requires a specific pneumatic actuation mechanism and F3's confidence-threshold validation gating the rejection, neither of which is recited or limited to in the claim's broad 'rejecting' language, making the specific mechanistic match only partial rather than a clean genus-species read.

All-elements note: Most claim elements (sensor/controller provision, substrate advancement and image capture/communication, defect identification via algorithmic analysis, and rejection of defective articles) appear to find counterparts in the invention's standardized units. However, the claim elements directed to creating/curating a labeled training database, training the CNN to generate the inspection algorithm, and cutting the substrate into discrete articles appear to lack explicit counterparts among the invention's disclosed units (F1-F5), which focus on the operational inspection-to-removal-to-MES pipeline rather than model training or web-cutting/converting operations.

Equivalents caution: For the 'rejecting absorbent articles that correspond with identified first defects' element (partially_corresponds), the difference lies in the invention's more specific requirement of pneumatic actuation and confidence-threshold-gated validation versus the claim's unqualified generic rejection step; whether this difference would be viewed as insubstantial is uncertain, since pneumatic actuation is one of several plausible rejection mechanisms and the confidence-threshold gating adds a validation layer not recited in the claim, so this should be flagged for further equivalents consideration rather than assumed insubstantial.

3.5 US11892417B1 — Finishing line automatic inspection system and method

Assignee: Columbia Insurance Co, Shaw Industries Group Inc · Published: 2024-02-06 · Status: Active · exp. 2041-12-22 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's 'first optical system for detecting characteristics of the individual units as each progresses on the production path' is a broad, generic optical detection limitation that could read on the invention's line-scan camera image acquisition on a moving production line.
- Claim 1's requirement that a 'processor ... analyzing the detected characteristics ... using the standards ... from the database' and determining 'at least one of the standards ... has not been met' is broadly worded and could be read to encompass the invention's CNN-based semantic segmentation defect detection combined with confidence-threshold grading (i.e., a computational determination that a defect condition is present), though the specific technique (pixel-level semantic segmentation neural network) differs from a generic 'standards database' comparison — treated here as an equivalents-type overlap rather than a clean distinction.
- Claim 1's 'piece part diverter assembly' uses a 'pneumatic pusher' to act on units determined defective, which is conceptually similar to the invention's automated pneumatic reject actuator that removes defective parts; the pneumatic actuation mechanism itself is a point of potential overlap even though the specific motion/geometry differs.
- Claim 27 similarly recites optical detection, a database of standards, and processor-based determination of non-conforming characteristics feeding into an automated removal mechanism — the same broad architecture (sense defect → computationally evaluate → physically remove) is present, and this genus-level claim structure could be read onto the invention's overall inspect-then-reject workflow.

Appears to differ (AI reasoning):

- Claim 1 requires the alternate conveyance path to be positioned 'above a portion of the production path' and requires an 'elevator system' that elevates units from the production path up to that alternate path; the invention's pneumatic reject mechanism, as described, simply removes/ejects defective parts from the line and does not appear to include an elevating/above-path bypass architecture.
- Claim 1 requires the pneumatic pusher to 'comprise a marking system' for marking defective units (e.g., with colored/UV chalk per dependent claims); the invention has no described marking capability for defective parts.
- Claim 1 requires 'at least one diversion conveyor for returning the selectively diverted ... individual units back to the production path' (i.e., a bypass-and-return loop enabling subsequent manual inspection); the invention's reject mechanism removes defective parts from the line rather than routing them through a bypass conveyor for return to the line.
- Claim 27 additionally requires specific structural elements (dual three-dimensional laser scanners, an alignment module with two vertically actuatable rods, a movement dampening module, and a robotic manipulator integrated with a marking system) that are not present in the invention's description, which relies on line-scan imaging and a CNN rather than 3D laser scanning, mechanical alignment rods, or robotic manipulation.
- The claims are directed to a specific mechanical/optical inspection architecture for piece parts such as floor covering planks (veneer voids, splits, bow, tongue/groove geometry, etc.), which is a narrower domain-specific context than the invention's general production-line surface defect detection using deep learning.

Note: This is an informational screening comparison only, not a legal or infringement opinion. The patent claims recite a specific mechanical bypass/diversion architecture (elevating pneumatic pusher, above-path alternate conveyor, marking system, return-to-line diversion conveyor) for wood/veneer plank inspection, which differs structurally from the invention's simpler line-scan/CNN detection plus pneumatic reject/removal and MES data logging. However, the broad language in claim 1 and claim 27 regarding optical detection, database/standard-based determination of defects, and pneumatic actuation for handling non-conforming units creates potential overlap at a conceptual level that should be reviewed against the full claim construction and prosecution history, particularly regarding what counts as a 'diverter assembly' and 'pneumatic pusher.' No claim language addresses MES data integration, so this invention feature does not raise overlap concerns under this patent.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing point about claim 1 requiring an elevator system/above-path architecture, marking system, and return-to-line diversion conveyor is used to argue non-overlap, but since claim 1 is the broadest independent claim and all these elements ARE required limitations of that claim (not absent from it), this is actually a valid narrowing distinction, not wrong-direction reasoning — this part is fine.
- The final summary statement 'No claim language addresses MES data integration, so this invention feature does not raise overlap concerns under this patent' is reasoning in the wrong FTO direction: the absence of a claim limitation on MES integration does not narrow the claim or protect the invention from infringement risk — an unclaimed invention feature is irrelevant to freedom-to-operate since infringement is assessed by whether the invention embodies everything IN the claim, not by whether the invention has extra unclaimed features. This statement is presented as if it reduces overlap concern, which is a mischaracterization of claim scope logic, though the underlying point (MES integration is simply not addressed by the patent) is technically true and mostly harmless.
- The characterization of claim 1's optical system and database-comparison limitation as potentially reading on 'CNN-based semantic segmentation' is speculative and somewhat overstated — the claim explicitly requires a 'database of standards' comparison, which is a materially different technique than a trained neural network performing pixel-level segmentation; labeling this 'equivalents-type overlap' stretches the evidence, though the note does hedge this appropriately by acknowledging the technique differs.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
E1: Mechanized transport of discrete product units along a defined path/direction, i.e., products in motion relative to an inspection station on a production line	F1	**CORRESPONDS**	F1 requires products in motion at an inspection point on a production line; claim's driven production path serially transporting piece parts provides the same underlying transport/motion context.
E2: A secondary transport path physically separate from the main line for receiving diverted units	—	**NO COUNTERPART**	None of F1-F5 describe a secondary physical conveyance path for diverted parts; the invention's F4 removal is described generically as physical separation without a defined alternate path structure, so this specific structural element appears to lack a counterpart in the standardized invention units.
E3: Optical sensing system for capturing characteristics of moving units at an inspection point	F1	**CORRESPONDS**	F1's continuous line-based optical image acquisition of moving objects at an inspection point corresponds to the claimed first optical system detecting characteristics of units as they progress; the claim's broader 'optical system' genus covers F1's line-scan

			species.
E4: Stored reference data defining acceptable characteristic values/thresholds against which detected characteristics are compared	F3	**PARTIAL**	F3 requires a quantitative confidence measure and threshold-based comparison for defect validation; the claim's database of standards for characteristic comparison is an adjacent concept (reference standards vs. confidence thresholds) but serves an analogous validation-comparison function, so correspondence is only partial.
E5: A processing unit that analyzes sensed characteristics against stored standards to determine compliance/defect status	F2	**CORRESPONDS**	F2's pixel-level deep learning based semantic segmentation for defect detection and localization is a specific implementation of the claimed broader processor-based analysis of detected characteristics against standards; the claim's genus (processor analyzing characteristics) covers F2's specific CNN-based approach.
E6: Automated mechanism that physically diverts/removes non-conforming units from the main path in response to processor-determined non-compliance	F4	**CORRESPONDS**	F4's automated physical removal of confirmed defective parts triggered by inspection results corresponds to the claimed diverter assembly performing automated physical separation of non-conforming units based on processor determination; both require physical removal (not mere flagging) triggered automatically by inspection outcome.
E7: Spatial arrangement placing the secondary path above the main path	—	**NO COUNTERPART**	This specific spatial/geometric arrangement is not addressed by any of the standardized invention units F1-F5, which do not specify relative positioning of a diversion path.
E8: Pneumatically actuated mechanism that physically	F4	**CORRESPONDS**	F4 explicitly requires pneumatic actuation for

lifts/moves the unit from the main path in response to inspection results			automated physical removal of confirmed defective parts; the claimed pneumatic pusher/elevator is a specific pneumatic actuation implementation falling within F4's requirement that the actuation mechanism be pneumatic.
E9: A marking mechanism integrated with the actuation mechanism to physically mark diverted units	—	**NO COUNTERPART**	None of the standardized invention units F1-F5 describe any physical marking of parts; F4 addresses only removal, not marking, so this element appears to lack a counterpart.
E10: A return conveyance mechanism that reintroduces diverted units back onto the main path	—	**NO COUNTERPART**	F4 only addresses removal of defective parts; none of the invention units describe a mechanism for returning diverted parts back to the main line, so this element appears to lack a counterpart.

All-elements note: Of the ten identified claim elements, five (E1, E3, E5, E6, E8) appear to find counterparts in the standardized invention units (F1, F2, F4), one (E4) appears to only partially correspond to F3, and four elements (E2, E7, E9, E10 — the alternate conveyance path, its above-path positioning, the marking system integrated with the pusher, and the return diversion conveyor) appear to lack counterparts in the standardized invention description; F5 (MES data feedback) also finds no corresponding claim element, though this is a feature of the invention not required by the claim and is not treated as a distinguishing point.

Equivalents caution: For E4 (database of standards vs. F3's confidence-threshold validation), the difference between comparing detected characteristics to stored reference standards versus comparing a quantitative confidence score to a threshold could plausibly be viewed as an insubstantial variation in implementation of a validation/comparison function, though this involves a doctrine-of-equivalents-type judgment and is noted here only informationally.

3.6 US10632022B2 — Systems and methods for inspecting absorbent articles on a converting line

Assignee: Procter and Gamble Co · Published: 2020-04-28 · Status: Active · exp. 2038-10-27 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's use of a sensor to create images of substrate/component parts, communicated to a controller for CNN-based defect identification broadly reads on the invention's line-scan camera image acquisition feeding a CNN-based semantic segmentation module
- Claim 1's 'inspection algorithm' generated via CNN and trained on defect/no-defect image databases potentially overlaps with the invention's CNN-based semantic segmentation defect detection, as the claim's CNN analysis step is broad enough to encompass pixel-level segmentation approaches

- Claim 1's step of 'rejecting absorbent articles that correspond with identified first defects' is a generic rejection step that could encompass the invention's automated pneumatic reject actuator, since claim does not limit the reject mechanism type
- Claim 14/20 similarly recite rejecting articles as a control action option, broadly overlapping with the invention's automated reject mechanism
- Claim 11/18's broader 'digitized signals' and 'inspection data' terminology (including images) potentially overlaps with the invention's line-scan image data
- Claim 15/21's list of characteristics (defect in substrate, defect in component, missing component, position of component) broadly overlaps with the types of surface defects the invention's segmentation network is designed to detect

Appears to differ (AI reasoning):

- Claim 1, 11, and 18 all require 'cutting the substrate with component parts added thereto into discrete absorbent articles' as an integral step of the claimed method — the invention as described is a generic production-line inspection system with no recited substrate-cutting/converting step, so this claim limitation appears unmet
- Claims 1/11/18 require the database creation and training steps (first group with defect, second group without defect) to be part of the claimed method; the invention description does not detail an analogous training-data creation limitation, though this may be an inherent/background step not fully described
- Claim 1/11/18 require 'sequentially adding component parts to the substrate' during a converting process — the invention's inspection station on a general production line does not appear to require this converting/assembly limitation
- No claim recites a confidence-threshold grading step or MES database write-back; however, since these are additional invention features not required by the claims, their absence in the claims does not distinguish the invention — noted here only for completeness, as claims are silent rather than contradictory

Note: This patent (US10632022B2) is directed specifically to inspection of absorbent articles (e.g., diapers) on a converting line, with claims requiring substrate advancement, sequential component addition, and cutting into discrete articles — a converting-process context absent from the invention's generic production-line description. The core CNN-based inspection-and-reject concept shows potential overlap in broad terms (sensor/camera image capture, CNN analysis, rejection action), but the claims' converting-line-specific process steps (cutting into discrete absorbent articles, sequential component addition) are limitations the invention as described does not appear to include. This is an informational screening note only, not a legal or infringement opinion; full claim charting against complete invention documentation is recommended.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement claiming claim 1's CNN analysis is 'broad enough to encompass pixel-level segmentation approaches' is an overstated inference; the claims do not mention segmentation or pixel-level analysis, so this is speculative rather than directly supported by the claim text
- The final bullet under distinguishing points explicitly acknowledges that the absence of confidence-threshold grading and MES write-back from the claims does not distinguish the invention, which is correct FTO logic, but the note still lists it under 'Distinguishing points' framing, which is internally inconsistent/confusing labeling even though the substantive conclusion is correct
- The statement that claim 1's generic rejection step 'is a generic rejection step that could encompass the invention's automated pneumatic reject actuator, since claim does not limit the reject mechanism type' is actually correctly reasoned as an overlap (broad claim capturing narrower invention feature), which is proper direction logic - no issue here, but flagged for review to confirm it aligns with correct FTO reasoning (it does)

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
E1: Assembling a labeled training dataset of images with and without a defect for supervised model training	—	NO COUNTERPART	The invention units (F1-F5) describe a deployed inspection/removal/feedback pipeline; no invention unit describes creation/curation of a labeled training dataset as a claimed step.
E2: Training a convolutional neural network on labeled data to produce an inspection model	—	NO COUNTERPART	F2 specifies use of a convolutional neural network for detection but is silent on a training-algorithm step producing the network parameters; training/model-generation is not among the described invention units, which begin at deployed image acquisition/inference.
E3: Networked connection of a sensor and a controller running the inspection algorithm	F1, F2	PARTIAL	F1 implies an image-acquisition sensor at an inspection point and F2 implies a controller/processor running the CNN, but neither invention unit specifies a communication network architecture connecting sensor and controller as a distinct claimed feature.
E4: Moving a workpiece through a manufacturing process while parts are sequentially added	—	NO COUNTERPART	F1 requires products in motion relative to the camera at an inspection point, but does not require or describe a converting process with sequential addition of component parts to a substrate; this manufacturing context is absent from the invention units.
E5: Line-scan/continuous optical image acquisition of moving objects at an inspection point and transmission of images to a processing unit	F1	CORRESPONDS	F1's continuous line-based optical image acquisition of moving objects at an inspection point, with implied transfer of images to a processing controller, is a genus that covers this claim element's image creation and communication to a controller.

E6: Detecting defects in acquired images via a trained CNN-based inspection algorithm	F2	**CORRESPONDS**	F2's pixel-level deep learning based semantic segmentation for defect detection and localization is a genus/specific case of 'identifying first defects by analyzing the images with the inspection algorithm,' since F2 requires a convolutional neural network performing defect detection, of which this claim language is the broader recitation.
E7: Separating a continuous web into discrete final product units	—	**NO COUNTERPART**	None of the invention units describe cutting a continuous substrate into discrete articles; F4 addresses removal of already-discrete confirmed defective parts, not web-cutting/singulation.
E8: Removing/discarding units identified as defective from the production line	F4	**PARTIAL**	F4 requires automated physical removal specifically via pneumatic actuation triggered by confirmed defect detection, whereas the claim broadly recites 'rejecting' without specifying the actuation mechanism; the claim's genus of rejection covers pneumatic rejection as one species, but since the claim does not itself require confidence-threshold confirmation (as in F3) before rejection, the correspondence to F4's conditioned pneumatic removal is not fully identical in mechanism specificity.

All-elements note: Two invention units (F1 image acquisition and F2 defect detection/localization) find clear counterparts in claim elements E5 and E6 respectively. Rejection of defective articles (E8) partially corresponds to F4's pneumatic removal mechanism. However, several claim elements — dataset creation/labeling (E1), CNN training/parameter generation (E2), the networked sensor-controller architecture (E3, partial), the converting process with sequential part addition (E4), and cutting the substrate into discrete articles (E7) — appear to lack a direct counterpart among the described invention units (F1-F5), which do not address training-data creation, model training, substrate conversion, or web-cutting. Additionally, F3 (confidence-based threshold filtering) and F5 (MES data feedback) have no corresponding recitation in this claim, meaning the invention appears to include additional features beyond what claim 1 requires, which is not treated as a distinguishing difference.

Equivalents caution: For E3 (communication network connecting sensor and controller), the difference is largely one of unstated architectural detail rather than a substantively different mechanism, so it could plausibly be viewed as an insubstantial difference if the invention's implied connectivity performs the *same function of conveying images/results to a processing controller. For E8 (rejecting vs. pneumatic-triggered removal conditioned on confidence-validated detection), the difference concerns the specific actuation mechanism and the absence of a claimed confidence-threshold gating step; since pneumatic actuation is one common species of a broader rejection genus, this difference may be viewed as insubstantial in the way defective parts are physically removed, though the absence of a threshold-validation step is a more substantive functional difference warranting caution.*

3.7 US10957031B1 — Intelligent defect detection from image data

Assignee: Accenture Global Solutions Ltd · Published: 2021-03-23 · Status: Active · exp. 2039-12-10 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 (and parallel claims 12, 23) broadly recites 'receiving image data representative of images of one or more items within a physical environment' depicting defects, which could read on the invention's line-scan camera image acquisition, as the claim does not limit the camera type or capture mode.
- Claim 1's step of 'processing... using one or more ML models to provide a set of defect characteristics representative of one or more defects' is broad and could encompass the invention's CNN-based semantic segmentation defect detection.
- Dependent claims 10, 21, 32 specifically recite that 'the defect type is determined based on a defect signature provided through semantic segmentation applied to at least one image,' which directly overlaps with the invention's semantic segmentation defect detection approach.
- Claim 1's broad language of 'generating one or more alerts based on the one or more root causes for remediation' could potentially overlap with the invention's downstream actions (e.g., triggering reject mechanism or writing to MES), if such actions are construed as a form of alert/remediation output, though the claim's emphasis on 'root cause' analysis is more specific than the invention's confidence-threshold/reject workflow.

Appears to differ (AI reasoning):

- Claim 1 (and parallel claims 12, 23) requires 'providing one or more of a set of augmented images using image augmentation... and a set of synthetic images using ML-based image synthesis based on the image data' as an intermediate step before ML processing; the invention as described does not appear to include an image augmentation or synthetic image generation step, so this required element appears missing.
- Claim 1 requires 'processing one of the set of augmented images and the set of synthetic images' (i.e., the ML model operates on augmented/synthetic images, not directly on the raw captured image); the invention's CNN appears to process the raw line-scan captured images directly, which may not satisfy this specific processing-target limitation.
- Claim 1 requires 'providing one or more root causes of each of the one or more defects by processing the set of defect characteristics and ancillary data, the ancillary data representative of the physical environment' — a root-cause analysis step using ancillary environmental data; the invention's confidence-threshold grading and reject/MES workflow does not appear to include any root-cause determination step, so this required element appears absent.
- Claim 1 requires 'generating one or more alerts... for remediation of at least one root cause' — i.e., alerts tied to root-cause remediation; the invention's outputs (pneumatic reject action, MES data write) are defect-instance responses rather than root-cause remediation alerts, so this limitation as claimed does not clearly match.
- Dependent claims requiring GAN-based synthetic image generation (claims 2,13,24), RPN-based defect count/location (5,16,27), RL-zoom/RL-enhanced killer defect or difference identification with golden-image alignment (7,8,18,19,29,30), and semiconductor wafer items (11,22,33) all recite specific elements not described in the invention's features, so these narrower claims appear to require elements the invention lacks.

Note: This is an informational screening note based solely on the verbatim claims provided, not a legal or infringement opinion. The patent's independent claims center on a multi-stage ML pipeline involving image augmentation/synthetic image generation, defect characteristic extraction, and root-cause analysis with alert generation for remediation — a workflow substantially different in structure and purpose from the invention's inspection-to-reject/MES pipeline. However, because independent claim 1 (and its system/medium counterparts) is broadly worded regarding image receipt and ML-based defect characteristic detection, and dependent claims 10/21/32 specifically claim semantic-segmentation-based defect typing, there is potential overlap in the core detection concept that would warrant closer comparison of the invention's full technical implementation (e.g., whether any augmentation/synthesis or root-cause analysis is present) against these claims. The invention's line-scan acquisition, confidence-threshold grading, pneumatic reject actuation, and MES integration are not addressed by any claim limitation and are not analyzed as distinguishing since added invention features cannot avoid a claim; rather, the distinguishing points above reflect claim limitations that appear unmet by the described invention.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement regarding claim 1's 'generating one or more alerts based on root causes for remediation' potentially overlapping with the invention's reject/MES actions is speculative and stretches the claim language ('alert' and 'remediation of root cause' vs. physical ejection and data logging); this is an overstated overlap not clearly supported by the evidence.
- The note's distinguishing points repeatedly rely on the invention lacking elements (augmentation/synthetic image step, root-cause analysis, alerts for remediation) that are present in claim 1 as additional required limitations narrowing the claim — this is correct direction reasoning (narrower claim, harder to infringe) and is properly framed, so this is not an error; however the note should be careful that these are used to show non-infringement of a narrow claim, not to dismiss FTO risk broadly, which it does state appropriately in the closing paragraph.
- The closing paragraph's statement that the invention's line-scan acquisition, confidence-threshold grading, pneumatic reject, and MES integration 'are not analyzed as distinguishing since added invention features cannot avoid a claim' is a correct FTO principle, but the note inconsistently uses missing claim elements (augmentation, root-cause) as distinguishing while also acknowledging that only claim breadth matters — this creates a mild internal tension but does not amount to wrong-direction reasoning since the cited missing elements are genuine additional claim limitations, not invention-only features.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.a: Acquisition/receipt of optical image data of items in a physical environment, at least some images depicting defects	F1	**PARTIAL**	F1 requires continuous line-scan (row-by-row) image acquisition of moving objects at a defined inspection point on a production line; claim element 1.a is a broader genus of merely 'receiving image data representative of images' with no requirement of line-scan capture, continuity, or object motion, so the specific line-scan/continuous/inspection-station limits of F1 are narrower than what is claimed here, creating a partial overlap rather than a

			straightforward genus-species match in either direction.
1.b: Generation of augmented or synthetic training/inference images derived from received image data via image augmentation or ML-based synthesis	—	**NO COUNTERPART**	None of F1-F5 describe generating augmented or synthetic images from acquired data; the invention units process the originally acquired images directly for segmentation, confidence filtering, actuation, and MES feedback, with no image augmentation or synthetic image generation step.
1.c: ML-model-based processing of augmented/synthetic images to derive defect characteristics representative of detected defects	F2	**PARTIAL**	F2 performs pixel-level CNN-based semantic segmentation for defect detection/localization directly on acquired images, which is a form of ML-based defect-characteristic extraction; however, the claim element specifically requires the ML model to process augmented or synthetic images (an input distinct from the raw acquired images used by F2), so the input data pathway differs even though both derive defect-related output via machine learning.
1.d: Root-cause determination for detected defects by processing defect characteristics together with ancillary environmental data	—	**NO COUNTERPART**	The invention units (F1-F5) address defect detection, confidence-based validation, physical removal, and MES data logging, but none perform root-cause analysis using ancillary physical-environment data; this functionality appears absent from the standardized invention units.
1.e: Generation of alerts targeted at remediating identified root causes of defects	—	**NO COUNTERPART**	F5 provides automated data feedback of inspection outcomes into an MES database, which is a data-recording/integration function, not an alert generated for root-cause remediation; no invention unit generates alerts tied to

			root-cause remediation, so this element appears to lack a counterpart.

All-elements note: Not every claim element found a clear counterpart in the standardized invention units. Element 1.a (image receipt) and 1.c (ML processing to yield defect characteristics) partially correspond to F1 and F2 respectively due to differing input/acquisition specifics. Elements 1.b (augmented/synthetic image generation), 1.d (root-cause determination using ancillary environmental data), and 1.e (alert generation for root-cause remediation) appear to lack counterparts in the invention units as described, since the invention's disclosed functionality centers on direct-image segmentation, confidence filtering, pneumatic removal, and MES data feedback rather than image augmentation/synthesis, root-cause analysis, or remediation alerts.

Equivalents caution: For element 1.a: the invention's line-scan, continuous, motion-based acquisition could be viewed as a specific implementation within the broader 'receiving image data' concept, so the difference may be viewed as a matter of implementation detail rather than a substantial functional difference, though the added continuity/motion/line-scan constraints are non-trivial and could weigh against treating them as insubstantial. For element 1.c: processing augmented/synthetic images versus directly acquired images represents a difference in the data pipeline preceding the ML model; whether this difference is insubstantial would depend on whether image augmentation/synthesis materially affects the segmentation outcome, so this is flagged as a plausible equivalents consideration rather than a clear substantial difference.

3.8 US12183010B2 — Systems and methods for instance segmentation based on semantic segmentation

Assignee: Beijing Didi Infinity Technology and Development Co Ltd · Published: 2024-12-31 · Status: Active · exp. 2040-10-16 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- The invention's use of a CNN performing pixel-level semantic segmentation to obtain a semantic label map appears to overlap with claim 1's/8's/14's step of 'perform semantic segmentation on an input image to obtain a semantic label map...using a trained semantic segmentation model,' which is broadly recited and could encompass the invention's defect segmentation step as a generic input stage.
- If the invention's defect localization involves distinguishing separate defect instances/regions from the segmentation output, this could potentially overlap with the claimed downstream processing of the semantic label map (boundary map generation and post-processing to differentiate objects), though the invention as described does not clearly perform the same instance-differentiation technique.

Appears to differ (AI reasoning):

- Claim 1/8/14 require generating a 'boundary map' using a 'trained generator' based on the semantic label map concatenated with the input image — the invention's description does not mention any boundary map generation or a trained generator (e.g., GAN-based) step.
- Claim 1/8/14 require a post-processing step performing 'Breadth-First-Search for each enclosed area of the semantic label map to get a mask for each enclosed area' — the invention's confidence-threshold grading of detected defects is a different mechanism and does not describe BFS-based enclosed-area mask extraction.
- Claims 4, 7, 10, 13, 15, 17 require a conditional GAN generator with deep supervision, weighted fusion layer, and/or a discriminator engaged in a minimax game — the invention's CNN-based semantic segmentation and confidence thresholding do not appear to include any GAN or discriminator component.
- The claims are directed to instance/panoptic segmentation of image classes generally (things/stuff), whereas the invention is directed to defect detection and a full inspection pipeline (line-scan capture, confidence grading, pneumatic rejection, MES integration) — these downstream physical

and data-integration elements are not addressed by the patent claims at all, but this alone does not distinguish since claims need not cover every invention feature; it is noted only as context.

Note: This patent's claims are centered on a specific two-stage architecture: semantic segmentation followed by trained-generator boundary-map creation and BFS-based post-processing to derive instance/panoptic masks, optionally trained via GAN/discriminator minimax mechanics. The invention as described appears to use only a semantic segmentation CNN plus a confidence threshold for defect confirmation, without any boundary-map generation, trained generator, or BFS-based mask extraction — these are required elements in every independent claim (1, 8, 14) and their absence in the invention description is a significant potential distinguishing factor. However, if the invention's actual implementation (not disclosed here) includes any post-segmentation step to separate/label distinct defect instances via a generator-and-BFS-like process, closer claim language comparison would be needed. Assessment is based solely on the invention summary provided; no additional technical documentation was available for deeper feature-by-feature mapping.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.1: A computing system comprising a memory storing instructions and a processor configured to execute them	—	CANNOT ASSESS	The invention units describe functional capabilities (image acquisition, segmentation, filtering, actuation, MES integration) implemented presumably via computing hardware, but no explicit storage medium/processor architecture is specified in the invention summary, so a generic hardware claim element cannot be assessed against the given abstractions.
1.2: Pixel-level classification of an image into predefined semantic classes using a trained segmentation model	F2	PARTIAL	F2 requires pixel-level semantic segmentation via a convolutional neural network for surface defect detection/localization, which is a species of the claimed genus of semantic segmentation into a specific set of classes; however F2 additionally requires the segmentation target be surface defects specifically and the network be convolutional, which are narrower than the claim's general 'specific set of classes' semantic segmentation, and the claim independently requires this only as an intermediate step

			feeding into instance/panoptic segmentation via a boundary map, a purpose not present in F2.
1.3: Generation of a boundary/edge map from a trained generative model conditioned on the semantic label map and original image	—	**NO COUNTERPART**	None of the invention units (F1-F5) describe generating a boundary map via a trained generator conditioned on concatenated semantic label map and input image; the invention's F2 performs segmentation for defect detection/localization but does not include this generator-based boundary map creation step.
1.4: Post-processing of a boundary map via Breadth-First-Search over enclosed areas of the semantic label map to produce per-instance masks with class labels, yielding instance or panoptic segmentation	—	**NO COUNTERPART**	The invention's F2 achieves detection and localization of defects via semantic segmentation but does not describe an instance/panoptic segmentation step, nor a Breadth-First-Search based post-processing of a boundary map to differentiate individual object instances; this specific algorithmic step has no counterpart in the invention units.

All-elements note: Of the four decomposed claim elements, one (generic storage medium/processor) cannot be assessed against the provided invention abstractions due to lack of comparable architectural detail, one (semantic segmentation using a trained model) partially corresponds to invention unit F2 in that F2's pixel-level CNN-based segmentation is a narrower species of the claimed genus but differs in defect-specific purpose, and two elements (the trained-generator-based boundary map generation, and the BFS-based post-processing to obtain instance/panoptic segmentation) appear to lack any counterpart in the invention units, as the invention describes defect detection/localization, confidence filtering, pneumatic removal, and MES integration, none of which involve boundary map generation or instance/panoptic differentiation via BFS.

Equivalents caution: For element 1.2 (semantic segmentation using a trained model), the difference lies in the invention's narrower defect-detection purpose and CNN specificity versus the claim's general multi-class semantic segmentation as an intermediate step toward instance/panoptic segmentation; this difference in purpose and downstream use is substantive rather than insubstantial, since the claim element serves a distinct function (feeding a boundary-map generator) not present in the invention, so an equivalents argument appears weak.

3.9 US10504020B2 — System and method for applying a deep learning neural network to data obtained from one or more sensors

Assignee: Sightline Innovation Inc · Published: 2019-12-10 · Status: Active · exp. 2035-06-10 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1/9 broadly recites sensors sensing an industrial scene and neural network-based scene parsing/matching to extract features, which in generic terms could encompass a camera-based sensor feeding image data for neural-network-based defect (feature) detection, overlapping conceptually with the invention's CNN-based image analysis of production-line parts
- Claim 1/9 requires the classification output to be used to control positioning, motion, or obtainment of sensor information of a peripheral device — broadly worded, this could be read to encompass an actuation response tied to inspection results, potentially overlapping with the invention's reject-actuator triggering, though the claim's framing is toward sensor/peripheral control rather than a physical reject mechanism
- Claims 6/8/14/16 reference provision of confidence scores/values associated with classification, which is broadly similar in concept to the invention's confidence-threshold grading of defect detections
- Claim 2/10 (image capture device sensors) reads on the invention's line-scan camera in broad terms

Appears to differ (AI reasoning):

- Claim 1/9 requires a network-accessible server system that provisions and sends a customized application to a client computing system based on a schema definition/metadata from the client — the invention as described does not appear to include this client-server application provisioning architecture
- Claim 1/9 requires that trained classification models be built at the server and then transmitted to the client computing system, with the client performing local feature parsing/matching using models received from the server — the invention's architecture (single system with CNN segmentation, threshold grading, and MES integration) is not described as having this server-trains/client-executes split
- Claim 1/9 requires matching extracted features against 'previously known components' — the invention performs pixel-level semantic segmentation for defect localization, not described as matching against a database of known components
- Claim 3/11 requires anonymization, encryption, compression and jurisdictional stamping of transmitted sensor data — no such data-handling features are described in the invention
- Claim 5/13 requires transmission of classification results to a 'ground truther' for active learning model evaluation — the invention describes writing results to an MES database, not a ground-truthing/active-learning feedback loop
- Claim 7/15 requires simultaneous application of a plurality of neural networks with a list of classifiers — the invention describes a single CNN performing semantic segmentation, not multiple simultaneous classifiers

Note: This patent's claims are directed to a cloud/client application-provisioning architecture for sensor data processing (server builds and transmits trained models to a client, which then performs local matching to control peripheral positioning/motion), with manufacturing verification listed only as one example application. The invention is a specific inline visual inspection and pneumatic rejection system with MES integration. There is thematic overlap (neural-network-based analysis of sensor/image data in an industrial scene, use of confidence scores, image-capture sensors) but the claims impose substantial architectural limitations (server-side model building and transmission to client, schema-based application provisioning, matching against previously known components, peripheral positioning/motion control) that are not evidently present in the invention description. Overall relevance is assessed as low given the divergent core architecture, despite surface-level topical overlap. This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement regarding reject-actuator triggering vs. 'controlling positioning, motion, or obtainment of sensor information' stretches the claim language; the claim is about controlling peripheral sensor positioning/motion for data acquisition, not physical part rejection — this is a plausible but somewhat overstated overlap characterization

- Several 'distinguishing points' (e.g., claim 3/11 encryption/anonymization, claim 5/13 ground truther, claim 7/15 multiple simultaneous classifiers) are dependent claims not present in independent claim 1/9; citing absence of these narrower dependent-claim features from the invention as distinguishing is directionally reasonable since dependent claims narrow scope, but the note should clarify these are dependent claims (not the broadest claim) to avoid implying the independent claims are avoided on these grounds alone
- The claim 1/9 requirement of server-side model building and transmission to a client for local execution is correctly identified as a limitation not described in the invention, which is valid distinguishing reasoning (narrowing the broad claim), not wrong-direction reasoning
- The statement about 'previously known components' matching as a distinguishing feature is properly tied to claim language and reasonably contrasted with the invention's segmentation-based defect localization, which is faithful

3.10 US10983478B2 — Complex defect diffraction model and method for defect inspection of transparent substrate

Assignee: National Taiwan Normal University NTNU · Published: 2021-04-20 · Status: Active · exp. 2039-03-21 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both involve computer-based defect detection with optional use of machine learning / convolutional neural networks (claim 14) to classify or identify defects, which broadly overlaps with the invention's CNN-based defect detection concept.
- Claim 1's overall goal of detecting and locating defects on a substrate/material has a generic functional similarity to the invention's defect detection and localization step.

Appears to differ (AI reasoning):

- Claim 1 requires a wavefront reconstruction unit producing a digital holographic microscopy hologram with amplitude and phase (complex) images; the invention uses a line-scan camera producing standard 2D intensity images, not holographic complex wavefront data — this core element appears absent from the invention.
- Claim 1 requires a defect diffraction module computing an effective diffraction range (minimum/maximum diffraction distance) and simulating phantom diffraction at multiple reconstruction distances; the invention's semantic segmentation network has no diffraction-distance or wavefront-propagation computation.
- Claim 1 requires determining defect location via contrast value of reconstructed penetrating/reflecting numerical light field diffracted to an imaging plane — a physics-based optical reconstruction technique not present in the invention's pixel-level CNN segmentation approach.
- Claim 1's classification step is explicitly tied to 'diffraction characteristics' of the complex images, whereas the invention's CNN operates on ordinary image pixels without diffraction-characteristic extraction.
- The patent's claims are directed to inspection of transparent substrates (glass, sapphire, PET film, etc.) via holographic/diffraction methods, whereas the invention is a general production-line inspection system with pneumatic rejection and MES integration — the diffraction-based location/classification limitations required by every claim appear absent from the invention.
- No claim addresses a pneumatic reject actuator or MES data integration; these are simply invention features not required by any claim and are not overlap points, but they underscore that the claimed method is confined to optical diffraction-based inspection, not a full inspect-and-reject production pipeline.

Note: This patent claims a specific digital holographic microscopy / diffraction-wavefront-based inspection method for transparent substrates, requiring complex (amplitude+phase) image reconstruction, diffraction-range/distance computation, and diffraction-characteristic-based classification. The invention described is a conventional line-scan camera + semantic segmentation CNN inspection system with confidence thresholding, pneumatic rejection, and MES integration. Apart from a generic overlap around using machine learning/CNN for defect classification (claim 14), the invention lacks the mandatory holographic/diffraction-based elements that appear in every independent and dependent claim, making the claimed subject matter appear substantially different in technical approach. Relevance is assessed as low given the fundamentally different sensing modality (holography vs. line-scan imaging) required by claim 1, though the CNN/machine-learning overlap warrants a cautionary equivalents note if used to assess use of CNN in defect classification contexts.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note lists 'no claim addresses a pneumatic reject actuator or MES data integration' as a point that 'underscores' the claimed method's confinement to optical inspection — this is reasoning in the wrong direction: the absence of a limitation in the claim makes the claim broader/easier to infringe, not a valid distinguishing point in the invention's favor; the note does partially caveat this by saying these are 'not overlap points,' but still uses the absence to bolster the distinguishing argument, which is the flawed direction.
- The claim 2 formula reference and other dependent claims (glass/sapphire/PET substrates) are not discussed but this is not a fabrication, just an omission; not counted as a major issue.
- Overall the core distinguishing statements (holographic wavefront reconstruction, diffraction range computation, contrast-value-based location, diffraction-characteristic classification) are well supported by claim 1 text and are faithfully described.

3.11 US11256960B2 — Panoptic segmentation

Assignee: Adobe Inc · Published: 2022-02-22 · Status: Active · exp. 2040-06-12 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both involve CNN-based pixel-level segmentation of images to identify regions of interest, which has a loose conceptual overlap with the claims' 'generating semantic information for the input image' step (claim 1, 8).

Appears to differ (AI reasoning):

- Claim 1 (and 8, 15) require generation of a feature pyramid with multiple feature maps at different resolution levels; the invention's semantic segmentation network is not described as using any feature pyramid structure.
- The claims require an attention module applied to the feature pyramid to produce an 'enhanced feature map' that is then combined with the original feature maps to form an 'enhanced feature pyramid' — no such attention/enhancement mechanism is described in the invention's defect-detection CNN.
- The claims require generation of both semantic information AND separate instance information (via object regions, RPN/instance head) that are combined into panoptic segmentation information; the invention performs only semantic segmentation for defect localization, with no instance-level object region proposals or panoptic combination step.
- Dependent claims 2-7, 9-14, 16-20 add further specific architectural elements (relative position representation, adaptive convolution/anchor refinement, fully connected + convolution instance heads, IoU-based mask scoring, deformable convolutions with SE blocks, double R-CNN heads, mask IoU heads) — none of these specific sub-components are mentioned in the invention description.

Note: This patent claims a specific panoptic segmentation architecture (feature pyramid network + attention-based enhancement + combined semantic/instance branches). The invention as described is a simpler pixel-level semantic segmentation CNN for surface defect detection integrated into an industrial inspection/reject/MES pipeline. The only conceptual overlap is the shared general category of 'CNN-based image segmentation generating semantic information,' but the claims require multiple specific structural elements (feature pyramid, attention module, instance branch, panoptic fusion) that are not described as present in the invention. This is an informational screening note only, not a legal or infringement conclusion; claims text should be reviewed against full implementation details of the invention's neural network architecture for a more definitive assessment.

3.12 US12094182B2 — Neural network based identification of areas of interest in digital pathology images

Assignee: Leica Biosystems Imaging Inc · Published: 2024-09-17 · Status: Active · exp. 2040-11-21 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 requires generating, using a convolutional neural network, an output image with per-pixel relevance-class assignments forming a segmentation mask marking areas of interest — this is conceptually analogous to the invention's CNN-based pixel-level semantic segmentation for defect localization, though the claim is expressly tied to histological images and pathologist-interaction training data.

Appears to differ (AI reasoning):

- Claim 1 requires the processed image to be a 'histological image' (tissue sample data), whereas the invention processes line-scan images of manufactured products; the claim's data domain limitation is not met by the invention.
- Claim 1 requires the first CNN be trained on a training data set including pathologist interaction data reflecting how pathologists interacted with other histological images — the invention's CNN training data (industrial defect images) does not involve this specific claimed training data type.
- Claim 1 requires a second CNN trained on untreated-tissue images to compute a distance/toxicity map and combine it with the segmentation map to increase a 'toxicity confidence score' — the invention has no second network, no toxicity map, and no distance-based confidence scoring; its confidence threshold grading is a different mechanism tied to a single detection network, not the claimed dual-network toxicity analysis.
- Claim 1 requires generating a toxicity map based on computed distances between a second CNN's output and the original image — the invention has no analogous toxicity mapping step.
- Dependent claims 2-8 and visualization/heat-map/UI features (14-20) require elements (visualization application, toxic area selection controls, heat maps, patient data repositories) entirely absent from the invention's pneumatic reject and MES integration architecture.
- The invention's pneumatic reject actuator and MES data integration features have no counterpart requirement in any claim; claims are silent on physical rejection mechanisms or manufacturing execution systems, so these invention features are not implicated by the claims either way.

Note: This patent is directed to histological/pathology image analysis (tumor/toxicity detection in tissue samples) using a dual-CNN architecture with pathologist-interaction training data and toxicity mapping, a substantially different technical domain from industrial line-scan defect inspection. The only conceptual overlap is the generic use of a CNN for pixel-wise segmentation to mark areas of interest, but claim 1 as a whole requires additional specific elements (histological image input, pathologist-interaction training data, second CNN toxicity/distance computation) that appear absent from the invention. Overall relevance is low; full claim text was reviewed and is not missing.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note's final bullet states that because claims are silent on pneumatic reject mechanisms and MES integration, these invention features 'are not implicated by the claims either way' — this framing is acceptable as neutral, but the broader distinguishing analysis throughout treats the claim's specific limitations (histological image, pathologist interaction data, second CNN toxicity mapping) as if their absence from the invention is what matters, when for FTO purposes the correct inquiry is whether the invention meets every claim limitation; the note does conclude non-infringement correctly by identifying limitations in claim 1 the invention lacks (second CNN, toxicity map, pathologist data, histological image domain), which is the right direction of reasoning since narrower/more specific claims with unmet limitations support a finding of no overlap. This is essentially correctly reasoned, but the phrasing 'the claim's data domain limitation is not met by the invention' and similar statements are properly used to show the invention falls outside the claim (correct direction), so no true wrong-direction fabrication was found; only note as a minor precision concern is the somewhat redundant restating of claim 1 elements as if independently dispositive without clearly aggregating that ALL elements must be met for infringement, which could slightly overstate the distinguishing strength of any single limitation in isolation.

3.13 US11650126B2 — Systems and methods for automatic visual inspection of defects in ophthalmic lenses

Assignee: Indizen Optical Technologies SL · Published: 2023-05-16 · Status: Active · exp. 2042-01-14 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both involve automated visual inspection systems that detect and classify surface/optical defects in items moving through an inspection process, which is a general conceptual overlap with the invention's defect detection goal
- Both systems produce a defect determination that can lead to downstream disposition of the inspected item (claims 4 and 15 use invalidation of the lens, loosely analogous to the invention's reject-mechanism triggering, though the claimed mechanism and technical basis differ substantially)

Appears to differ (AI reasoning):

- All independent claims (1 and 13) require deflectometric measurement of phase visibility and modulation visibility values using fringe patterns projected through/reflected by a transmissive lens from at least two points of view — the invention uses a line-scan camera capturing standard images, with no fringe-pattern deflectometry or multi-viewpoint phase/modulation measurement
- The claims require a specific sensitivity formula S=Z·2π/p tied to screen-lens distance and fringe period, an optical setup absent from the invention's line-scan imaging approach
- Defect classification in the claims is explicitly based on phase/modulation visibility comparisons to classify defect type as transmissive, prismatic, lenslet, or cosmetic — the invention instead uses CNN-based pixel-level semantic segmentation without any phase/modulation visibility analysis
- Claims require measurements 'through an inspection area having a front and back surface of the lens' and often require deciding front/back surface localization via disparity or triangulation between two points of view — the invention has no front/back surface localization step and inspects opaque/general products, not transmissive lenses specifically
- No claim recites a confidence-threshold grading step for defect confirmation, a pneumatic reject actuator, or MES data integration — the independent claims are silent on any physical rejection mechanism or manufacturing-system data write-back, and the 'invalidating' concept in claims 4/15 is tied to visual inspection standards for lenses rather than an automated pneumatic ejection tied to a production line
- The claimed subject matter is specific to transmissive lens inspection (ophthalmic, contact, intraocular lenses, windshields, etc. per claim 9) using deflectometry, whereas the invention is a generic production-line surface-defect detection and rejection system using line-scan imaging and CNN segmentation, a materially different technical field and detection modality

Note: This patent is directed to deflectometric (fringe-pattern, phase/modulation visibility) inspection of transmissive lenses for classifying defect types (transmissive/prismatic/lenslet/cosmetic) and localizing them to front/back lens surfaces. The invention describes a line-scan camera plus CNN semantic segmentation defect detection with confidence thresholding, automated pneumatic rejection, and MES integration for generic production-line parts. The core technical approaches (deflectometry/fringe-pattern phase analysis vs. line-scan imaging with CNN segmentation) are fundamentally different, and none of the independent claims' required elements (fringe pattern generation, multi-point-of-view phase/modulation measurement, front/back surface localization for transmissive lenses) appear present in the invention. Overlap is only at a high conceptual level (automated defect detection/classification in a manufacturing context); the specific claimed technical means are not addressed by the invention. This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The last bullet in the distinguishing points list ('No claim recites a confidence-threshold grading step... pneumatic reject actuator, or MES data integration... independent claims are silent on any physical rejection mechanism or manufacturing-system data write-back') is wrong-direction reasoning: the absence of these limitations from the claims makes the claims broader, not narrower, and thus does not distinguish or reduce FTO risk — it is being used incorrectly as a distinguishing point rather than flagged as a risk factor.
- The statement that claims are silent on these features is factually accurate per the claim text, but framing this silence as a basis for distinguishing the invention (reducing overlap concern) misapplies FTO logic, since claim scope silence generally does not narrow the claim.

3.14 US11893732B2 — Computer supported review of tumors in histology images and post operative tumor margin assessment

Assignee: Leica Biosystems Imaging Inc · Published: 2024-02-06 · Status: Active · exp. 2041-01-20 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1/13/18's core step of generating a segmentation mask from a CNN output image, where each pixel is assigned one of a plurality of tissue classes, is analogous in structure to the invention's CNN-based pixel-level semantic segmentation for defect detection/localization — both rely on a CNN producing a per-pixel classified output mapped back to the source image.
- The claims' 'compute statistics for each tumor' and 'score each tumor... according to a scoring algorithm' followed by filtering to 'remove insignificant tumors' is functionally analogous to the invention's confidence threshold grading step used to confirm valid defect detections, in that both use a computed metric/score to filter/validate detected regions before further action.

Appears to differ (AI reasoning):

- Claim 1/13/18 requires generation of a 'segmentation mask' with 'areas occupied by individual tumors' and specifically requires 'ranking the tumors according to their score' — the invention's confidence threshold grading is a pass/fail validation step, not a ranking of multiple detected defects, so this specific ranking limitation does not appear to be present in the invention.
- Independent claims require 'applying a filter to the statistics... to edit the segmentation mask' as a distinct step from scoring/ranking; the invention's single confidence-threshold-based confirmation step does not clearly include this separate filter-then-score-then-rank pipeline structure.

Note: This patent is centered on histological/medical image tumor identification, margin assessment, and visualization — a different technical field from industrial line-scan surface-defect inspection. There is a structural/functional analogy at a high level of abstraction (CNN pixel-wise segmentation plus a threshold/score-based confirmation step), which is noted as potential overlap under broad claim language, but the claims' specific requirements (tumor-specific statistics, ranking by score, histological image context, visualization panes) do not appear to be met by the invention's described features. No claim element concerning pneumatic actuation or MES integration is present in this patent, so those invention features are not addressed by these claims (irrelevant to overlap analysis but noted for completeness). Full claims text was provided and reviewed in full.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing points reason in the wrong FTO direction: they argue that because the invention lacks the claim's ranking/filter-then-score-then-rank pipeline, the invention is distinguished/safer. But claims are infringement risks only if the invention includes ALL claim elements; if the invention lacks the ranking and filter steps, this actually means the invention does NOT infringe (a valid non-overlap conclusion), so this particular point is directionally fine as a non-infringement argument, but the note frames it ambiguously as 'distinguishing' in a way that could be mistaken for narrowing risk analysis rather than clarifying that missing elements defeats infringement - this framing is imprecise and should be flagged for clarity, not necessarily reasoning in the wrong direction outright.

- The claim requires 'histological image' and tumor-specific classes (non-tumorous/tumorous tissue) which is correctly used to distinguish the invention's industrial defect-detection context; this is faithful to the abstract and claims.
- The statement that the invention's confidence threshold grading is 'functionally analogous' to the claims' compute-statistics-and-score-then-filter step is a reasonable but somewhat overstated analogy, since the claim's filter/score/rank pipeline is more complex (multiple sequential steps: statistics, filter, score, rank) than the invention's single threshold check; labeling this as 'functionally analogous' slightly overstates the similarity.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.pre: A computing apparatus with memory and processor configured to analyze histological images for tumor identification	—	**NO COUNTERPART**	The invention units concern in-line optical inspection of manufactured products on a production line for surface defects; there is no disclosed application to histological/medical tissue image analysis or tumor identification, so this preamble context finds no counterpart in the invention.
1.a: Pixel-level classification via convolutional neural network producing a segmentation mask that spatially marks and localizes discrete detected regions of interest within an input image	F2	**CORRESPONDS**	F2 requires pixel-level (semantic segmentation) detection and localization of surface defects using a convolutional neural network; the claim's broader recitation of per-pixel tissue-class assignment and tumor-area marking via a CNN-generated output image is a genus that covers F2's specific surface-defect segmentation implementation.
1.b: Calculation of quantitative metrics for each detected/localized region identified by the segmentation output	—	**NO COUNTERPART**	F3 involves a confidence measure per detected defect and threshold comparison, but the invention units do not disclose computing generalized statistics (e.g., size, shape, other tumor statistics) as a distinct step preceding filtering; this appears to be an additional data-computation step not present in the invention units.
1.c: Threshold/criterion-based	F3	**CORRESPO**	F3 requires a quantitative

filtering of detected regions using computed statistics to validate or discard detections, editing the output to remove insignificant/invalid detections		**NDS**	measure per detection and a threshold-based comparison such that only detections meeting/exceeding the threshold are confirmed valid; the claim's filter that selects/deselects tumors based on statistics to remove insignificant ones is a genus-level recitation covering F3's confidence-threshold validation, differing mainly in the specific statistic used (generic 'statistics' vs. 'confidence').
1.d: Assignment of a numerical score to each validated detected region and ordering of the regions by that score	—	**NO COUNTERPART**	The invention units include no step of scoring and ranking multiple validated defects relative to one another; F3 stops at threshold-based validation without a subsequent relative ranking/ordering function, so this appears to be an element the invention lacks.

All-elements note: Of the five identified claim elements, two (the segmentation-mask generation via CNN, and the statistics-based filtering) appear to find counterparts in the invention's standardized units (F2 and F3, respectively, at a genus level covering the invention's specific implementation). Three elements — the histological/tumor-specific computing apparatus context, the discrete 'compute statistics for each tumor' step, and the 'score and rank tumors' step — appear to lack a counterpart in the disclosed invention units, which are directed to industrial surface-defect inspection, confidence-threshold validation, pneumatic rejection, and MES feedback rather than medical image tumor scoring/ranking.

Equivalents caution: No partially-corresponding elements — no equivalents flag.

3.15 US12182721B2 — Deep learning-based anomaly detection in images

Assignee: Yissum Research Development Co of Hebrew University of Jerusalem · Published: 2024-12-31 · Status: Active · exp. 2042-02-25 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- The invention's semantic segmentation defect detection, which localizes defects at pixel level, potentially overlaps with the claimed process of extracting feature representations from sub-image/pixel locations and determining per-location anomaly status (claims 1, 7, 8, 14, 15, 20), since the claim's k-nearest-neighbor distance-based anomaly determination is a generic technique for identifying anomalous image regions that could encompass a segmentation-based defect localization approach if implemented via feature-distance comparison.
- The invention's confidence threshold grading step potentially overlaps with the claim's requirement of comparing a calculated distance to a 'predetermined threshold' to determine anomaly status (claims 1, 8, 15), as both use a threshold-based decision mechanism to confirm/validate a detection, though the underlying metrics (confidence score vs. feature distance) differ and may only be equivalent under a broad reading.
- The invention's CNN-based feature extraction for defect detection potentially overlaps with the claim's requirement of extracting feature representations via a 'pre-trained machine learning model'

comprising a 'deep-learning neural network architecture' with a feature pyramid (claims 5, 12, 19), if the invention's CNN uses multi-layer/pyramid-style feature concatenation, though this is not confirmed by the invention description.

Appears to differ (AI reasoning):

- The claims require a training methodology based on a majority of training images representing 'normal data instances' and detecting deviation via nearest-neighbor distance to normal feature representations (an unsupervised/anomaly-detection paradigm); the invention as described uses supervised semantic segmentation for defect detection, which does not appear to require this normal-instance-based training or distance-to-k-nearest-neighbors calculation.
- The claims require calculating a distance between a target feature representation and a subset of k-nearest feature representations (or cluster means, claims 4/11/18) from a training set; the invention's confidence threshold grading appears to operate on segmentation/classification confidence scores rather than a nearest-neighbor feature-distance metric, so this specific computational limitation may not be present.
- The claims are silent on line-scan image acquisition, pneumatic reject actuation, and MES data integration — these are not overlap points (added features cannot avoid a claim) but are noted only because the claims contain no corresponding requirement, so no overlap analysis applies to them.
- Claims 3/10/17 require designating a 'segment' of the image as anomalous based on multiple determined anomalous sub-image locations; whether the invention's segmentation-based defect map is generated via this specific location-by-location distance-threshold aggregation process, versus a single-pass CNN segmentation output, is unclear from the provided description.

Note: This patent claims a specific unsupervised anomaly-detection method centered on feature-distance-to-k-nearest-neighbors (or cluster means) compared against a predetermined threshold, trained primarily on 'normal' images. The invention as described uses supervised pixel-level semantic segmentation with a confidence threshold for defect detection integrated into a physical reject/MES pipeline. There is conceptual overlap at a high level (feature extraction via deep learning, per-location/pixel anomaly determination, threshold-based confirmation), which could be relevant if the invention's underlying model implementation employs nearest-neighbor feature-distance techniques, but the specific claimed algorithmic steps (k-NN distance calculation, clustering, feature pyramid concatenation, normal-instance training set) are not confirmed as present in the invention description. This is an informational screening note only, not a legal or infringement conclusion; a full claim-chart comparison against actual implementation details would be needed for further assessment.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The third distinguishing point explicitly frames the claims' silence on line-scan acquisition, pneumatic reject actuation, and MES integration as 'not overlap points' and states 'no overlap analysis applies to them' — while the note correctly notes added features cannot avoid infringement, framing this as a 'distinguishing point' at all is borderline wrong-direction reasoning, since claim silence on these features means the claims are not narrowed by them and thus doesn't help distinguish the invention from the claims; listing it among distinguishing points risks implying these absences help avoid infringement.
- The claim overlap statement regarding CNN-based feature extraction potentially overlapping with the feature pyramid limitation (claims 5,12,19) is speculative and self-admitted as 'not confirmed by the invention description,' which is appropriately hedged but borders on fabricated overlap since no evidence supports the invention using a feature pyramid architecture.
- The overlap statement on confidence threshold grading vs. predetermined threshold acknowledges the metrics differ, which is appropriately hedged, but the initial framing overstates similarity by calling it a 'threshold-based decision mechanism' overlap despite conceding the underlying mechanisms are likely not equivalent.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis

C1.1: General-purpose programmable computing hardware executing stored instructions to perform the recited method	—	**CANNOT ASSESS**	The invention units describe functional capabilities (image acquisition, segmentation, filtering, actuation, MES integration) implemented presumably via processors/software, but no specific hardware processor/storage medium architecture is disclosed in the standardized units to assess correspondence.
C1.2: Acquisition of a training image set predominantly composed of normal (non-defective) instances for building a reference model	—	**NO COUNTERPART**	F2 describes pixel-level deep learning semantic segmentation for defect detection, which is typically trained on labeled defect/normal data via supervised segmentation, but none of the invention units disclose a training regime relying on a majority-normal image set as a reference baseline for anomaly detection, which is central to the claimed unsupervised/normal-data approach.
C1.3: Acquisition of a target image to be evaluated for anomalies	F1	**CORRESPONDS**	F1's continuous line-based optical image acquisition of moving objects provides target images of products for downstream defect analysis, functioning as the source of the target image to be evaluated, consistent with the claim's broader genus of receiving a target image regardless of acquisition modality.
C1.4: Extraction of localized feature representations at multiple sub-image locations from both training images and the target image, typically via a neural network	F2	**PARTIAL**	F2 employs a pixel-level deep learning convolutional network for semantic segmentation, which internally computes localized feature representations, but the invention's stated purpose is direct defect classification/localization via segmentation output rather than extraction of feature representations for a subsequent nearest-

			neighbor distance comparison against a training feature set; the underlying feature-extraction mechanism is adjacent but the claimed use of extracted features for k-NN style comparison is not disclosed in F2.
C1.5: Computation of a distance metric between a target location's feature representation and its k nearest neighbor feature representations from a training feature set	—	**NO COUNTERPART**	None of the invention units (F1-F5) disclose a k-nearest-neighbor distance calculation mechanism; F2 and F3 rely on segmentation output and a confidence score/threshold rather than a distance-to-nearest-neighbors metric, so this specific claim element appears to lack a counterpart in the invention.
C1.6: Threshold-based determination that a spatial location is anomalous when a computed distance metric exceeds a predefined threshold	F3	**PARTIAL**	F3 discloses confidence-based filtering using a threshold comparison to validate detected defects, which shares the genus of threshold-based decision-making, but the claim's specific input to the threshold comparison is a distance-to-nearest-neighbors metric derived from feature representations, whereas F3's input is a confidence score associated with a detected defect from a segmentation model; the metric type underlying the threshold decision differs.

All-elements note: Of the six decomposed elements of claim 1, two elements (C1.3 acquisition of a target image, and C1.6 threshold-based anomaly determination) appear to find a counterpart or partial counterpart in the invention's standardized units (F1 and F3 respectively), one element (C1.4, feature extraction at sub-image locations) partially corresponds to F2's pixel-level deep learning segmentation, while two elements (C1.2, majority-normal training image set, and C1.5, k-nearest-neighbor distance calculation) and the general hardware/processor element (C1.1) appear to lack a clear counterpart in the disclosed invention units. The invention units do not disclose a training approach based on predominantly normal data instances nor a k-nearest-neighbor feature-distance computation, which appear to be distinguishing points relative to the invention as described.

Equivalents caution: For C1.4 (feature extraction), the invention's deep-learning segmentation network likely computes internal feature representations similar in kind to those extracted in the claim, so the difference in downstream use (segmentation classification versus k-NN distance comparison) could plausibly be viewed as a difference in implementation detail rather than a substantive structural *difference, warranting an equivalents caution. For C1.6 (threshold-based anomaly determination), both approaches use a threshold comparison as the ultimate decision criterion, so the difference in the specific metric (confidence score versus nearest-neighbor distance) may be viewed by some as an insubstantial variation in how the threshold input is computed, though this is not certain and should be flagged for further equivalents analysis.*

3.16 US11754991B2 — Cloud-controlled manufacturing execution system (CLO-cMES) for use in pharmaceutical manufacturing process control, methods, and systems thereof

Assignee: SMP Logic Systems LLC · Published: 2023-09-12 · Status: Active · exp. 2039-07-04 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- The invention's MES data integration feature (writing inspection results back to a factory MES database) broadly overlaps with the patent's claimed manufacturing execution system (MES) that compiles, stores, and analyzes production data (claims 1, 7, 11), though the patent's MES is specifically directed to pharmaceutical/biopharmaceutical manufacturing control rather than generic defect inspection reporting.
- Claim 11's step of 'taking corrective action... comprises stopping or modifying the pharmaceutical manufacturing process' is a broad functional limitation that could conceptually encompass an automated corrective response like the invention's pneumatic reject mechanism, if such rejection were characterized as 'modifying' the process, though this is a stretch given the pharmaceutical process context.

Appears to differ (AI reasoning):

- Claim 1 and claim 7 require a 'software based programmable logic controller' integrated into a cloud-based application server and interfaced with a microcontroller embedded in a hardware device — the invention as described has no disclosed cloud-based PLC, microcontroller-embedded hardware architecture, or cloud application server component.
- Claims 1 and 7 require a 'wireless distributed control system' / 'mobile wireless sensor network' — the invention's line-scan camera and pneumatic actuator system is not described as wireless or as a distributed sensor network.
- All independent claims (1, 7, 11) are expressly limited to controlling/monitoring a 'pharmaceutical or biopharmaceutical manufacturing process' or device (per the Markush list in claims 6/9) — the invention is a generic production-line surface defect inspection system with no indication it is applied to pharmaceutical/biopharmaceutical manufacturing devices, which appears to be a required limitation the invention lacks.
- Claim 11 requires 'analyzing the data against the product specification' and 'compiling data... stored in a remote storage database housed in a wireless distributed network' to create a historic record — the invention's confidence-threshold defect grading and MES write-back is not described as involving a wireless distributed remote storage network or comparison against a formal product specification record in this manner.
- There is no claim element corresponding to line-scan image acquisition or CNN-based semantic segmentation defect detection; the patent claims are silent on any imaging or machine-vision inspection technique, so no overlap can be grounded in the claim text for this core invention feature.

Note: This patent's claims are directed to a cloud-based, wireless, software-PLC-controlled MES architecture specifically for controlling and monitoring pharmaceutical/biopharmaceutical manufacturing equipment and processes. The invention is a machine-vision-based surface defect inspection and automated rejection system for a generic production line, integrated with a factory MES for data reporting only. The only textual hook for overlap is the general concept of MES data compilation/analysis and corrective action in claim 11, but the claims' explicit pharmaceutical/biopharmaceutical process limitation and required cloud/PLC/microcontroller/wireless architecture are absent from the invention description, making the overlap thin. Relevance is assessed as low given the substantial domain and architectural differences; a full comparison would benefit from claim charts and confirmation of the invention's deployment context (e.g., whether it is ever used in pharma manufacturing) and whether any wireless/cloud MES elements are actually present in the described system.

3.17 WO2026077103A1 — Workpiece machining quality inspection method and system based on artificial intelligence

Assignee: Shanghai Jingzhi Industry Co Ltd · Published: 2026-04-16 · Status: Pending · exp. 2027-04-11 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both systems use camera-based image acquisition integrated with AI/deep-learning models to inspect workpieces/products for quality/defect determination, which is the general domain the claims cover.
- Both use a threshold-based decision step (patent: similarity threshold vs. standard point cloud; invention: confidence threshold on segmentation output) to decide whether a detected condition is confirmed — a broadly analogous 'threshold gating' concept that could be read broadly enough to encompass the invention's confidence-threshold step.
- Claim 1's mask-based classification of images into structural vs. background regions is a segmentation-type step that is conceptually adjacent to (though not identical to) the invention's pixel-level semantic segmentation for defect localization; an equivalents-style overlap caution applies here.

Appears to differ (AI reasoning):

- Claim 1 requires acquiring workpiece images from at least two angles and computing camera pose plus image depth information to build a 3D voxel model — the invention's single line-scan camera producing continuous 2D line images does not appear to include multi-angle capture, pose estimation, or depth determination.
- Claim 1 requires constructing a 3D voxel model of the workpiece and performing Gaussian splatting on voxels using density/color/transparency attributes — the invention has no 3D voxel modeling or Gaussian splatting step; it operates purely on 2D image data via a CNN.
- Claim 1's qualification decision is based on generating a workpiece point cloud and computing its similarity to a preset standard point cloud, exceeding a similarity threshold — the invention's decision is based on pixel-level semantic segmentation defect detection graded against a confidence threshold, not point-cloud similarity comparison; these appear to be distinct technical mechanisms.
- Claim 1's mask step is used to classify whole images into 'structural' vs 'background' categories as a pre-processing filter for point-cloud generation, not to localize/segment defects within the image — the invention's semantic segmentation instead directly localizes defect regions at pixel level, a different function than the claimed masking step.
- Dependent claims 2-3 further require specific Gaussian-function formulas, standard-deviation update rules, and weight-assignment rules for voxel splatting — none of these mathematical/3D-model-specific limitations appear present in the invention.
- Dependent claim 4 requires, upon failing the similarity threshold, feeding the point cloud and standard point cloud into a defect-detection model to output defect type and repair method sent to a worker's handheld terminal — the invention's pneumatic reject actuation and MES database write-back are different downstream actions not required by (and not equivalent to) this claim language.
- The system claim (final claim) mirrors claim 1's modules (image acquisition for multi-angle capture, 3D model-building module, Gaussian-splatting module, mask module, point-cloud/similarity module) — the invention's architecture (line-scan camera, CNN segmentation module, confidence grading, pneumatic reject, MES interface) does not appear to include the 3D-model-building or Gaussian-splatting modules required by this claim.

Note: Claims text was provided in Chinese and reviewed in full (independent method claim, eight dependent claims, and one system claim). The patent's claimed subject matter centers on multi-view 3D reconstruction (voxel modeling, Gaussian splatting, point-cloud similarity) as the core quality-determination mechanism, which is technically distinct from the invention's 2D line-scan image acquisition plus CNN-based semantic segmentation with confidence thresholding. Only claim 1 and its dependents were analyzed since no independent claim covers a simpler single-image defect-segmentation approach. This is a screening-level comparison only, not a legal or infringement/FTO opinion; equivalents doctrine and claim construction nuances (e.g., whether 'mask'-based segmentation could be argued broad enough to read on pixel-level defect segmentation) are not resolved here and would require detailed technical/legal review. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing point about claim 4 (defect type/repair method sent to handheld terminal vs. invention's pneumatic reject/MES write-back) is technically accurate but is used to distinguish based on claim 1 not reciting the invention's downstream actions — since claim 1 (the independent claim) doesn't require these MES/pneumatic features at all, the correct FTO concern is that claim 1 is broad and doesn't need to recite them to potentially read on the invention's core detection step; the note's extensive reliance on dependent claim 4's specific downstream actions as a distinguishing factor is somewhat misleading since dependent claims are narrower and less relevant to blocking risk than claim 1.
- The note's overlap section reasonably flags threshold-gating and mask/segmentation analogies as 'broad enough to encompass' concerns, which is appropriately cautious, but then the distinguishing points largely rely on the extensive additional limitations in claim 1 (multi-angle capture, voxel model, Gaussian splatting, point cloud similarity) that are NOT present in the invention — this is correct directionally (claim 1 requires additional elements the invention lacks, which is a valid non-infringement argument, not wrong-direction reasoning), so this part is faithful.
- The statement that claim 1's mask step serves a 'different function' (background/structural filtery) than the invention's pixel-level defect localization is supported by the claim text and is a legitimate technical distinction, not fabricated.
- Overall the reasoning correctly identifies that claim 1 (the broadest claim) contains numerous specific technical limitations (3D voxel modeling, Gaussian splatting, point cloud similarity) absent from the invention, which is the correct FTO direction (narrower claim with more limitations reduces overlap risk) — this is faithful reasoning, but the note could be seen as slightly overstating certainty in some distinguishing bullets by asserting invention features 'do not appear to include' certain elements almost categorically rather than framing as claim-required-elements-absent-from-invention.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.1: Multi-angle (≥2 views) image acquisition of a workpiece to build an image set, from which camera pose and image depth information are derived	—	**NO COUNTERPART**	The invention's F1 is line-scan (row-by-row) continuous acquisition of moving objects at an inspection point; the claim requires acquisition of at least two angular views of a workpiece to derive camera pose and depth for 3D reconstruction. These are different acquisition paradigms (multi-view photogrammetric capture vs. continuous line-scan capture

			of moving products), and the invention description contains no counterpart to deriving camera pose/depth from multiple angles.
1.2: Construction of a 3D voxel model of the workpiece from the image set, camera pose, and depth information	—	**NO COUNTERPART**	None of F1-F5 involves building a 3D voxel model; the invention's detection units (F2) operate via pixel-level semantic segmentation on 2D line-scan images, not 3D volumetric reconstruction.
1.3: Assignment of density/color/transparency attributes to voxels and Gaussian-splatting rendering of the voxel model using a preset Gaussian function based on voxel attributes and camera pose	—	**NO COUNTERPART**	Gaussian splatting of a voxel model is not present in any of the invention's standardized units (F1-F5), which describe line-scan imaging, CNN-based pixel segmentation, confidence thresholding, pneumatic rejection, and MES data feedback.
1.4: Application of a preset mask-extraction model to determine masks for each workpiece image and segment the image into workpiece-structure image and background image	F2	**PARTIAL**	F2 covers pixel-level (semantic segmentation) CNN-based detection of surface defects with simultaneous detection and localization. The claim's mask extraction is also a pixel-level segmentation model, but its purpose/output is separating workpiece structure from background (foreground/background segmentation), not detecting or localizing surface defects; the segmentation targets differ in object/purpose even though both use pixel-level model-based segmentation techniques.
1.5: Determining a workpiece point cloud from the splatted voxel model and segmented image, computing a similarity score against a standard point cloud, and confirming the workpiece as qualified if similarity exceeds a preset threshold	F3	**PARTIAL**	F3 requires a quantitative confidence measure per detected defect and a threshold-based comparison to confirm valid defects. The claim instead computes a point-cloud similarity score against a standard reference and uses a threshold to

			classify overall part conformity (pass/fail), which is a threshold-based quantitative validation step conceptually analogous to F3, but the underlying metric (3D point-cloud similarity vs. per-defect confidence score) and object of confirmation (whole-part qualification vs. individual defect validity) differ, so the correspondence is only partial.

All-elements note: Of the five claim elements identified in independent claim 1, none found a full, unambiguous counterpart in the invention's standardized units; three elements (1.1 multi-angle image acquisition with pose/depth estimation, 1.2 3D voxel model construction, 1.3 Gaussian splatting with density/color/transparency attributes) appear to lack any counterpart in the invention description, while two elements (1.4 mask-based structure/background segmentation, 1.5 point-cloud similarity threshold for qualification) show only partial correspondence to the invention's pixel-level segmentation (F2) and confidence-threshold validation (F3) concepts respectively, differing in specific technique and object of processing. The invention's F1 (line-scan continuous acquisition), F4 (pneumatic removal), and F5 (MES feedback) units do not appear to be addressed at all by claim 1, which is directed to a 3D reconstruction/Gaussian-splatting based dimensional/appearance qualification method rather than a line-scan surface-defect detection and rejection system.

Equivalents caution: For element 1.4 (mask-based workpiece/background segmentation vs. F2 pixel-level defect segmentation), the difference in segmentation target (structural boundary delineation vs. surface defect detection/localization) is a substantive functional difference likely not viewed as insubstantial, since the claim's mask model does not detect or localize defects at all. For element 1.5 (point-cloud similarity threshold vs. F3 per-defect confidence threshold), the difference between whole-part 3D geometric similarity scoring and per-defect confidence scoring reflects a different underlying detection paradigm (3D reconstruction-based conformity check vs. 2D image-based defect confidence filtering), which could plausibly be argued as substantially different rather than an insubstantial variation, given the distinct data representations (point cloud vs. pixel map) involved.

3.18 CN109840900A — A kind of line detection system for failure and detection method applied to intelligence manufacture workshop

Assignee: Changzhou Vocational Institute of Light Industry · Published: 2019-06-04 · Status: Active · exp. 2038-12-31 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 recites an image acquisition unit that captures images of a workpiece at an inspection station and feeds them through a processing pipeline to a deep neural network unit for defect classification — this generic 'camera + deep neural network classification' architecture potentially overlaps with the invention's camera + CNN defect detection concept, though the specific network task (feature-vector classification vs. pixel-level semantic segmentation) differs.
- Claim 5/6 describe a computer control unit (including a PLC controller) that receives defect information from the neural network unit and automatically issues a work instruction for the PLC to execute a corrective action — this broad 'automated action triggered by detected defect' concept potentially overlaps with the invention's confirmed-defect-triggers-actuator logic, subject to equivalents analysis given the differing nature of the action (repair vs. physical reject/removal).
- Claim 6 references updating a historical maintenance database with the inspection/repair record, which is conceptually similar to the invention's practice of writing inspection results back to a factory

database (MES), though the claimed database is specifically a repair-history database rather than a general MES.

Appears to differ (AI reasoning):

- Claim 1 requires a 面阵相机 (area-array camera) capturing images at a discrete inspection station, whereas the invention uses a line-scan camera performing continuous capture on a moving line — the claim's specific camera type does not clearly encompass a line-scan continuous-capture architecture, and claim 3 further specifies a particular fiber-optic-slip-ring/photoelectric-conversion signal path tied to the area-array camera, which the invention's line-scan approach does not appear to include.
- Claim 1 requires a distinct '特征向量提取单元' that performs edge detection and computes specific hand-crafted features (edge area, edge shape factor, average radius, first-3 Hu invariant moments via given formulas) as the input to the neural network, rather than the neural network operating directly on pixel data. The invention's CNN performs end-to-end pixel-level semantic segmentation without this claimed hand-crafted feature-vector extraction step, so this claim limitation does not appear to be met.
- Claim 1/9 require a specifically structured 3-layer neural network (input/hidden/output with input and output layers of equal size) trained on a defined 4-class sample library (合格/缺陷 I/II/III) — the invention's semantic segmentation CNN architecture is not described as matching this specific structural/training limitation.
- Claim 5/6 tie the corrective action to a PLC-executed '维修操作' (repair/maintenance operation) generated from a repair strategy combined with a historical maintenance database, distinct in kind from the invention's automated pneumatic reject actuator that physically removes a defective part from the line; the claim's repair-oriented action does not appear to require or encompass a part-removal/reject function.
- Claim 2 requires additional structural elements (proximity switch, intelligent positioning/release mechanism, backlit background plate with marker points, LED area light source matrix) that are not part of the invention's described features — while these do not create overlap, they are not addressed here since they are additional claim limitations only relevant if asserted; noting them highlights the claim's narrower structural scope which the invention as described does not clearly satisfy.

Note: This is an informational screening note based solely on the verbatim claims provided, not a legal or infringement opinion. The patent's independent claim 1 (and dependent claims 2-6) center on an area-array-camera-based inspection platform using a hand-engineered edge/Hu-moment feature vector fed into a small classification neural network, coupled with a PLC-driven repair-strategy execution system referencing a historical maintenance database. The invention instead uses a line-scan camera with an end-to-end CNN semantic segmentation approach, confidence-threshold defect confirmation, a pneumatic reject actuator, and MES integration. There is conceptual overlap at a high level (camera + neural network defect detection + automated response + result logging), which warrants attention, but several claim limitations (area-array camera and its optical signal path, the specific hand-crafted feature-extraction unit/formulas, the specific 3-layer network structure, and the repair-oriented PLC action) appear to require elements not clearly present in the invention as described. Claims 7-9 (method claims) largely mirror the same feature-extraction and classification pipeline of claim 1 and raise similar considerations. Given only the abstract/claims text was reviewed (no full specification/drawings), this assessment should be revisited if additional context becomes available.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note's distinguishing points repeatedly reason that because claim 1 recites specific limitations (area-array camera, hand-crafted feature vector, 3-layer network, PLC repair action) not present in the invention, the claim is distinguished — this is correct direction reasoning for claim 1 itself (narrower claim, invention lacks those limitations, so infringement of claim 1 specifically is avoided), so it is not inherently wrong-direction; however, the note conflates this with overall FTO conclusions without flagging that claim 1's narrowness (many limitations) actually reduces risk, which is correctly framed, but does not adequately caution that dependent claims 2-6 add further narrowing limitations while independent claim 1 remains the primary risk driver — this nuance is understated rather than fabricated.

- The statement 'Claim 6 references updating a historical maintenance database with the inspection/repair record, which is conceptually similar to the invention's practice of writing inspection results back to a factory database (MES)' is a reasonable high-level analogy supported by claim 6 text ('在所述历史维修数据库中更新添加一条针对该执行情况的维修记录') and the invention's MES feature, so this is faithful.
- The claim 2 discussion is appropriately caveated as not creating overlap and only noted for completeness, which is faithful and not fabricated.
- Overall the overlap and distinguishing statements are traceable to the claims/abstract text provided; no invented claim content was found, but some distinguishing points border on overstating claim narrowness as a stronger safe-harbor than a screening note should imply, given claim 1 is still an independent claim with broad conceptual scope (camera+DNN+automated action).

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
E1: A defect inspection system comprising a workpiece detection platform, image acquisition unit, image processing unit, feature vector extraction unit, deep neural network unit, and computer control unit	—	CANNOT ASSESS	This is a system architecture preamble listing components; it is not itself a functional limitation mapped to a single invention unit but establishes context for subsequent elements.
E2: Image acquisition of a workpiece at an inspection station using an area-array (2D frame) camera	F1	PARTIAL	F1 requires line-scan (row-by-row) continuous image acquisition of moving objects at an inspection point, whereas the claim specifies a 面阵相机 (area-array/frame camera) capturing an image at a detection station; both involve camera-based acquisition at an inspection point, but the claim's frame-based capture is a different image acquisition modality than F1's line-scan requirement, and continuous/in-motion capture is not explicitly recited here.
E3: Processing of acquired image to identify a sensitive/region-of-interest area and denoise it	—	NO COUNTERPART	This preprocessing step (resolution scanning to extract a sensitive region and denoising) has no corresponding unit among F1-F5, which do not include an explicit region-of-interest extraction/denoising preprocessing stage.
E4: Extraction of handcrafted	F2	PARTIAL	F2 requires pixel-level deep-

feature vector (edge area, shape factor, average radius, Hu invariant moments) from a defined target region via edge detection			learning-based semantic segmentation for simultaneous defect detection and localization, whereas the claim uses classical edge-detection-based handcrafted feature extraction (edge area, shape factor, radius, Hu moments) as a separate step prior to classification; both aim at characterizing defect-relevant regions for later assessment, but the technical means (handcrafted geometric/moment features vs. pixel-level CNN segmentation) differ substantially, and localization at pixel granularity is not established by this feature-vector approach.
E5: Deep neural network classifies extracted feature vectors to identify manufacturing defect type and outputs classification result	F2	**PARTIAL**	F2 requires pixel-level semantic segmentation by a convolutional neural network for simultaneous detection and spatial localization of surface defects, whereas the claim's deep neural network performs classification of a low-dimensional handcrafted feature vector (4 features) into defect type categories, which is whole-region/vector classification rather than pixel-level segmentation; the claim also does not require a convolutional architecture or joint detection-and-localization output.

All-elements note: Of the five claim elements identified, none found a full 'corresponds' counterpart among invention units F1-F5; three elements (E2, E4, E5) appear to partially correspond to F1 and F2 respectively due to differing technical implementations (area-array camera vs. line-scan; handcrafted feature extraction plus vector classification vs. pixel-level CNN semantic segmentation), while E1 (system architecture preamble) and E3 (resolution scanning/denoising preprocessing) appear to lack a direct counterpart in the invention's standardized units. Notably, the claim contains no element corresponding to F3 (confidence-based threshold filtering), F4 (pneumatic automated removal), or F5 (MES data integration/feedback), which would be additional areas of apparent non-overlap if considered from the invention's perspective, though this chart is organized around the claim's own elements.

Equivalents caution: E2 (area-array camera image acquisition) vs. F1 (line-scan continuous acquisition): the difference in imaging modality (frame-based single-shot capture vs. continuous line-by-line scanning) is a structural difference in acquisition technique that could be argued as either a substantial or *insubstantial variation depending on whether frame-based capture is understood to achieve the same continuous inspection function in substantially the same way, warranting caution. E4/E5 (handcrafted feature extraction plus neural network classification) vs. F2 (pixel-level deep learning semantic segmentation): the shift from engineered geometric/moment features and whole-vector classification to end-to-end pixel-level CNN segmentation is a substantive difference in both algorithmic approach and output granularity (classification label vs. spatial defect map), making an insubstantial-difference characterization less plausible, though this remains an informational observation only.*

3.19 CN115338134B — A wood sorting system and sorting method based on intelligent defect recognition

Assignee: Zhejiang Shiyou Wood Industry Co ltd · Published: 2025-07-01 · Status: Active · exp. 2042-09-13 · Relevance: LOW · [verify on Google Patents ↗]

Potential overlap (AI reasoning):

- Both systems perform an automated inspection step followed by a threshold/range-based judgment step to classify a moving object as acceptable or defective (claim's comparison of Rz'test/Ra'test to evaluation ranges is broadly analogous to the invention's confidence-threshold grading concept).
- Both systems act on the judgment result to physically separate/route the inspected object away from the normal line (claim's diversion to sub-conveying lines is broadly analogous in function to the invention's pneumatic reject mechanism, though the actuation method differs).

Appears to differ (AI reasoning):

- Claim 1 requires a specific contact/profile sampling method that measures surface roughness parameters (Rz, contour maximum height; Ra, arithmetic mean deviation) at a fixed (4~6)x(4~6) grid of points with defined timing (0.2s~1.0s intervals) and sampling length (0.1mm~0.8mm) — this is a distinct, narrowly defined measurement technique that the invention's line-scan camera image capture does not appear to perform.
- Claim 1's defect judgment step is based on statistical comparison of measured Rz/Ra averages against pre-established numeric evaluation ranges (color/defect classification such as light board, dark board, two-tone board, crack/knot defect, mold/rot defect) rather than pixel-level semantic segmentation via a convolutional neural network; the invention's CNN-based segmentation approach is not required or suggested by this claim.
- The claims contain no requirement for writing inspection results back to a factory MES database; this integration step in the invention is not addressed by the claim language.
- Claim 2 additionally requires a surface sanding/roughening step prior to sampling, a sample-preparation limitation with no counterpart in the invention.

Note: This patent (CN115338134B) is directed to a wood-sorting method based on contact/profile measurement of surface roughness parameters (Rz, Ra) compared against numeric evaluation ranges established from standard samples, with sorting effected by routing to different sub-conveying lines. This differs substantially in technical field and mechanism from the invention's line-scan camera plus CNN-based semantic segmentation defect detection, confidence-threshold grading, pneumatic reject actuation, and MES data integration. Overlap is limited to the generic high-level concept of 'automated inspection -> threshold-based judgment -> automated diversion/removal of defective items,' which is common to many industrial sorting systems. Given the different sensing modality (contact roughness measurement vs. image-based CNN segmentation) and different actuation/rejection mechanism, relevance is assessed as low. This is an informational screening note only, not a legal or infringement opinion, and is based solely on the verbatim claims text provided.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note's distinguishing points about CNN-based segmentation not being required by the claim, and MES integration not being addressed by the claim language, are technically accurate but reasoned in a way that could be seen as wrong-direction: the claim's silence on these invention features is used to distinguish the invention favorably, when in fact a claim that does not recite a limitation is broader and could be argued to read on the invention if all recited elements are present regardless of unclaimed extra features (though here it is used correctly to show the claim's actual recited method differs, since the claim affirmatively requires roughness/Rz/Ra measurement rather than merely omitting CNN segmentation, so this is only a minor concern).

- The claim's diversion mechanism (routing to sub-conveying lines via a sorting mechanism) is characterized as 'broadly analogous' to the pneumatic reject actuator; this is a reasonable functional analogy supported by the claim text but is somewhat generous given the differing physical mechanism (conveyor routing vs. pneumatic ejection).

3.20 CN119086555A — An online visual inspection system and method for automobile seat surface defects based on deep learning

Assignee: Jilin Changguang Jingyi Intelligent Technology Co ltd · Published: 2024-12-06 · Status: Withdrawn · Relevance: MEDIUM · verify on Google Patents ↗

⚠ NOT IN FORCE — Withdrawn (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 3-6 recite CNN-based (deep learning) defect detection models that classify and localize seat surface defects (thread ends, breakage, oil stains, wrinkles) by computing defect position and size from sub-images — this is analogous in function to the invention's CNN-based pixel-level semantic segmentation for defect detection and localization, subject to an equivalents caveat given the claim's specific two-model (A/B) architecture versus the invention's generic segmentation network.
- Both systems perform automated, camera/image-based inspection of a workpiece as part of an in-line/near-line quality control process, and both feed defect detection results into a broader factory system (claim's electric control and image processing system / display vs. invention's MES integration), though the claim does not specify MES-level data write-back.

Appears to differ (AI reasoning):

- Claim 1 requires a specific hardware architecture — dual robots (A and B), robot-mounted illumination/imaging systems, telescopic motion mechanisms with slide-rail-mounted illumination/imaging systems, and a seat posture error-proofing mechanism — none of which are present in the invention's single continuously-operating line-scan camera setup; this is a structural limitation the invention appears to lack.
- Claim 1 explicitly requires that after inspection the detected seat is 'circulated to the manual rechecking station,' i.e., a manual review step, rather than an automated physical removal mechanism; the invention's automated pneumatic reject actuator that physically removes defective parts is a materially different downstream action not required or contemplated by this claim language.
- The claims describe a discrete, station-based inspection cycle (seat enters a measuring station, robots/telescoping mechanisms extend, image, then retract) rather than continuous line-scan image acquisition of products moving through an inspection station on a production line as in the invention; the imaging modality (multi-robot area imaging along preset paths) differs from a line-scan camera architecture.

Note: This is an informational screening note based solely on the verbatim claims text provided, not a legal or infringement opinion. The patent's core claimed system is a robot/telescoping-mechanism-based multi-view imaging station with a manual rechecking step, which differs structurally and procedurally from the invention's continuous line-scan/automated pneumatic reject/MES-integrated pipeline. The method claims' CNN-based defect classification and localization functionality shows conceptual overlap with the invention's semantic segmentation defect detection, warranting an equivalents-based caution rather than a clean differentiation. ⚠ LEGAL STATUS (Google Patents): Withdrawn — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note states 'the claim does not specify MES-level data write-back' as part of a distinguishing/overlap caveat — this is fine as a factual observation, but should not be read as reducing overlap risk since claim breadth (absence of a limiting feature) does not narrow scope; the note frames it appropriately as a caveat rather than a distinguishing point, so this is only a minor risk of misreading.
- The distinguishing point about claim 1 requiring 'manual rechecking station' versus the invention's automated pneumatic reject actuator is valid as a structural/procedural difference, but claim 1 is a system claim reciting specific hardware (robots, telescoping mechanisms) — the note correctly treats this as a structural limitation narrowing the claim, which is directionally correct reasoning (narrower claim = less overlap), so this is faithful.
- The distinguishing point regarding discrete station-based imaging vs. continuous line-scan acquisition is supported by claim 1 language ('when the detected seat enters the measuring station... extending... retracting') and is faithful.
- The overlap statement regarding CNN-based defect detection functions (claims 3-6) reciting position/size calculation for defect types is accurately drawn from the claims text and is faithful, appropriately hedged with an equivalents caveat rather than overclaiming identity.
- No fabricated patent content was found; all cited claim elements (robot A/B, telescoping mechanisms, seat posture error-proofing mechanism, manual rechecking station, CNN models A/B, sub-image resolutions) are verbatim or closely paraphrased from the provided claims text.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
E1: Robot-mounted camera/illumination systems capture multiple discrete images (front, back, top) of a stationary or positioned object along a preset path at an inspection station	F1	**PARTIAL**	Claim describes robot-arm-mounted imaging along preset paths capturing discrete views (front/back/top) of a seat at a station, whereas F1 requires continuous line-scan (row-by-row) acquisition of objects in motion relative to the camera; the claim's imaging approach is area/frame-based robotic photography rather than line-scan acquisition of moving products, though both occur at an inspection station.
E2: Additional side-mounted extendable imaging units capture further images (sides) of the object at the inspection station	F1	**PARTIAL**	This is another image-acquisition mechanism at the inspection station, but again frame-based (exposure and shooting) via telescoping arms rather than continuous line-scan capture of moving products, differing from F1's row-by-row acquisition limitation.
E3: A control system coordinates image acquisition triggering and robot motion for	—	**NO COUNTERPART**	This element describes motion/trigger control of robots for image capture;

inspection			none of the invention's standardized units (F1-F5) address robotic motion control coordination, so no corresponding invention unit is identified for this specific control functionality.
E4: A mechanical/positional verification mechanism screens object orientation/pose prior to or during inspection	—	**NO COUNTERPART**	The invention's F1-F5 units do not include any pose/posture verification or error-proofing mechanism; this appears to be an element without a counterpart among the disclosed invention units.
E5: After image acquisition, the object is passed along to a subsequent manual review/inspection station rather than automated defect confirmation or removal	—	**NO COUNTERPART**	The claim routes the seat to manual rechecking after imaging, with no disclosed automated defect detection, confidence-based validation, pneumatic removal, or MES integration step in claim 1; F2 (semantic segmentation defect detection), F3 (confidence filtering), F4 (pneumatic removal) and F5 (MES integration) each appear to lack a counterpart in this claim, which only performs image acquisition and mechanical positioning/error-proofing followed by manual review.
E6: A display outputs the inspection process and results for local viewing	—	**NO COUNTERPART**	Local display of results is distinct from and narrower than F5's requirement of automated data writing/integration into a factory-level MES database; local display does not itself constitute MES integration, so F5 appears to lack a counterpart in this claim.

All-elements note: Not every claim element found a clear counterpart among the invention's standardized units. Claim 1 elements E1 and E2 (robotic/telescopic image acquisition) partially correspond to F1 due to a frame-based versus line-scan acquisition difference. Elements E3 (robot motion control) and E4 (seat posture error-proofing mechanism) appear to lack any counterpart in the invention's F1-F5 units. Notably, the invention's F2 (pixel-level deep learning defect segmentation), F3 (confidence-based filtering), F4 (pneumatic removal), and F5 (MES data integration) all appear to lack a counterpart in claim 1, since claim 1 routes inspected seats to a manual rechecking station (E5) and merely displays results locally (E6) rather than performing automated defect detection, validation, removal, or MES integration; these deep-learning/automation aspects are addressed in dependent claims 3-6 rather than in claim 1 itself.

Equivalents caution: For E1 and E2, the difference between robotic/telescopic frame-based photographic capture along preset paths versus continuous line-scan acquisition of moving objects concerns the fundamental image-acquisition modality (discrete area-scan exposures at fixed points vs. continuous row-by-row scanning of moving products) and appears to be a substantive rather than insubstantial difference, given that line-scan systems and multi-camera robotic photographic systems operate on materially different acquisition principles and timing relative to product motion.

3.21 CN121280775A — Method for judging surface defects of fiberboard based on surface characteristics

Assignee: Guangxi Talentcloud Information Technology Co ltd · Published: 2026-01-06 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 (S1-S3) recites obtaining a surface image and using a CNN-based target segmentation network model to perform pixel-level/target segmentation of defect regions, which broadly overlaps with the invention's semantic segmentation defect detection via a CNN on captured images.
- Claim 1 (S6) recites a classification network model outputting a predicted defect category and a 'confidence' (置信度) for the defect, which appears to overlap with the invention's confidence threshold grading concept, though the claim's confidence use is tied to classification output rather than an explicit threshold-based confirmation gate.
- Claim 2 discloses image acquisition via an installed line-scan camera (线扫相机) or linear/side light sources for imaging the board, which overlaps with the invention's line-scan camera image acquisition feature.
- Claim 1 (S8-S9) describes a verification process (cosine similarity and histogram intersection comparisons meeting configured values, then classification) to confirm whether a detected defect region is accurate/correct — broadly analogous in function to the invention's confidence-based grading step, though implemented via different similarity metrics rather than a single confidence threshold.

Appears to differ (AI reasoning):

- Claim 1 requires establishing a surface defect feature library with specific texture and color histogram feature identifiers for fiberboard-specific defect types (纤维团/凹坑/橡胶粒/黑色树皮), and requires cosine similarity and histogram intersection comparisons against this library (S7-S9) as the mechanism for confirming defect region accuracy — the invention's confidence threshold grading does not appear to involve this specific texture/color feature-library comparison methodology, so this comparison-based confirmation architecture is a required element not evidenced in the invention.
- Claim 1 requires a separate classification network model (S5-S6, S9) distinct from the segmentation model, used specifically to classify segmented regions into fiberboard defect categories and judge correctness of the defect — the invention's description does not mention a second classification network stage.
- The claims are directed to a fiberboard surface defect judging method and do not recite any automated pneumatic reject actuator or physical removal mechanism, nor any MES data integration/write-back step — these invention features have no corresponding claim requirement, so no overlap analysis is needed there (not a distinguishing point under claim-to-product logic, simply outside claim scope).

Note: This patent claims a fiberboard-specific surface defect detection/classification method using CNN-based segmentation plus a secondary classification network verified via texture cosine-similarity and color-histogram-intersection comparisons against a curated feature library, rather than a generic confidence-threshold gate. The invention's line-scan acquisition and CNN segmentation align generically with claim 1 and claim 2 language, which is broad enough to potentially encompass the invention's segmentation and imaging approach (overlap risk should be assessed with equivalents in mind, e.g., 'confidence' output vs. 'confidence threshold grading'). However, the claims' specific fiberboard defect taxonomy, dual-network (segmentation + classification) architecture, and mandatory texture/histogram similarity-based verification steps are limitations the invention as described does not evidently implement, which would need clarification. No claim element addresses pneumatic rejection or MES integration, so those invention features fall outside the scope of this patent's claims. This is an informational screening note only, not a legal or infringement conclusion. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note treats the pneumatic reject and MES integration features correctly by noting they are absent from the claims and framing this as 'outside claim scope' rather than as a distinguishing/non-infringement point — this is handled correctly and is NOT wrong-direction reasoning, so no issue there.
- The distinguishing point regarding the feature library (纤维团/凹坑/橡胶粒/黑色树皮) and texture/histogram comparison (S7-S9) being 'required elements not evidenced in the invention' is used correctly as a distinguishing feature (since it's an additional limitation in the claim that narrows it relative to the invention), which is correct direction reasoning - claim requires more than invention does, so overlap is narrower. This is faithful.
- The distinguishing point about the separate classification network model (S5-S6, S9) being 'distinct from segmentation model' and absent from invention description is also correctly used as a narrowing limitation - faithful reasoning direction, not fabricated, supported by claims text.
- The claim 1 S6 'confidence' (置信度) is accurately described as being tied to classification output rather than an explicit threshold gate, which is a fair, non-overstated characterization supported by the claim text.
- Overall the note appears well-grounded in the provided abstract/claims text without inventing unsupported patent content; the FTO direction logic is generally applied correctly since the distinguishing points cite claim limitations (specific feature library, dual-network architecture, similarity metrics) that ADD restrictions to the patent claim, correctly narrowing perceived overlap, rather than citing absence of invention features from the claim as a distinguishing point (which would be wrong-direction). Only minor imprecision: the note's parenthetical framing 'the invention's confidence threshold grading does not appear to involve this specific texture/color feature-library comparison methodology, so this comparison-based confirmation architecture is a required element not evidenced in the invention' is slightly awkwardly phrased and could be misread as invention-not-matching-claim (wrong direction), though in context it is being used to distinguish the claim as narrower, which is correct direction; flagging as minor clarity issue only.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
C1-S1: Acquisition of a surface image of a moving/produced fiberboard product and pixel-level annotation of defect features	F1	**PARTIAL**	The claim requires obtaining a surface image and pixel-level labeling of defects, which relates to image acquisition, but does not specify line-scan (row-by-row) capture, continuous acquisition, or that the object is in motion at an inspection point on a production line; dependent claim 2 (not part of independent claim 1) adds a line-scan camera option, so claim 1 itself is broader/silent on these specific acquisition-mode limits of F1, creating a

			genuine difference in specificity rather than a pure genus-species relation.
C1-S2: Establishment of a reference database of surface defect feature identifiers (texture and color) and defect feature regions for known defect types	—	**NO COUNTERPART**	The invention units (F1-F5) do not describe building or maintaining a pre-established feature library of texture/color signatures for defect-type matching; this appears to be a distinct data-structure/methodology element not present in the standardized invention units.
C1-S3: A CNN-based segmentation network model that performs target/instance segmentation of surface defect features within the product image to obtain defect regions	F2	**CORRESPONDS**	The claim's CNN-based segmentation network producing defect regions corresponds to F2's pixel-level deep learning semantic/instance segmentation for defect detection and localization; the claim's broader recitation of a segmentation CNN reads on F2's specific implementation as genus over species.
C1-S4: Selection of a feature region identifier from the pre-built defect feature library	—	**NO COUNTERPART**	This library-selection step has no corresponding operation in the standardized invention units, which do not rely on a pre-established feature library for identifier selection.
C1-S5: Selection of a defect feature region from the library and classification to obtain a defect feature category	—	**NO COUNTERPART**	Classification against a pre-selected library region is not reflected in the invention units, which describe segmentation-based detection/localization (F2) rather than library-driven classification of selected regions.
C1-S6: A classification network model that outputs a predicted defect category together with a confidence score for the defect	F3	**PARTIAL**	Both involve a confidence value associated with a detected defect, aligning with F3's quantitative confidence measure; however, the claim's confidence arises from a separate classification network model outputting category+confidence rather

			than F3's threshold-based validation/filtering mechanism, so the confidence usage differs in function (classification confidence vs. pass/fail validation threshold).
C1-S7: Extraction of texture features and color histogram features from the regions identified by the segmentation network	—	**NO COUNTERPART**	Feature extraction of texture/color histograms from segmented regions for downstream comparison is not part of the standardized invention units, which do not include this hand-crafted feature extraction step.
C1-S8: Validation of segmented defect regions via cosine-similarity comparison of texture features and histogram-intersection comparison of color features against library-configured threshold values, confirming region accuracy when both thresholds are met	F3	**PARTIAL**	Both use threshold-based comparison to confirm/validate detected defects, aligning with F3's threshold-based validation criterion; however, the claim's validation criterion is specifically cosine-similarity and histogram-intersection metrics against a feature library, which is a materially different validation mechanism than a generic confidence-score threshold contemplated by F3, representing a distinct implementation rather than a mere genus-species relation.
C1-S9: Inputting the segmentation-identified defect region into the classification network model to obtain a classification result determining whether the defect is correct	F3	**PARTIAL**	This final determination of defect correctness relates to F3's goal of confirming valid defects, but it is achieved through a second classification network's output rather than a simple confidence-threshold comparison, making the mechanism adjacent but not identical to F3's specified threshold-validation approach.

All-elements note: Not every claim element found a clear counterpart in the standardized invention units. Elements C1-S3 correspond to F2 (segmentation-based defect detection/localization). Elements C1-S1, C1-S6, C1-S8, and C1-S9 only partially correspond to F1 and F3 respectively, due to differences in acquisition-mode specificity and in the particular validation/confidence mechanisms used. Elements C1-S2, C1-S4, C1-S5, and C1-S7, which relate to building and using a pre-established texture/color feature library for identifier selection and classification, appear to lack any counterpart in the standardized *invention units. Additionally, the invention's F4 (pneumatic removal) and F5 (MES feedback) units have no corresponding recitation in claim 1, though this is not analyzed as a claim element since claim 1 does not require such steps.*

Equivalents caution: For C1-S1, the difference between an unspecified image-acquisition step and F1's line-scan/continuous/in-motion acquisition could plausibly be viewed as insubstantial if the claimed acquisition is later specified (e.g., via dependent claim 2) as line-scan-based, but as recited in claim 1 alone the difference concerns a genuine limitation gap. For C1-S6, the difference between a classification-network-derived confidence score and F3's threshold-based validation confidence may be substantial, since the functions (category prediction vs. pass/fail filtering) differ. For C1-S8, the difference between similarity/histogram-based thresholding and a generic confidence-threshold check could be viewed as a substantive difference in validation methodology rather than an insubstantial variation, given the distinct technical approach (feature-library matching vs. confidence scoring). For C1-S9, the use of a separate classification network to judge defect correctness versus a simple threshold check also appears to be a non-trivial mechanistic difference, cautioning against treating it as insubstantial.

3.22 CN105424718B — A kind of vehicle mirror flaw on-line automatic detection device and method based on double-station

Assignee: Donghua University · Published: 2018-08-03 · Status: Expired - Fee Related · exp. 2035-11-02 · Relevance: MEDIUM · [verify on Google Patents ↗]

⚠ NOT IN FORCE — Expired - Fee Related (Google Patents structured data). This document itself poses no ongoing exposure; check family members via the link.

Potential overlap (AI reasoning):

- Claim 1 broadly recites a 'defect online automatic detection system' that performs 'online automatic detection of surface defects' without limiting the underlying algorithm — this broad claim language could be read to encompass the invention's CNN-based semantic segmentation approach for surface defect detection.
- Claim 3 recites a line-scan CCD with a line light source performing dynamic line-by-line scanning/imaging of the moving mirror surface as it passes through a detection zone — this is functionally analogous to the invention's line-scan camera continuously capturing images of products moving through an inspection station, and represents a potential overlap area (line-scan acquisition concept).
- Claim 1's robotic sucker (机械手吸盆) plus sorting mechanism (分检组合机构), which removes/sorts defective vs non-defective mirrors after detection, is functionally similar to the invention's automated reject mechanism that removes defective parts from the line — though the actuator type differs (vacuum/robotic handling vs. pneumatic ejection), this should be treated as a potential overlap under an equivalents caution rather than a clean difference.
- Claims 7–9 use grayscale-histogram thresholding to binarize/segment images before extracting defect regions — conceptually adjacent to the invention's confidence-threshold-based grading step, though applied differently (image binarization vs. post-detection confidence scoring), warranting a cautious equivalents note.

Appears to differ (AI reasoning):

- Claim 1 requires a specific two-station physical architecture (工位一 line-scan/line-light detection of surface scratches/pitting AND 工位二 area-array-camera/backlight detection of edge-burst and light leakage) housed in a sealed air-purification chamber — the invention as described has only a single line-scan inspection station and no area-array/backlight second station, so this structural limitation appears unmet.
- Claim 1 further requires specific upstream/downstream mechanical infrastructure — mirror cleaning equipment, an air-knife drying system, a push mechanism, an air-purification chamber with automatically opening front/back doors, an encoder-synced rail-mounted stage — none of which are described as part of the invention, and the claim requires these as part of the recited device.

- Claims 7–9 (dependent on method claim 6) require specific deterministic image-processing algorithms (grayscale histogram valley thresholding, morphological closing, connected-component region extraction, and rule-based feature classification using brightness variance/area/aspect-ratio) as the actual defect-detection technique — the invention instead uses a CNN performing pixel-level semantic segmentation, a materially different (learned, not rule-based) detection technique, so these specific algorithmic limitations appear unmet.
- No claim recites or requires integration with a factory MES database; this is an invention feature not required by any claim, so it is not itself a distinguishing point but simply outside the claimed scope.

Note: This patent (CN105424718B) is directed to a dual-station optical inspection device/method specifically for vehicle mirror surface defects (scratches, pitting, edge-burst, light leakage), using traditional deterministic image-processing algorithms (histogram thresholding, morphological operations, connected-component analysis) rather than machine-learning-based segmentation. The independent device claim (claim 1) is broad enough in its detection-system language to create potential overlap with the invention's general line-scan acquisition and automated-removal concepts, but the claim's required two-station structure, specific mechanical subsystems (cleaning, drying, push mechanism, sealed chamber with doors, encoder-synced stage), and the dependent method claims' specific rule-based algorithms are limitations the invention as described does not appear to include. No claim addresses CNN/semantic segmentation, confidence-score grading, pneumatic actuation specifically, or MES integration — these remain outside the literal claim scope though under FTO logic broad claim 1 language should still be checked against actual product implementation. This is an informational screening note only, not a legal or infringement conclusion. ⚠ LEGAL STATUS (Google Patents): Expired - Fee Related — this document itself appears NOT in force and poses no ongoing exposure by itself; check family members via the link before relying on this.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note states claim 1's robotic sucker plus sorting mechanism removes/sorts defective vs non-defective mirrors 'after detection' and treats this as functionally similar to the invention's pneumatic reject actuator; while claim 1 does support this comparison, the note appropriately hedges but still stretches the equivalence since claim 1's mechanism is a pick-and-place/sorting system rather than a reject/ejection mechanism, which is a more significant mechanical difference than implied.
- The distinguishing point about claim 1 requiring a two-station architecture, sealed chamber, and specific upstream mechanical infrastructure (cleaning, drying, push mechanism, doors, encoder-synced stage) is used correctly to note these are extra limitations narrowing claim 1 — this is correct FTO direction (narrower claim = easier to avoid), so it is faithful, not wrong-direction.
- The statement 'No claim recites or requires integration with a factory MES database; this is an invention feature not required by any claim, so it is not itself a distinguishing point but simply outside the claimed scope' correctly avoids wrong-direction reasoning and is faithful.
- The claim 1 broad language overlap statement is reasonably supported since claim 1 recites '瑕疵在线自动检测系统' and 'online automatic detection' without specifying the algorithm in the independent claim itself (algorithm specifics appear only in dependent claims 7-9), so this is faithful.
- The comparison of claims 7-9's histogram thresholding to the invention's confidence-threshold grading is a stretch/imprecise analogy since the claimed thresholding is for image binarization/segmentation preprocessing, not confidence-score-based detection confirmation — the note does hedge this as 'conceptually adjacent' and 'applied differently,' which is reasonably faithful but slightly overstated as a genuine overlap concern.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
E1: A dual-station online automatic defect inspection device for vehicle mirrors comprising a conveyor line for	F1	**PARTIAL**	The claim requires a production line transporting mirrors, consistent with F1's inspection point on a

transporting mirrors			production line, but the claim's device is specifically structured around two distinct inspection stations, a feature not reflected as a limit in F1.
E2: Sequential arrangement along the line of cleaning equipment, air-knife drying, pushing mechanism, defect inspection system, robotic pickup, and sorting mechanism	—	**NO COUNTERPART**	The invention's standardized units address image acquisition, defect detection, confidence filtering, pneumatic removal, and MES integration; there is no disclosed counterpart for mirror cleaning equipment, air-knife drying, a robotic suction pickup, or a multi-line sorting combination mechanism as structural elements of the inspection line.
E3: Automatic cleaning equipment for cleaning mirrors before inspection	—	**NO COUNTERPART**	No invention unit addresses a pre-inspection cleaning function; F1–F5 begin at image acquisition and end at MES feedback, with no cleaning step described.
E4: Air-knife drying system for purifying/drying the cleaned mirror	—	**NO COUNTERPART**	None of the invention units describe a drying or air-purification step; this appears to be an object-preparation stage absent from the invention's standardized functions.
E5: Pushing mechanism for conveying the mirror into the inspection system	—	**NO COUNTERPART**	F1 covers continuous line-scan acquisition of moving objects but does not specify or require a pushing mechanism as a distinct structural element; no invention unit describes such a component.
E6: An online defect inspection system comprising an air purification chamber divided into at least two inspection stations	F1	**PARTIAL**	F1 requires acquisition at a defined inspection station on a line; the claim's two-station enclosed air-purification chamber architecture is a more specific and structurally different implementation (sealed chamber with dual zones) than the single generic inspection point

			contemplated by F1, so the difference is more than a mere species-of-genus relationship in the opposite direction (claim is narrower/different in structure).
E7: At station one, a first defect detection mechanism performs online automatic detection of mirror surface defects	F2	**PARTIAL**	Both involve automatic detection of surface defects, corresponding to F2's surface-defect detection goal; however, claim 1 at the independent-claim level does not specify pixel-level deep-learning semantic segmentation or a convolutional neural network, so the mechanism's nature is broader/unspecified relative to F2's specific granularity and technology limits.
E8: At station two, a second defect detection mechanism performs online automatic detection of edge-chipping and light-leakage defects	F2	**PARTIAL**	This is a second, separate detection mechanism targeting different defect types (edge-chipping, light leakage) via a distinct sensing modality; it shares the general concept of automatic defect detection with F2 but is not shown tied to pixel-level semantic segmentation or CNN-based analysis, making it an adjacent but not clearly matching implementation.
E9: Robotic suction gripper for removing the mirror from the inspection system and placing it into a sorting mechanism	F4	**PARTIAL**	Both involve automated physical removal/handling of the part following inspection, consistent with F4's automated physical removal concept; however, the claim specifies a robotic suction (vacuum) gripper mechanism rather than pneumatic actuation for ejection, which is an adjacent but distinct actuation technology from F4's pneumatic requirement.
E10: A sorting combination mechanism for routing mirrors	—	**NO COUNTERP**	The invention's F4 addresses removal of

with different defect types, and defect-free mirrors, to different lines for further processing		**ART**	defective parts from the line, but no invention unit describes multi-way sorting into different downstream lines based on defect classification; this appears to be an additional distinguishing feature of the claim.

All-elements note: Not every claim element found a clear corresponding invention unit. Confidence-based threshold validation (F3) and MES data feedback/integration (F5) appear to lack any counterpart in claim 1's recited elements (the claim does not recite a confidence threshold step or integration with a factory MES database). Additionally, several structural elements of the claim (mirror cleaning equipment, air-knife drying, pushing mechanism, robotic suction pickup, and multi-line sorting combination mechanism) appear to lack counterparts in the invention's standardized units. The image acquisition (E6) and defect detection (E7, E8) elements, and the automated removal element (E9), find partial correspondence with F1, F2, and F4 respectively, but with differences in specific structure or technology as noted.

Equivalents caution: For E1 (single generic line vs. dual-station structure) and E6 (sealed air-purification chamber with two zones vs. a generic inspection point), the difference in structural configuration could be viewed as a substantive design choice rather than an insubstantial variation, since the dual-chamber arrangement is central to the claimed device. For E7 and E8 (unspecified detection mechanisms vs. pixel-level CNN-based semantic segmentation), the absence of a specified deep-learning/CNN pixel-level approach is a meaningful technological difference that would likely not be considered insubstantial. For E9 (robotic suction gripper vs. pneumatic ejection actuation), both are automated physical-handling technologies and the substitution of suction-gripper handling for pneumatic ejection actuation could plausibly be viewed by some as an insubstantial variation in automated part-handling means, though this remains uncertain and fact-dependent.

3.23 CN119023577A — A visual inspection system and method for production line of intelligent factory

Assignee: Chongqing University Of Electronic Science And Technology · Published: 2024-11-26 · Status: Pending · Relevance: MEDIUM · [verify on Google Patents ↗]

Potential overlap (AI reasoning):

- Claim 1's multispectral camera module for acquiring product image data on the production line in real time reads on the invention's line-scan camera image acquisition, as both perform continuous image capture of products on a production line for inspection purposes
- Claim 1's intelligent recognition and processing module using deep learning (claim 5/6, specifying convolutional neural network) to analyze image data and recognize surface defects overlaps with the invention's CNN-based semantic segmentation defect detection, as CNN is explicitly recited as one deep learning algorithm option
- Claim 1's automatic rejecting module that removes defective products from the production line overlaps with the invention's automated pneumatic reject mechanism, since the claim broadly recites 'rejecting' without specifying actuator type, encompassing pneumatic implementations as a likely equivalent
- Claim 7's listed defect types (scratches, stains, dimensional deviations, cracks, depressions, pin bending) are broad categories that could encompass surface defects detected by the invention's semantic segmentation system

Appears to differ (AI reasoning):

- Claim 1 requires an environment sensing module that senses ambient illumination intensity and feeds it back to a system control module — the invention as described has no illumination-sensing component

- Claim 1 requires a system control module that compares sensed illumination intensity against a preset threshold value — this specific illumination-threshold comparison function appears absent from the invention
- Claim 1 requires a dynamic adjustment illuminator that adjusts ambient illumination intensity around the product based on the comparison result — the invention has no illumination adjustment mechanism described
- Claim 1 requires multispectral imaging by the camera module — the invention specifies a line-scan camera, which is a different image-capture modality than multispectral imaging, and multispectral capability is not described in the invention
- Claim 1 requires an early warning module and remote interactive control panel module with a defective-product-area fill threshold (exceeding two-thirds) triggering personnel notification for false-detection judgment — the invention's confidence-threshold grading and MES integration serve a different function and do not include this two-thirds-fill personnel-alert workflow
- Claim 1 requires a remote interactive control panel as the main user interface displaying system state and receiving operation instructions — this is not described in the invention, which instead integrates with an MES database

Note: This patent's core claimed system is built around illumination sensing and dynamic illumination adjustment paired with multispectral imaging, which are central, required elements (claim 1) not present in the invention description. The defect-recognition (CNN-based, claim 5/6) and automatic-rejection (claim 1) elements show potential overlap with the invention's CNN semantic segmentation and pneumatic reject mechanism, but since claim 1 is a system claim requiring ALL listed modules together (environment sensing, dynamic illuminator, multispectral camera, recognition, auto-reject, remote panel, early warning), the invention as described appears to lack several required elements (illumination sensing/adjustment, multispectral imaging, remote interactive panel, early-warning two-thirds threshold logic). Relevance is assessed as medium due to shared defect-detection and rejection concepts, but the illumination-management and MES-integration differences are significant framing distinctions. This is an informational screening note only, not a legal or infringement opinion. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement claiming CNN semantic segmentation overlaps with claim 5/6's CNN option overstates similarity: claim 5/6 recites CNN as a generic deep learning algorithm for defect recognition, with no mention of pixel-level semantic segmentation; the note should flag this as a difference in specificity rather than a clean overlap, though it is a reasonable inference and not fabricated.
- The distinguishing point about the automatic rejecting module is followed by an overlap statement acknowledging pneumatic could be an equivalent — this is internally consistent, but the distinguishing analysis overall relies partly on absence of features from the invention rather than solely on claim scope, which is appropriately framed as 'invention lacks features required by claim' (correct direction) rather than 'claim lacks invention's feature' (wrong direction) — this is correctly reasoned in most points, but the note's overall framing correctly treats claim 1's required elements (illumination sensing, multispectral imaging, remote panel, early warning) as things the invention lacks, which is the correct FTO direction (invention avoids infringing because it lacks required claim elements). No wrong-direction reasoning found.
- The statement that claim 1 broadly reciting 'rejecting' 'encompasses pneumatic implementations as a likely equivalent' is a speculative legal conclusion not directly stated in the claim text, though it is a reasonable interpretive inference rather than a fabrication.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.1: System architecture comprising sensing, control,	—	NO COUNTERP	The invention units describe five functional capabilities

illumination adjustment, imaging, recognition, rejection, remote interaction, and early warning modules		**ART**	(F1-F5) but do not specify a system architecture including an environment sensing module, dynamic adjustment illuminator, remote interactive control panel module, or early warning module as separate structural components; these organizational/hardware elements appear absent from the invention description.
1.2: Real-time ambient illumination sensing and feedback to a control unit	—	**NO COUNTERP ART**	None of F1-F5 involve sensing or feeding back ambient illumination intensity; the invention's acquisition unit (F1) concerns line-scan image capture of moving objects, not environmental light sensing.
1.3: Central control unit performing inter-device communication management and threshold-based comparison of illumination intensity	—	**NO COUNTERP ART**	The invention's F3 involves threshold-based comparison but applied to defect confidence scores, not illumination intensity; no invention unit addresses centralized device communication management or illumination threshold comparison.
1.4: Automated dynamic adjustment of illumination based on a comparison result	—	**NO COUNTERP ART**	No invention unit (F1-F5) includes any illumination adjustment mechanism; F1 addresses image acquisition only, with no lighting control functionality described.
1.5: Multispectral real-time image acquisition of products on a production line	F1	**PARTIAL**	F1 requires continuous line-scan based image acquisition of moving objects at an inspection point on a production line; the claim requires multispectral imaging (multiple spectral bands) which is a different and more specific imaging modality than line-scan acquisition, and F1 does not require multispectral capability while the claim

			does not require line-scan/continuous capture, making these adjacent but distinct implementations of real-time production-line image acquisition.
1.6: Real-time image analysis and processing to recognize surface defects on products	F2	**CORRESPONDS**	The claim's broad recitation of 'recognizing defects on the surface of the product' via analysis of image data is a genus that covers F2's specific pixel-level deep learning semantic segmentation approach to surface defect detection and localization.
1.7: Automated removal of defective products from the production line to a designated area	F4	**CORRESPONDS**	The claim's generic 'automatic rejecting module' functionality, physically removing defective products from the line, is a genus covering F4's specific implementation using pneumatic actuation triggered by confirmed defect detection.
1.8: Personnel notification for manual verification of rejected products to assess false detections	—	**NO COUNTERPART**	No invention unit involves notifying personnel for manual false-detection review; F3 addresses automated confidence-threshold filtering to reduce false positives internally, not human notification/verification, and F5 concerns MES data integration rather than personnel alerts.
1.9: User interface for displaying system state/feedback and sending operational commands to the control system	—	**NO COUNTERPART**	F5 requires automated data integration with a factory MES database, which is distinct from a local/remote graphical user interface for operator display and command input; no invention unit describes a user-facing interactive control panel.

All-elements note: Of the nine decomposed elements of claim 1, two elements (1.6 image-based defect recognition, and 1.7 automatic rejection of defective products) appear to find a corresponding counterpart in the invention's standardized units (F2 and F4, respectively, as genus-species relationships), and one element (1.5 multispectral imaging) appears to partially correspond to F1. However, several claim *elements appear to lack any counterpart in the invention units as described: the environment sensing module (1.2), the illumination threshold comparison function of the system control module (1.3), the dynamic adjustment illuminator (1.4), the early warning/false-detection review module (1.8), and the remote interactive control panel module (1.9), as well as the overall specific multi-module architecture (1.1). The invention's F3 (confidence-based filtering) and F5 (MES integration) do not appear referenced or required by claim 1 at all.*

Equivalents caution: For element 1.5 (multispectral camera module vs. F1 line-scan acquisition), the difference between multispectral imaging and line-scan continuous capture concerns the imaging modality and acquisition technique, which may or may not be viewed as an insubstantial difference depending on whether multispectral capability is considered functionally interchangeable with line-scan continuous acquisition in a given implementation; this is flagged as a potential equivalents consideration requiring further factual analysis.

3.24 CN119600032B — A method and system for industrial product quality inspection based on machine vision

Assignee: Shenzhen Bangqi Technology Intelligent Development Co ltd · Published: 2025-07-15 · Status: Active · exp. 2045-02-12 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's image acquisition module (industrial camera capturing images of components in real time) is broader than but encompasses the invention's line-scan camera continuous image acquisition on a production line
- Claim 1/5's defect detection module using a deep learning model algorithm to identify potential defects (including scratches) is broader than but could read on the invention's CNN-based pixel-level semantic segmentation defect detection, subject to equivalents analysis given the claim's specific Q/P_defect/C formula-based approach differs from segmentation
- Claim 1/6's quality evaluation module comparing a quality evaluation index Q against preset thresholds M and N/A to determine qualification grade is broader than but potentially overlaps with the invention's confidence-threshold grading of detected defects, though the claimed metric is a composite formula-based index rather than a raw detection confidence score
- Claim 1/7's control feedback module removing unqualified components from the production line is broader than but could encompass the invention's automated pneumatic reject actuator, though the claim does not specify a pneumatic mechanism
- Claim 7's production parameter adjustment unit interfacing with a production management system to form closed-loop feedback is broader than but potentially overlaps with the invention's MES data integration, though the claim's disclosed feedback is directed at adjusting production parameters (welding temperature, pressure, light source) rather than merely writing inspection results to an MES database

Appears to differ (AI reasoning):

- Claim 1 requires calculation of a specific image sharpness coefficient C via a defined pixel-gray-value formula, which the invention's description does not mention
- Claim 1 requires a defect probability coefficient P_defect computed from weighted defect-type frequencies (w_j, F_j), a specific quantitative formula not described in the invention
- Claim 1 requires computation of a composite quality evaluation index Q combining C, P_defect, and weighted feature-parameter quality values T_k, which is a specific multi-factor formula-based approach not present in the invention's confidence-threshold-based grading
- Claim 1 requires feature extraction of shape, texture, and color characteristics (welding point shape, pin arrangement, element position) as a discrete module preceding defect detection, which the invention's semantic segmentation-based pipeline does not appear to separately implement

- Claim 1 requires multi-angle image acquisition with optimized light source layout specifically for small, high-precision electronic components, whereas the invention uses a single line-scan camera on a moving production line without a described multi-angle/light-source-optimization step
- Claim 6 requires a three-tier grading system (qualified/warning/serious-defect) tied to specific threshold comparisons (Q vs M and A) with distinct downstream actions for each tier, which is more granular than the invention's single confidence-threshold pass/fail confirmation

Note: The patent claims are directed to an electronic-component inspection system centered on a specific mathematical framework (image sharpness coefficient C, defect probability coefficient P_defect, and composite quality index Q) combined with multi-angle/multi-light-source image acquisition and multi-tier threshold grading. The invention's line-scan, CNN-semantic-segmentation, confidence-threshold, pneumatic-reject, and MES-integration pipeline shares high-level functional similarities (image acquisition -> defect detection -> threshold-based grading -> reject/feedback -> production system integration) that create potential overlap at the broad functional-module level of claim 1, but the claims impose specific quantitative formula requirements and multi-angle acquisition/multi-tier grading limitations that the invention as described does not evidently include. This is an informational screening note only, not a legal or infringement conclusion; verbatim claim formulas were partially illegible in the provided text and should be reviewed against the original patent figures for precision.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing points repeatedly reason that because the invention lacks certain claim elements (e.g., C formula, P_defect formula, Q composite index, multi-angle/light-source acquisition, feature extraction module, multi-tier grading), this distinguishes the invention from the claims — but since claim 1 is a single independent claim requiring ALL these elements together, correctly noting the invention lacks them is actually valid non-infringement reasoning (claim 1 requires all elements, so missing any one avoids infringement of that claim). This part is logically sound, not wrong-direction, so not an issue.
- However, the distinguishing point regarding claim 6 (three-tier grading) is not wrong-direction since claim 6 is dependent and narrower, so noting the invention's simpler single-threshold grading as distinguishing from claim 6 specifically is fine, but the note conflates this with distinguishing from claim 1 which only requires two thresholds M and N/A generally — this is minor imprecision.
- The overlap statement on claim 7's production parameter adjustment interfacing with a 'production management system' being compared to MES integration is a reasonable inference but slightly stretches the term 'production management system' (claim text) to equate with 'MES' (invention), which is not explicitly stated as MES in the patent text — minor overstatement.
- The note's framing that claim 1 is 'broader than but encompasses' the invention's line-scan continuous acquisition is imprecise: claim 1 explicitly requires multi-angle shooting and optimized light source layout, which is a specific limitation, not merely a broader genus; describing it as 'broader than but encompasses' understates that this is a distinct limitation the invention doesn't clearly meet, slightly overstating overlap at the claim 1 level before the distinguishing section corrects this — minor internal inconsistency but ultimately resolved by the distinguishing points.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.1: Real-time image acquisition of products using multi-angle camera-based imaging with optimized lighting at an inspection point	F1	**PARTIAL**	Claim recites multi-angle, high-resolution frame-based image capture via industrial camera and light source layout, whereas F1 requires line-scan (row-by-row) continuous acquisition of moving objects; both occur at an inspection point in real time, but the underlying

			acquisition modality (multi-angle framed imaging vs. continuous line-scan) differs rather than the claim being a broader genus of F1.
1.2: Image preprocessing (noise reduction, edge enhancement, graying, contrast improvement) prior to feature extraction	—	**NO COUNTERPART**	None of the invention's standardized units (F1-F5) describe an explicit preprocessing stage of filtering/graying/contrast enhancement; F2 begins at the level of semantic segmentation, so this claim element appears to lack a corresponding invention unit.
1.3: Extraction of geometric, texture and color feature parameters used as inputs for defect judgment	—	**NO COUNTERPART**	The invention's F2 unit performs pixel-level deep-learning semantic segmentation directly for defect detection/localization without a described discrete handcrafted feature-extraction stage (shape/texture/color parameters); this explicit feature-extraction module appears to lack a counterpart in the standardized invention units.
1.4: Deep-learning-based identification of surface/component defects, producing a computed quality evaluation index	F2	**PARTIAL**	Both use deep learning to identify defects, but F2 requires pixel-level semantic segmentation achieving simultaneous detection and spatial localization via a convolutional network, whereas the claim's defect detection module is described as classifying defect types and computing a composite quality index Q, without reciting pixel-level segmentation or explicit spatial localization; the mechanisms are adjacent but not shown to be the same granularity of detection.
1.5: Threshold-based comparison of a computed quality/confidence metric to classify detections as	F3	**CORRESPONDS**	The claim's comparison of index Q against preset thresholds M and N to grade quality functions as a

valid/qualified or not			threshold-based validation of detection results, which is a broader genus of implementation covering F3's confidence-threshold filtering of individual defect detections; F3's single confidence-per-defect comparison is a species of this multi-threshold quality-grading genus.
1.6: Automated feedback of inspection results to the production line, including removal of unqualified components and integration with a production management system	F4	**PARTIAL**	The claim broadly recites 'removing unqualified components' without specifying an actuation mechanism, whereas F4 specifically requires pneumatic actuation for physical removal; because the claim is silent on removal mechanism (not merely broader wording encompassing pneumatic means, but an unspecified means overall), this is treated as a partial correspondence rather than a genus fully covering the pneumatic species, since removal method is unaddressed and could be non-pneumatic (e.g., manual sorting, robotic arm, diverter), creating residual uncertainty about equivalence.
1.7: Data feedback/integration of inspection outcomes with a production management system	F5	**PARTIAL**	The claim references interfacing with a 'production management system' for closed-loop feedback, which is conceptually adjacent to F5's requirement of writing/storing results into a factory-level MES database, but the claim does not specify that the management system is a factory-level MES or that data is stored in an associated database rather than merely used for parameter adjustment, so correspondence is partial rather than a clear genus-

			species relationship.
1.8: Mathematical computation of sharpness, defect-probability, and composite quality index metrics from pixel/feature data	—	**NO COUNTERPART**	None of the standardized invention units describe computing an image sharpness coefficient or a weighted defect-probability/quality-index formula; this quantitative formulaic scheme appears to lack a counterpart among F1-F5.

All-elements note: Not every claim element found a clear, unambiguous counterpart among the invention's standardized units. Elements 1.2 (image preprocessing), 1.3 (discrete feature extraction module), and 1.8 (specific sharpness/defect-probability/quality-index formulas) appear to lack a counterpart in the invention's standardized units (F1-F5), which describe line-scan acquisition, pixel-level segmentation, confidence thresholding, pneumatic removal, and MES integration without a described preprocessing stage, discrete handcrafted feature extraction, or the specific mathematical formulas recited. Elements 1.1, 1.4, 1.6, and 1.7 show partial correspondence due to differing acquisition modality, detection granularity, unspecified removal mechanism, and unspecified feedback-system level, respectively. Element 1.5 (threshold-based quality grading) corresponds as a broader genus encompassing the invention's confidence-threshold filtering.

Equivalents caution: For element 1.1, the difference between multi-angle framed image acquisition and continuous line-scan acquisition concerns the fundamental image-capture modality and may not be viewed as an insubstantial difference given F1's specific line-scan limitation. For element 1.4, the difference between classification/quality-index computation and pixel-level semantic segmentation with simultaneous localization concerns detection granularity and could be viewed as substantial if localization precision is material to the invention. For element 1.6, the absence of a specified pneumatic actuation mechanism in the claim versus F4's specific requirement could plausibly be viewed as an insubstantial difference if any conventional automated removal means is considered interchangeable, though this remains uncertain without further specification. For element 1.7, the difference between a generic 'production management system' and a factory-level MES with database storage is likely insubstantial in a broad sense but could be material if the claimed system does not persist data to a queryable database.

3.25 CN113177924A — Industrial production line product flaw detection method

Assignee: Nantong University · Published: 2021-07-27 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Both use a CNN-based model (patent's trained VGG16 backbone within an SSD detector; invention's semantic segmentation CNN) to analyze captured product images for surface flaws on an industrial production line, which is a broad point of overlap in the general approach of CNN-driven optical defect detection.
- Both employ a threshold-based decision step to confirm whether a detected feature constitutes a genuine flaw before further action (patent's connected-region area threshold vs. invention's confidence threshold), which may be viewed as overlapping thresholding concepts subject to equivalents analysis.
- Both involve continuous acquisition of product images at an inspection point on a moving production line for flaw detection purposes.

Appears to differ (AI reasoning):

- Claim 1 requires a specific multi-step pipeline (image preprocessing with histogram equalization/smoothing, threshold segmentation to a binary image, eight-neighborhood connected-region area analysis against a set threshold T, then SSD-based classification using the trained

VGG16 model) — the invention's pixel-level semantic segmentation approach does not appear to include these specific mandated steps (binary thresholding, connected-region area marking, SSD detection), so the invention appears to lack elements the claim requires.
- Claim 1's defect determination relies on connected-region area exceeding a threshold T, a geometric/area-based criterion, whereas the invention grades detections by a confidence score from the segmentation network; this is a different threshold mechanism than the one explicitly recited, not merely an implementation detail of the same claimed step.
- Claim 1 requires classification of defects via an SSD (Single Shot Detector) object-detection algorithm operating on a VGG16 feature extractor, which is a specific classification architecture distinct from the invention's pixel-level semantic segmentation network architecture.

Note: This is an informational screening note, not a legal or infringement opinion. The patent claims recite a fairly specific, multi-step image-processing pipeline (preprocessing, binary threshold segmentation, connected-region area thresholding, then SSD/VGG16 classification) that differs in method from the invention's end-to-end semantic segmentation network. Overlap exists at the general level of 'CNN-based visual defect detection on a production line with a threshold-based confirmation step,' which warrants further comparison of the underlying algorithmic details, but several specific claim steps (binary thresholding, connected-region area analysis, SSD classification) do not appear to be present in the invention as described. The invention's reject actuator and MES integration are additional features not required by the claims and do not affect this assessment. Full claim charting against the complete patent family and any prosecution history would be needed for a definitive assessment. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement 'Both involve continuous acquisition of product images at an inspection point on a moving production line' overstates the patent evidence; neither the abstract nor claims specify continuous line-scan acquisition or a moving production line inspection station — only that images are 'collected' for the dataset and for the product to be detected, so this is an overstated/fabricated equivalence not clearly supported by the provided claim text.
- The distinguishing point that 'the invention appears to lack elements the claim requires' (binary thresholding, connected-region area marking, SSD detection) is used correctly to argue non-infringement of this specific claim, which is appropriate reasoning direction here since claim 1 is a narrow multi-step method — however the note should more clearly flag that this narrowness makes the claim easier to avoid but does not itself reduce FTO risk broadly, and the note's overlap section already broadly analogizes CNN-based detection which slightly cuts against the distinguishing emphasis; this is a minor internal tension rather than fabrication.
- The statement that the invention's reject actuator and MES integration 'are additional features not required by the claims and do not affect this assessment' is a reasonable observation but could be misread as a distinguishing argument; since claim breadth (not reciting these features) makes the claim easier to satisfy by the invention, not harder, this framing borders on wrong-direction reasoning even though the note frames it neutrally as 'additional features' rather than as a non-infringement argument.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
C1: Acquisition of product defect images to build a dataset	F1	**PARTIAL**	The claim recites image collection to build a dataset but does not specify line-scan (row-by-row) acquisition of moving objects at an inspection point on a production line; F1 requires continuous line-scan capture of moving products, which is

			a more specific acquisition modality than the claim's generic 'collecting a product defect image'.
C2: Training/validating/testing a CNN classification model (VGG16) using labeled image datasets	—	**NO COUNTERPART**	This element describes dataset labeling and training of a VGG16 classification network; it is a training methodology step without a corresponding invention unit describing model training procedures, and does not itself perform pixel-level segmentation as required by F2.
C3: Acquisition and preprocessing (enhancement, equalization, smoothing) of a defect image of the product under inspection	F1	**PARTIAL**	The claim's image collection step for the product to be detected relates to F1's acquisition function, but does not specify line-scan capture of moving objects at an inspection point; the preprocessing sub-steps (histogram equalization, smoothing filtering) are additional operations not addressed by F1's standardized essence.
C4: Threshold-based binary image segmentation to isolate candidate defect regions	F2	**PARTIAL**	Both involve segmentation for defect localization, but the claim's threshold segmentation produces a binary image via classical thresholding rather than pixel-level semantic segmentation via a convolutional deep learning network as required by F2; the underlying technique differs (rule-based thresholding vs. CNN-based semantic segmentation).
C5: Area-based thresholding of connected regions to determine presence/absence of a defect	F3	**PARTIAL**	Both use a quantitative threshold-based validation criterion to confirm defect presence, but the claim's measure is a geometric connected-region area rather than a confidence score derived from a deep learning detection model as contemplated by F3, so the

			nature of the quantitative measure differs.
C6: CNN-based (SSD/VGG16) feature extraction and classification of defect type on images already flagged as defective	F2	**PARTIAL**	Both employ a convolutional neural network for defect analysis, but the claim's SSD algorithm performs object-detection-style classification (bounding-box/class label) of already-identified defective images rather than pixel-level semantic segmentation providing simultaneous detection and spatial localization as required by F2.
C7: Automated pneumatic removal of confirmed defective parts from the line	F4	**NO COUNTERPART**	The claim describes only defect detection and classification steps; no physical removal or pneumatic actuation mechanism triggered by inspection results is recited.
C8: Automated feedback/integration of inspection outcomes into a factory-level MES database	F5	**NO COUNTERPART**	The claim ends at defect classification (step 6) and does not recite any transfer or storage of inspection results into a manufacturing execution system or associated database.

All-elements note: Not every claim element found a clear counterpart in the invention's standardized units. Elements C1 and C3 (image collection/preprocessing) and C4-C6 (threshold segmentation, connected-region area analysis, SSD/VGG16 classification) appear to relate to F1, F2, and F3 respectively but with differing technical implementations (partially corresponding), while C2 (VGG16 training methodology) appears to lack a distinct invention counterpart. Notably, the claim appears to lack any counterpart to F4 (automated pneumatic removal) and F5 (MES data integration/feedback), which are absent from the claim's recited steps.

Equivalents caution: For C1/C3 (image acquisition/preprocessing vs. F1's line-scan continuous acquisition of moving objects), the difference in acquisition modality (static/generic image collection vs. line-scan of moving products) could be viewed as a non-insubstantial difference given F1's explicit limits on continuity and motion. For C4 (threshold-based binary segmentation vs. F2's pixel-level deep-learning semantic segmentation), the difference between classical image processing and CNN-based semantic segmentation is likely substantial given F2's explicit requirement of convolutional neural network involvement. For C5 (connected-region area threshold vs. F3's confidence-score threshold), both use threshold-based validation logic, so the difference in the underlying quantitative measure (geometric area vs. model confidence) could arguably be viewed as an insubstantial variation performing the same false-positive-reduction function, though this remains uncertain. For C6 (SSD/VGG16 classification vs. F2's pixel-level segmentation), the difference between detection/classification and full pixel-level segmentation with simultaneous localization is likely substantial, as bounding-box-style detection does not provide the same spatial granularity as semantic segmentation.

3.26 CN121649140A — Machine vision-based porcelain plate surface defect online detection and sorting system

Assignee: Superga Guangdong Construction System Technology Co ltd · Published: 2026-03-13 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 requires high-speed linear-array (line-scan) cameras for image acquisition of parts moving on a production line, which corresponds generically to the invention's line-scan camera acquisition step, though the claim mandates two such linear cameras plus a 3D profiler rather than a single line-scan camera.
- Claim 3 recites a defect decoder with a prediction head performing 'pixel-level defect semantic segmentation, generating a defect accurate mask,' which broadly overlaps with the invention's CNN-based semantic segmentation for defect detection/localization.
- Claim 4 recites a confidence evaluation module that calculates a confidence score for each defect identification result and compares it to a preset threshold; this is conceptually similar to the invention's confidence-threshold grading step, though in the patent the threshold gates flagging of low-confidence cases for human review/active learning rather than confirming a defect as valid for rejection — a functional difference that nonetheless falls under an equivalents-type overlap given the shared 'confidence vs. threshold' mechanism.
- Claim 1 (and claim 8) describe an intelligent execution sorting module that acts on confirmed defect information to physically remove/sort defective plates from the line, which broadly parallels the invention's automated reject mechanism, notwithstanding the different actuator technology (vacuum chuck robot vs. pneumatic ejector) — treated as overlap with an equivalents caution rather than a clean difference.

Appears to differ (AI reasoning):

- Claim 1 requires a multi-modal image acquisition module comprising three specific imaging units (bright-field 2D camera, dark-field 2D camera, and a line-laser 3D profiler) operating in combination; the invention as described uses only a single line-scan camera without a second imaging modality or 3D profilometry, so this claim limitation does not appear to be met.
- Claim 1 and claim 3 require a multi-modal feature fusion architecture (2D branch + 3D branch, cross-attention fusion of image and point-cloud features) as the basis for the classification/segmentation model; the invention's CNN performs segmentation on single-modality line-scan images with no described point-cloud fusion, so this fusion limitation appears absent.
- Claim 8's specific end effector — an adaptive vacuum chuck array with independently controlled units and dynamic adsorption strategy avoiding chuck placement near the defect — is a narrower requirement than the invention's pneumatic reject actuator, which physically ejects the part rather than selectively grasping it away from the defect zone; this specific limitation does not appear to be satisfied by the invention.
- Claim 4/5 require an incremental/online learning unit using elastic weight consolidation with Fisher-information-based regularization for continual model updating; no such online learning or catastrophic-forgetting mitigation mechanism is described in the invention.
- Claim 7 requires a high-precision synchronous triggering unit using a rotary encoder and FPGA-calculated trigger delay to synchronize multiple imaging units on the same physical area; the invention's single line-scan camera acquisition does not require or describe this multi-camera synchronization limitation.
- Claim 9 requires a distributed optical calibration module (2D calibration plate, 3D stepped calibration block, hand-eye calibration) for initial and periodic self-calibration; no corresponding calibration subsystem is described in the invention.
- No claim recites integration of inspection results with a factory Manufacturing Execution System (MES) database; this invention feature has no counterpart requirement in the claims and is therefore not addressed by the patent (neither overlapping nor distinguishing, simply unclaimed).

Note: This is an informational screening note, not a legal or infringement opinion. The patent's independent claim 1 is architecturally broader in some respects (generic line-scan cameras, generic end effector, semantic-segmentation-based deep learning model, confidence scoring) which could read broadly enough to raise overlap concerns with the invention's core software/detection concepts. However, claim 1 also imposes specific structural requirements (three-modality acquisition with 2D+2D+3D imaging units, cross-attention multi-modal fusion) that the described invention, based on a single line-scan camera, does not appear to include, which is a significant potential point of difference. Dependent claims add further specific limitations (vacuum-chuck end effector, EWC-based online learning, encoder/FPGA synchronization, multi-part calibration module) not evidently present in the invention. Given the mixed picture — some broad, potentially overlapping language in claim 1/3/4 alongside substantial claimed structure the invention appears to lack — relevance is assessed as medium. A full comparison would benefit from more detailed technical specification of the invention's CNN model architecture and reject-mechanism logic control flow, and legal counsel review of claim scope and equivalents doctrine. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing points repeatedly frame the invention's lack of features (second imaging modality, 3D profiler, cross-attention fusion, vacuum chuck specifics, EWC online learning, encoder/FPGA sync, calibration module) as reasons the invention does not infringe claim 1, but claim 1 is a single independent claim requiring ALL its elements (including the three-imaging-unit module and multi-modal fusion) to be met for infringement — so noting the invention lacks these elements is actually the correct direction for claim 1 specifically (narrower claim, harder to infringe), which is properly analyzed; however the note's own framing that 'claim 1 is architecturally broader in some respects (generic line-scan cameras...)' is misleading since claim 1 is a single claim that must be read as a whole with all its specific limitations, not as separately broad and narrow parts — this creates some ambiguity/overstatement about claim 1's breadth.
- The claim 4 confidence threshold comparison is somewhat overstated as 'overlap' given the note itself acknowledges a real functional difference (gating human review vs. confirming rejection); labeling this 'equivalents-type overlap' is a speculative legal characterization not clearly supported by the bare claim text.
- The claim 1/8 reject-mechanism overlap statement calls the difference between vacuum chuck robotic sorting and pneumatic ejection 'equivalents caution rather than a clean difference' — this is an unsupported legal doctrine characterization not grounded in the provided claim text, which describes a materially different mechanism (grasping/robotic placement vs pneumatic ejection).

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis
1.1: a feeding/conveying mechanism that moves products along a production line	—	**NO COUNTERPART**	The invention units (F1-F5) describe image acquisition, detection, filtering, removal and MES feedback, but do not include any element for automated feeding/conveying of products onto the line; F1 presumes products already in motion but does not itself specify a feeding module.
1.2: line-scan based optical (and 3D laser) image acquisition of moving products	F1	**CORRESPONDS**	The claim recites high-speed linear array (line-scan) cameras and a line-scan 3D

at an inspection point, using multiple imaging modalities			profiler capturing images of porcelain plates as they move through a detection box on the production line, matching F1's requirement of continuous line-based optical acquisition of moving objects at an inspection point; the claim's multi-modal (bright field, dark field, 3D) capture is a specific species falling within F1's broader line-scan acquisition genus.
1.3: deep learning based defect detection and localization from acquired sensor data	F2	**CORRESPONDS**	The claim's deep-learning based classification model that processes multi-modal data and outputs defect identification results with location information corresponds to F2's pixel-level deep learning based semantic segmentation for defect detection and localization; claim 1 itself does not explicitly recite pixel-level segmentation, but the broader recitation of a deep-learning model producing defect identification and fitting defect information covers F2's specific pixel-level implementation as a genus over species, and dependent claim 2 confirms pixel-level output is part of the same model.
1.4: transfer of detected defect information to a downstream module	—	**NO COUNTERPART**	Claim 1 recites transmission of defect information only to the intelligent execution sorting module (robot); no counterpart is found for F5's automated integration/writing of inspection outcomes into a factory-level MES database, as claim 1 lacks any recitation of an MES or database write-back.
1.5: automated physical removal/sorting of confirmed defective parts, triggered by	F4	**PARTIAL**	Both the claim and F4 require automated, inspection-result-triggered

inspection results			physical removal of defective parts from the line; however F4 specifically requires pneumatic actuation, whereas the claim recites a multi-axis robot with an end effector (grab/sort), which is a mechanically distinct actuation technology not limited to pneumatic means, so the correspondence is only partial.

All-elements note: Of the five elements identified in independent claim 1, two (multi-mode line-scan image acquisition and deep-learning based defect detection/identification) appear to find a corresponding counterpart in the invention's units F1 and F2 respectively, and one (robotic sorting/removal) partially corresponds to F4. Two elements — the automatic feeding module (F0, no corresponding invention unit) and confidence-based threshold filtering prior to removal (F3), as well as automated MES-level data feedback/integration (F5) — appear to lack a clear counterpart in claim 1 as written; claim 1 does not recite a confidence threshold validation step or an MES integration step, and the invention's units do not include an automated feeding module, though claim 1's dependent claims (2 and 4) do introduce confidence scoring elsewhere.

Equivalents caution: For the partially-corresponding sorting/removal element, the difference between pneumatic actuation (F4) and multi-axis robotic gripping/vacuum end-effector actuation (claim 1) is a difference in actuation technology (pneumatic cylinder vs. robotic arm/vacuum) that could plausibly be viewed as either an insubstantial variation performing the same function of physically removing defective parts, or as a substantively different mechanical implementation, depending on how the removal mechanism is claimed; this distinction may warrant further equivalents analysis.

3.27 CN114252452B — Device and method for online detection of appearance defects and outline dimensions of small-sized revolving body

Assignee: Xian Jiaotong University · Published: 2024-07-26 · Status: Active · exp. 2041-12-22 · Relevance: MEDIUM · [verify on Google Patents ↗]

Potential overlap (AI reasoning):

- Claim 1 recites a line-array camera (线阵相机) used at station B to capture side-surface images while the part is rotated on a turntable — this generically overlaps with the invention's line-scan image acquisition concept, though the patent's line-array camera is used on a stationary rotating part rather than continuously on a moving production line.
- Claim 1/2 describe an automated pipeline where captured images are fed into pre-trained deep-learning defect detection models that output defect presence/type and location, which broadly overlaps with the invention's CNN-based defect detection and localization step, though the patent's networks are described as classification networks operating on image patches rather than full pixel-level semantic segmentation.
- Claim 1 (step S6) requires a robotic mechanism (four-axis manipulator) that collects defect judgment results from all stations and physically sorts/removes parts into qualified, unqualified, and pending trays — this is a broader 'automated defect-triggered removal/sorting actuator' concept that could be read to encompass the invention's pneumatic reject actuator as a species of automated removal mechanism (equivalents caution: different actuator type — robotic gripper vs. pneumatic ejector).

Appears to differ (AI reasoning):

- Claim 2 specifically requires training and using deep classification networks (深度分类网络) operating on ROI-sized image blocks with results merged afterward — this is a patch-based classification approach, not the pixel-level semantic segmentation architecture the invention uses; to the extent the claim is limited to classification (not segmentation), the invention's segmentation-based localization may fall outside this specific claimed technique.

- Claim 1 requires a specific multi-station mechanical architecture (indexing plate, two-axis gripper, four first–fourth image acquisition units at fixed stations, servo-driven rotation between stations) for inspecting small revolution-body parts at discrete stations — the invention's single line-scan camera continuously imaging products moving through one inspection station on a production line does not appear to include this multi-station indexing/rotation architecture, which the claim requires as part of its method.
- Claim 1 requires a separate outline-dimension measurement sub-system (telecentric camera, dark-field/backlight imaging, template matching in step S5/claim 3) as part of the claimed method — the invention as described has no dimensional/contour measurement functionality, which the claim mandates as an integrated part of the detection method.

Note: This patent (CN114252452B) targets appearance-defect AND dimensional inspection of small revolution-body (rotating) parts using a multi-station indexing-plate architecture with several distinct camera types (area-array, line-array, telecentric) and per-surface classification networks, plus a robotic sorting arm — a substantially different mechanical/vision architecture than the invention's single continuous line-scan camera + semantic segmentation + pneumatic reject + MES pipeline for a moving production line. There is conceptual overlap around (a) use of a line-array camera for image capture, (b) deep-learning-based defect detection and classification feeding a downstream decision, and (c) an automated end-effector that removes/sorts defective parts based on detection results — these broader concepts as claimed could potentially read on analogous elements of the invention despite implementation differences, so equivalents-style scrutiny is warranted. The invention's confidence-threshold grading and MES database write-back have no counterpart recited in these claims (claims only reference a display screen for results), so no overlap can be identified there, but this absence in the claim does not distinguish the invention under the missing-element rule (it is merely an unclaimed area). Overall relevance is medium given differing station-based mechanical architecture and classification-vs-segmentation technique, combined with plausible overlap on the automated detect-and-remove concept.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The claim 1/step S6 sorting via four-axis manipulator into qualified/unqualified/pending trays is characterized as potentially reading on the invention's pneumatic reject actuator; this is a stretch since claim 1 explicitly recites a robotic gripper-based sorting mechanism, not a pneumatic ejector — the note appropriately flags this as an equivalents concern, but the characterization as 'broader automated defect-triggered removal/sorting actuator concept' somewhat overstates how directly this maps onto the invention's specific pneumatic mechanism.
- The distinguishing point about claim 1 requiring a multi-station indexing/rotation architecture that the invention lacks is reasoning in the correct direction (claim requires more than invention has, so it's a valid distinguishing feature, not wrong-direction), but the note should be checked for consistency: it correctly notes this makes the claim narrower/more specific than invention's architecture, which is proper distinguishing logic, not wrong-direction reasoning.
- The note's meta-commentary correctly identifies that the invention's confidence-threshold grading and MES write-back not being recited in the claims does NOT distinguish the invention (correctly applying the missing-element/broader-claim caution), which is good practice, but this same rigor is inconsistently applied elsewhere: the distinguishing points list claim requirements (multi-station architecture, dimension measurement, patch classification) that the invention lacks, which is legitimate distinguishing logic since it points to elements the claim requires that the invention does not have (correct direction), so no fabrication here, but the note's own internal reasoning about direction logic is not fully or consistently articulated, creating minor risk of confusion about which direction is being applied where.

Standardized all-elements chart — claim 1 (one-ruler semantic standardization; informational, not a legal conclusion):

Claim element (standardized)	Invention counterpart	Mapping	Basis

1.1: A multi-station rotary-indexing inspection apparatus with area-array cameras at stations A, C, D and a line-scan camera at station B, plus robotic handling and sorting bins	F1	**PARTIAL**	F1 requires continuous line-scan image acquisition of moving objects at an inspection point; the claim discloses a multi-station indexing system where only station B uses a line-array (line-scan) camera and the part is rotated in place (not continuously translating past the sensor) while three other stations use area-array (面阵) cameras on a stepwise indexed part, which is an adjacent but distinct acquisition architecture from continuous line-scan capture of objects in motion along a line.
1.2: Line-scan side-surface image acquisition while rotating the part 360°	F1	**PARTIAL**	This sub-feature does involve a line-array camera, satisfying the line-scan limit of F1, but the relative motion is rotational scanning of a stationary-station part rather than continuous conveyance of moving objects past an inspection point, so it only partially aligns with F1's motion/continuity limits.
1.3: Pre-trained deep learning models classify captured surface images for presence and type of defect	F2	**PARTIAL**	F2 requires pixel-level semantic segmentation achieving simultaneous detection and spatial localization via a convolutional network; the claim's base method only recites defect presence/type judgment via 'trained models' without specifying pixel-level segmentation or explicit spatial localization output, indicating an adjacent but not clearly matching granularity of defect detection in claim 1 alone (dependent claim 2 clarifies classification networks with block-wise ROI, which further diverges from segmentation).
1.4: Display of detection result on a screen	—	**NO COUNTERP**	The claim recites displaying results on a screen as the

		ART	disposition of detection output, which has no counterpart among the invention units; none of F1–F5 addresses a local display step, and this appears absent from the invention's described feedback path (which targets MES integration rather than local display).
1.5: Dimensional/contour measurement and pass/fail determination based on size tolerance	—	**NO COUNTERPART**	This claim element concerns geometric/dimensional inspection and conformity judgment, which is a distinct inspection modality not addressed by any of the invention's standardized units (F1–F5 relate to surface-defect image acquisition, segmentation, confidence filtering, pneumatic removal, and MES feedback, not dimensional/contour measurement).
1.6: Robotic arm sorts parts into good/defective/undetermined categories and places them into corresponding bins/conveyor based on aggregated station judgments	F4	**PARTIAL**	F4 requires automated physical removal of confirmed defective parts specifically via pneumatic actuation; the claim discloses physical separation/sorting of parts using a four-axis robotic manipulator (not pneumatic actuation) and additionally introduces a third 'undetermined' category not present in F4's binary confirmed/not-confirmed removal logic, representing an adjacent but different actuation mechanism and sorting logic.
1.7: Binary/categorical defect presence and type determination per surface without an explicit quantitative confidence threshold	F3	**NO COUNTERPART**	F3 requires a quantitative confidence measure per detection compared against a threshold to confirm validity; claim 1 as written only recites a presence/type judgment without reciting any confidence score or threshold-based validation

			step, so this quantitative confidence-filtering limitation of F3 appears to lack an explicit counterpart in the claim language.
1.8: No feature directed to writing/integrating inspection results into a factory-level Manufacturing Execution System database	F5	**NO COUNTERPART**	Claim 1 discloses only local display of results and physical sorting outcomes; it contains no step of transferring or storing inspection data into an MES database at the factory level, so F5 appears to lack any counterpart in the claim.

All-elements note: Not every invention unit found a clear corresponding claim element. Claim element 1.3 and 1.6 partially correspond to F2 and F4 respectively but with differing granularity/mechanism; claim elements 1.1 and 1.2 only partially correspond to F1 due to differing motion/architecture. Elements corresponding to F3 (quantitative confidence-based threshold filtering) and F5 (MES database integration) appear to lack a counterpart in claim 1, and the claim itself contains elements (display on screen; contour/dimensional measurement) that have no counterpart among the invention's standardized units. These items represent potential distinguishing points between the claim and the invention as described, phrased factually and without legal conclusion.

Equivalents caution: For element 1.1/1.2 (line-scan camera limited to one rotational station versus continuous line-scan of objects in linear motion), the difference in motion type (rotation-in-place vs. continuous conveyance) is a structurally significant change to the acquisition method and may not be viewed as an insubstantial variation. For element 1.3 (model-based presence/type judgment vs. pixel-level semantic segmentation), the absence of explicit pixel-level localization suggests a difference in output granularity that could be substantial rather than insubstantial, though this depends on unclaimed implementation detail. For element 1.6 (robotic sorting vs. pneumatic actuation), use of a mechanical robotic arm rather than pneumatic ejection is a differing physical mechanism for removal that could plausibly be viewed as a non-insubstantial structural difference, warranting caution before treating it as equivalent.

3.28 CN118967672B — Industrial defect detection method, system, device and storage medium

Assignee: Wuxi University · Published: 2025-04-29 · Status: Active · exp. 2044-10-15 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 requires image acquisition of the workpiece (though multi-modal: visible/infrared/ultrasonic) as input to a defect detection pipeline, which overlaps generically with the invention's line-scan camera image acquisition insofar as both capture images of the product for defect analysis.
- Claim 1's defect detection model performs instance segmentation and object detection to generate candidate boxes and mark possible defect regions — this is a broader/different but related concept to the invention's pixel-level semantic segmentation for defect detection and localization; both use deep-learning-based pixel/region-level defect localization, so there is potential overlap under a broad reading of 'segmentation-based defect detection using neural networks.'
- Claim 1 explicitly recites retaining prediction boxes with confidence scores above a set threshold and removing low-confidence boxes ('保留置信度较高的预选框...设置置信度分数阈值'), which overlaps with the invention's confidence threshold grading step to confirm valid defect detections.
- Claim 1 requires sorting workpieces into qualified/unqualified bins based on computed defect severity ('将工件送入合格物料盒'/'不合格物料盒'), which is a physical sorting/removal action that

overlaps conceptually with the invention's automated pneumatic reject mechanism for removing defective parts, though the actuation mechanism (bin routing vs. pneumatic ejection) is not identical and should be treated as a potential equivalent rather than a clean match.

- Claim 1 requires saving defect location, type, confidence score, and severity information to a database ('保存到数据库中'), which broadly overlaps with the invention's MES data integration step of writing inspection results back to a factory database system.

Appears to differ (AI reasoning):

- Claim 1 mandatorily requires multi-modal data acquisition combining visible light, infrared, AND ultrasonic images with a fusion algorithm producing a comprehensive feature map — the invention's line-scan camera appears to be a single visible-light imaging modality only, lacking infrared and ultrasonic sensing and multi-modal fusion, which is a required element of claim 1.
- Claim 1 requires a dedicated illumination analysis and dynamic correction step (computing brightness/contrast, local binary pattern analysis, illumination correction, histogram equalization) prior to detection — the invention's description does not mention any illumination condition analysis or correction step, which appears to be a required limitation absent from the invention.
- Claim 1 requires an online learning mechanism that updates/optimizes the detection model in real time using newly collected multi-modal data — the invention's description does not indicate any real-time online model updating capability.
- Claim 1's defect detection model architecture is specifically claimed as a two-stage region-proposal/anchor-based instance segmentation and detection pipeline (backbone, feature pyramid, anchor boxes, RoI pooling, classification/bbox regression branches, NMS via IoU thresholding, segmentation mask branch) — this is a specific architecture distinct from the invention's semantic segmentation CNN; if the invention strictly performs pixel-level semantic segmentation without anchor-based proposal/instance segmentation, this specific claimed pipeline structure may not be met (though broader semantic-segmentation-only implementations could still be assessed separately for overlap).

Note: Assessment based solely on the verbatim claims of CN118967672B provided. Claim 1 is a multi-modal (visible+infrared+ultrasonic) fusion-based system with mandatory illumination correction, online learning, and a specific instance-segmentation/anchor-box detection pipeline — all required elements. The invention as described uses only line-scan visible imagery with semantic segmentation, without disclosed multi-modal fusion, illumination correction, or online learning, so several claim limitations appear unmet (missing-element differences). However, confidence-threshold filtering, database/MES-style result storage, and defect-triggered physical removal/sorting show conceptual overlap with corresponding claim steps. This is an informational screening note only, not a legal or infringement conclusion; further review (e.g., of dependent claims and any equivalents doctrine) is recommended.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing points list several claim limitations (multi-modal fusion, illumination correction, online learning, specific anchor-based instance segmentation architecture) as reasons the invention differs, and frames these as 'required elements' the invention lacks — this is correct directionally for claim-scope narrowing (since claim 1 does require these elements, absence of them in the invention means the invention doesn't infringe claim 1), so this part of the reasoning is actually sound, not wrong-direction; however the note should be careful not to imply this makes the invention automatically 'safe' without checking broader dependent/alternative claims or other patents, which the note does acknowledge in its caveat.
- The overlap statement about claim 1's sorting into qualified/unqualified bins being an 'automated pneumatic reject mechanism' equivalent is a stretch: the claims say nothing about pneumatic actuation, only bin routing, so calling it a 'potential equivalent' is a reasonable hedge but borders on overstatement since no evidence in the claims supports a pneumatic or ejection-based mechanism.
- The overlap statement conflating instance segmentation/object detection (claim 1) with the invention's pixel-level semantic segmentation is labeled as overlap 'under a broad reading' — this is appropriately hedged, but the note still asserts a common 'segmentation-based defect detection using neural networks' overlap that is somewhat generic and not strongly grounded in the specific verbatim claim language, which describes a distinct anchor-box/RoI pipeline rather than semantic segmentation.

3.29 CN118527377B — Debris detection and removal device and method

Assignee: Nanjing Bison Smart Technology Co ltd · Published: 2024-11-22 · Status: Active · exp. 2044-07-26 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 (and dependent claims) recite acquiring an image sequence of a moving/vibrating product via a camera for defect detection, which broadly overlaps with the invention's camera-based image acquisition of products on a production line, though the patent's specific acquisition method (structured/reticulate-pattern projection with dual high-definition cameras and vibration-plate frequency synchronization) is a narrower implementation than the invention's line-scan approach — the overlap exists at the level of 'image-based defect detection during product transport,' with an equivalents caution given the differing acquisition hardware.
- Claim 1 step S4 (and claim 3/7 elaborations) require comparing a computed quality/defect score against a preset threshold and, if below threshold, issuing a rejection instruction — this broadly overlaps with the invention's confidence-threshold grading step that confirms valid defect detections before triggering rejection, notwithstanding the patent's much more elaborate scoring pipeline (ensemble learning, fuzzy inference, TOPSIS).
- Claim 1 (S4) and claim 8 recite that a confirmed defect/quality determination automatically triggers a '剔除机构' (rejection/removal mechanism) that removes the part from the line; claim 8 specifies a '真空吸取剔除单元' (vacuum suction removal unit). This is a different actuator type from the invention's pneumatic reject actuator, but vacuum/suction and pneumatic ejection are related fluid-actuation approaches, so this should be treated as potential overlap with an equivalents caution rather than a clean distinction.

Appears to differ (AI reasoning):

- Claim 1 requires a specific frequency-matching/synchronization step (S1) between the camera's capture frequency and a vibration plate's vibration frequency, including adjustment of camera, vibration plate, and reticulate-pattern projection unit parameters — the invention's line-scan continuous acquisition includes no such vibration-plate synchronization requirement.
- Claim 1 requires structured-light (reticulate pattern projection) illumination combined with phase-unwrapping and triangulation to reconstruct a 3D surface model of the product (steps S25/S31-S34), and fusion of 2D masks with 3D point-cloud/shape/texture/spectral data — the invention's semantic segmentation operates on 2D line-scan images without any claimed 3D surface reconstruction, so this 3D-reconstruction limitation appears absent from the invention.
- Claim 1 requires a specific multi-stage classification and scoring pipeline — ensemble learning (random forest + AdaBoost) for defect fine-classification, Mamdani fuzzy inference with PSO-optimized severity scoring, and AHP/TOPSIS (with Choquet integral in claim 7) for overall quality scoring — rather than a CNN-based pixel-level semantic segmentation network as used by the invention; since the claim requires this particular classification/scoring architecture, the invention's CNN semantic-segmentation approach does not appear to satisfy this specific limitation.
- The claims (1-8) contain no requirement corresponding to writing inspection results back to a factory MES database; this MES-integration feature of the invention is not addressed by the claim language (noted for completeness, though under the stated rules this alone cannot create overlap and is only relevant as an invention feature outside claim scope).

Note: This is an informational screening note based solely on the verbatim claims provided, not a legal or infringement/FTO opinion. The patent's independent claim 1 is drawn to a specific structured-light/3D-reconstruction and multi-stage classical-feature ensemble-learning/fuzzy-TOPSIS pipeline for tablet fragment detection, synchronized to a vibration plate, with a vacuum-suction rejection unit (claim 8). The invention's line-scan camera + CNN semantic segmentation + confidence threshold + pneumatic reject + MES integration shares only the general concept of vision-based defect detection with threshold-triggered automated removal. Because claim 1 imposes multiple specific technical limitations (vibration-frequency sync, structured-light 3D reconstruction, ensemble/fuzzy/TOPSIS scoring) that do not appear to be present in the invention, overall relevance is assessed as medium, with overlap concentrated only in the generic threshold-triggered-rejection concept, subject to equivalents analysis on the actuator type.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The MES integration bullet correctly notes claims don't address it, but the note appropriately flags this doesn't create overlap - this is fine and not an issue.
- The overall reasoning that claim 1's numerous specific limitations (vibration sync, structured-light 3D reconstruction, ensemble/fuzzy/TOPSIS scoring) being absent from the invention makes overlap narrower is actually correct direction (narrower claim = less overlap), so this is not a wrong-direction FTO error.
- The distinguishing point about the classification/scoring pipeline (ensemble learning, fuzzy inference, TOPSIS) versus CNN semantic segmentation is faithful to claim 1/S4 text.
- The distinguishing point about 3D reconstruction (structured light, phase unwrapping, triangulation) is faithful to steps S25/S31-S34 in the claims.
- The distinguishing point about vibration-plate frequency synchronization is faithful to step S1 in claim 1.
- The overlap statement about vacuum suction vs pneumatic actuator correctly cites claim 8's '真空吸取剔除单元' and reasonably flags it as a related but different actuator type, not fabricated.
- The overlap statement on threshold-triggered rejection is faithful to claim 1 step S4 and claim 8.
- One minor imprecision: the note states 'Claim 1 (and dependent claims) recite acquiring an image sequence of a moving/vibrating product via a camera' - this is supported by S1/S2 in claim 1, so this is accurate, not fabricated.
- The final summary paragraph's characterization of claim 1 as 'drawn to a specific structured-light/3D-reconstruction...pipeline' is well supported by the claim text and is a fair synthesis.

3.30 CN111179250B — Industrial product defect detection system based on multitask learning

Assignee: Beihang University · Published: 2023-03-24 · Status: Active · exp. 2039-12-30 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's multi-task model performs pixel-level semantic segmentation via a multilayer convolutional neural network generating a mask binary image describing defects, overlapping with the invention's CNN-based semantic segmentation for defect detection and localization
- Claim 1's image input layer directly connects to an automatic optical detection (AOI) system forming a continuous image data stream, which broadly reads on the invention's line-scan camera continuously capturing images at an inspection station
- Claim 2's decision network outputs a confidence vector for each class label via softmax, which overlaps conceptually with the invention's confidence threshold grading of detected defects, though the claim does not specify thresholding logic explicitly
- Claim 1's result output layer outputs generated results to an external system, which broadly overlaps with the invention's MES data integration as one possible 'external system' implementation

Appears to differ (AI reasoning):

- Claim 1 requires a specific two-stage multitask architecture (segmentation submodel producing a mask plus a decision submodel that splices mask with intermediate features for joint defect classification) with a defined 9-layer segmentation network structure; the invention's segmentation approach is not described as having this specific two-submodel spliced architecture, so this specific structural requirement may not be met
- Claim 1 requires an image preprocessing stage with specific steps (cropping, resizing, de-equalization/normalization, canny operator edge extraction as a fourth channel) that are not described as part of the invention's line-scan acquisition pipeline

Note: This patent centers on a two-stage (segmentation + decision) multitask CNN architecture for defect detection/classification, connected to AOI equipment and an external decision system. The invention's semantic segmentation, continuous line-scan image capture, and downstream data integration show conceptual overlap with claim 1's generic input/output layer and segmentation function, and claim 2's confidence-vector output loosely overlaps with confidence-threshold grading. However, the claims impose specific architectural limitations (two-submodel structure, defined 9-layer network, specific preprocessing steps) that are not confirmed as present in the invention description, which may distinguish it. The invention's pneumatic reject mechanism is an additional feature not addressed by these claims and does not affect overlap analysis. This is an informational screening note only, not a legal or infringement conclusion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing points reason in the wrong FTO direction: stating that the invention lacks the claim's specific two-submodel architecture, 9-layer structure, or preprocessing steps as a basis for distinguishing is backwards — since claim 1 requires these specific elements, if the invention does not include them, the invention would NOT infringe (correct direction), but the note frames this ambiguously as 'may distinguish it' based on absence in the invention description rather than clearly noting that infringement requires ALL claim elements to be present, which is actually correct reasoning here, not wrong-direction; however the note's phrasing conflates whether patent claim breadth vs. invention feature absence, which is imprecise but not clearly fabricated
- The claim 1 'image input layer directly connected to automatic optical detection (AOI) system' does not specify continuous acquisition or line-scan technology; describing this as broadly reading on 'continuously capturing images' is an overstatement not fully supported by the claim text, which only mentions forming an 'image data stream'
- The claim's 'result output layer outputs to an external system' is generic and does not mention MES or factory execution systems; framing this as overlapping with MES integration is a stretch/overstatement, though flagged as 'broad' by the note itself, which is reasonably transparent
- The note appropriately notes softmax confidence vector is not explicit thresholding logic, which is accurate and not fabricated

3.31 CN117299581A — Intelligent ore sorting equipment and method based on visible light and X-ray image fusion

Assignee: Hunan University · Published: 2023-12-29 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Line-scan image acquisition overlaps with claim 1's CCD color line scanning camera and X-ray line scanning camera arranged above/below the conveyor belt, which continuously scan items moving on a conveyor (analogous to production line inspection station)
- CNN-based defect/feature detection overlaps with claim 1's identification host comprising a deep learning module that performs classification discrimination via a neural network model (claim 2/3), though the patent's network performs multi-modal fusion and grade classification rather than pixel-level semantic segmentation of surface defects
- Confidence threshold grading overlaps with claim 2's step of outputting 'category and confidence coefficient of each ore' and dividing ore into classes 'according to a preset classification standard and a preset threshold value'
- Automated pneumatic reject mechanism overlaps with claim 1's electromagnetic air valve controlling a sorting cylinder and nozzle to perform blowing separation of items based on the control signal, and claim 2's step S4 describing timed pneumatic ejection into different collection boxes

Appears to differ (AI reasoning):

- Claim 1 requires acquisition and fusion of two distinct image modalities (visible light CCD line-scan plus X-ray line-scan/transmission imaging), whereas the invention as described uses only a single line-scan camera without any X-ray sensing or multi-modal image fusion — the claims require this dual-sensor X-ray transmission channel structure which the invention appears to lack

- Claim 1/2 require image registration, affine transformation, and edge-detection-based framing/cropping to align the two modalities before classification; the invention's semantic segmentation pipeline on a single image stream does not appear to include this cross-modal registration/fusion step, which is a required element of the claims
- Claims 2-6 require a specific encoder-decoder fusion architecture (pretrained then fine-tuned, with L1-norm+average or addition fusion strategy for combining modality feature maps) as the mechanism producing the classification input; the invention's single-stream pixel-level segmentation network does not appear to implement this required fusion-layer/encoder-decoder architecture
- The claims direct sorting output toward ore grade categories (high/medium/low grade) tied to compositional/density classification, a specific classification scheme not evidently required to match, though this alone would not distinguish if broader claim language existed — no MES/database integration step is recited or required by any claim, so this is not a claim limitation issue but noted as absent from the patent's described system

Note: This patent claims an ore-sorting apparatus/method fundamentally built around fusing two co-registered image modalities (visible RGB line-scan and X-ray line-scan) via a trained encoder-decoder fusion network, followed by pneumatic (electromagnetic valve + cylinder/nozzle) ejection sorting by grade. Overlap exists at a generic level: line-scan camera capture on a moving conveyor, CNN-based defect/feature classification with confidence/threshold output, and pneumatic actuation for removing/sorting items. However, claim 1 (and all dependent claims) affirmatively require the dual-modality X-ray+visible fusion architecture and its registration/fusion steps as core limitations; the invention as described operates on a single line-scan visual image stream with pixel-level semantic segmentation, lacking the X-ray sensing and multi-modal fusion elements the claims require. This is a genuine missing-element distinction, not merely an added feature. Given the substantial required elements the invention lacks, but shared conceptual overlap in image-based defect/quality detection triggering pneumatic rejection, relevance is assessed as medium. This is an informational screening note only, not a legal or infringement opinion. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The final summary paragraph states 'no MES/database integration step is recited or required by any claim, so this is not a claim limitation issue but noted as absent from the patent's described system' — this reasoning is backwards under FTO logic: the claim NOT reciting a feature the invention has does not distinguish the invention from the claim (broader/narrower claim scope point), and framing it as relevant to distinguishing is wrong-direction reasoning, though the note does soften it by saying it's 'not a claim limitation issue' which mitigates but does not fully resolve the confusion
- The characterization that claim 1 requires the X-ray/visible fusion as elements the invention 'lacks' is correctly framed as a missing-element (invention lacks patent's required elements) which is the correct FTO direction, but the note's phrase 'this is a genuine missing-element distinction, not merely an added feature' correctly caveats the direction issue raised elsewhere, creating some internal inconsistency in how added vs. missing features are handled across the distinguishing points list
- The claim of 'continuously' scanning items is an inference — claims describe line-scan cameras scanning ore on a conveyor but do not explicitly state 'continuously capturing images' the way the invention description does; this is a minor overstatement of the analogy rather than fabrication

3.32 CN106409711B — A solar silicon wafer defect detection system and method

Assignee: Guangdong Fozhi Chip Microelectronics Co., Ltd. · Published: 2019-03-12 · Status: Active · exp. 2036-09-12 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 recites an 'industrial camera' (工业相机) capturing images of parts (silicon wafers) moving on a conveyor belt at an inspection station — this is a broad/generic image-acquisition limitation that could encompass a line-scan camera implementation as used in the invention.

- Claim 1 and claim 2 recite an image-processing system that automatically analyzes captured images and uses a neural network (BP neural network, per claim 1/S3 and claim 5) to classify/detect defects, sending results to a control system that acts on them — this generic 'NN-based defect detection triggering downstream action' concept overlaps with the invention's CNN-based detection and confirmation workflow, though the specific network architecture differs (see distinguishing points).
- Claim 1 and claim 4 describe an automated sorting system (PLC-controlled sorting robotic arm) that physically removes/sorts parts from the line based on the image-processing result — this is conceptually similar to the invention's automated pneumatic reject actuator that removes defective parts; the actuator type differs (robotic arm + sorting boxes vs. pneumatic ejector) so this is best treated as an equivalents-type overlap rather than a clean difference.

Appears to differ (AI reasoning):

- Claim 1 requires a specific mechanical architecture (loading robotic arm, material trough, material table, conveyor belt, coaxial/ring illumination, sorting robotic arm, sorting boxes, PLC, IO board, industrial PC with acquisition card) — the invention as described does not include these specific hardware elements, and claim 1 requires them as part of the system.
- Claim 1's detection method requires measuring geometric features (wafer length/width) via ROI edge-point detection and iterative line-fitting (Hesse normal form, weighted least squares) to check dimensional conformance — the invention's described features do not include this specific geometric-measurement/edge-fitting requirement.
- Claim 1/4/5 specify that defect detection is performed via a Blob algorithm (grayscale preprocessing, image segmentation into blobs, connected-component extraction of area/perimeter/circularity/centroid/gray mean/gray std) feeding a BP neural network classifier with a defined 6-input/12-output/10-hidden-node architecture — this is a specific, non-pixel-level feature-engineering + shallow-NN classification pipeline that differs from the invention's pixel-level CNN semantic segmentation approach; the claim's specific computational method does not appear to be met by the invention's described segmentation technique.

Note: This screening is based solely on the verbatim claims of CN106409711B as provided. The patent's claimed system is directed to solar silicon wafer inspection with a specific mechanical architecture (robotic loading/sorting arms, sorting boxes, PLC/IO-board control) and a specific detection pipeline combining geometric edge-fitting measurement with Blob-feature extraction and a BP neural network classifier. The invention's line-scan camera + CNN pixel-level semantic segmentation + pneumatic reject + MES integration overlaps at a general conceptual level (camera-based inline inspection feeding an NN-based classifier that triggers automated removal), but the specific technical implementations diverge significantly, particularly the detection algorithm (Blob/BP vs. CNN segmentation) and the reject actuator type (robotic arm/sorting boxes vs. pneumatic ejector). This is an informational overlap screening only, not a legal or FTO opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note states 'the invention as described does not include these specific hardware elements' (loading arm, material trough, sorting boxes, PLC/IO board, etc.) as a distinguishing point. This is wrong-direction FTO reasoning: claim 1 requires these specific elements, meaning the claim is narrower than a generic camera+NN+actuator system. The invention lacking these elements would tend to mean the invention does NOT infringe this narrow claim (which is correct conclusion), but the note frames it ambiguously in a way that could be read as the invention being safer because it has fewer features than the claim requires — actually here the logic direction is correct (claim requires extra elements invention lacks → less overlap), so this point is not itself wrong-direction, but should be double-checked; however no issue since narrower claim + missing required elements is valid non-infringement reasoning.
- The 'automated sorting system' overlap paragraph explicitly acknowledges the actuator type differs (robotic arm + sorting boxes vs. pneumatic ejector) yet still calls it 'conceptually similar' and 'best treated as an equivalents-type overlap' — this is speculative language not strictly grounded in the provided claim text about pneumatic mechanisms, slightly overstating similarity beyond what the evidence supports.
- The BP neural network vs CNN distinguishing point is well-supported by claim 5's explicit architecture (6 inputs, 12 outputs, 10 hidden nodes, sigmoid activation) and is faithful.

- Overall the geometric feature-measurement (Hesse normal form line-fitting) distinguishing point is accurately traced to claim 1/S3, and the Blob-algorithm distinguishing point is accurately traced to claims 1/4/5 — these are faithful.

3.33 EP2437706B1 — Systems and methods for detecting and rejecting defective absorbent articles from a converting line

Assignee: Procter and Gamble Co · Published: 2020-03-25 · Status: Active · exp. 2030-06-02 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1 recites 'inspecting the substrate and component parts with the sensor' and 'identifying defects in virtual segments based on the inspection parameters' in broad, generic terms that could encompass a line-scan camera plus CNN-based semantic segmentation as one form of sensor/defect-detection implementation, creating potential overlap with the invention's image acquisition and defect detection steps.
- Claim 1's 'rejecting absorbent articles that correspond with virtual products having virtual segments with identified defects' is broad functional language for defect-triggered rejection that could read on the invention's confidence-graded defect confirmation and pneumatic reject actuation, subject to an equivalents-type caution given differences in mechanism/timing basis.
- The overall claimed workflow (inspect substrate -> identify defects -> reject corresponding product) parallels the invention's general defect-detection-to-rejection pipeline at a high level.

Appears to differ (AI reasoning):

- Claim 1 requires a communication network (154) connecting a synchronized sensor clock and controller clock, with timestamped inspection parameters (Tsn) used to correlate inspection data to virtual segments based on substrate speed — the invention description contains no timestamp-based clock synchronization or virtual segmentation/virtual product tracking scheme.
- Claim 1 requires 'virtually segmenting the substrate into a plurality of virtual products' and 'virtually dividing the virtual products into a plurality of virtual segments' along the machine direction prior to cutting — this virtual-segment/virtual-product architecture is not present in the invention, which appears to operate on discrete already-formed parts via image-based CNN detection rather than virtual segment correlation.
- Claim 1 requires 'cutting the substrate with component parts added thereto into discrete absorbent articles' as part of the claimed process — the invention's description does not include a substrate-cutting step; it inspects and rejects parts already discrete on a production line.
- Claim 1 is directed specifically to a 'web converting manufacturing process' for 'absorbent articles/products' (diapers, diaper ears per dependent claims) — the invention is described generically for 'products' on a production line without limitation to web-converting or absorbent article manufacture, though this narrower claim scope reduces overlap risk rather than expanding it.
- No claim requires or references a convolutional neural network, semantic segmentation, confidence-threshold grading, a pneumatic actuator specifically, or MES database integration; these invention-specific implementation details are not addressed one way or another by the claims, but their absence does not itself create overlap.

Note: EP2437706B1's claims are narrowly framed around a specific timestamp/clock-synchronization and virtual-segmentation architecture for correlating sensor data to virtual product segments in a web-converting/absorbent-article process, then cutting and rejecting based on that correlation. The invention's line-scan/CNN/confidence-threshold/pneumatic-reject/MES pipeline shares only the high-level concept of inspect-then-reject; the claim's mandatory clock-synchronization, virtual-segmentation, and substrate-cutting elements appear absent from the invention as described, which are significant missing-element differences. However, the generic 'inspecting' and 'rejecting' language in claim 1 is broad enough to warrant a medium-relevance flag for further review of dependent claims and file history. This is an informational screening note only, not a legal or infringement opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note explicitly states 'this narrower claim scope reduces overlap risk rather than expanding it' — this is a correct FTO-direction statement acknowledging narrower scope reduces risk, which is proper reasoning, not an error; however the adjacent statement that 'their absence does not itself create overlap' regarding CNN/semantic segmentation/confidence-threshold/pneumatic actuator/MES is technically correct but could be seen as unnecessary since absence of these limitations in the claim actually makes the claim broader and more likely to read on the invention if the other elements match — the note underweights this by treating it as neutral rather than flagging that broad generic claim language increases overlap risk.
- The claim requires mandatory elements (clock synchronization, virtual segmentation, substrate cutting) not present in the invention description; the note correctly identifies these as missing-element distinctions, which is valid reasoning since these are affirmative limitations in the claim, not absent limitations — this is correctly applied, no fabrication.
- The statement that claim 1's sensor/inspection language 'could encompass a line-scan camera plus CNN-based semantic segmentation as one form of sensor/defect-detection implementation' is a reasonable but speculative interpretation not directly supported by explicit patent language, slightly overstating overlap likelihood without clear evidentiary basis in the claims.

3.34 CN115769275A — Deep Learning Platform for Automated Visual Inspection

Assignee: Amgen Inc · Published: 2023-03-07 · Status: Pending · Relevance: LOW · [verify on Google Patents ↗]

Potential overlap (AI reasoning):

- Claim 19/31 recite capturing container images via an imaging system prior to processing, which broadly overlaps with the invention's line-scan image acquisition step, though the claim's imaging system is generic and not specifically a line-scan camera
- Claims 1/20/32 involve neural networks performing automated visual inspection to detect defects, which broadly overlaps with the invention's CNN-based defect detection concept, though the claimed networks are specifically trained via the cropped/downsampled training-image-generation technique rather than performing pixel-level semantic segmentation

Appears to differ (AI reasoning):

- Claims 1 and 20 require a specific training methodology of generating multiple per-defect-class training images from subsets/crops of container images (feature identification via template matching or blob analysis, generating first training image as a subset depicting the identified feature) — the invention as described does not include this specific training-data-generation process
- Claim 32 requires obtaining a plurality of neural networks each corresponding to a different defect category, trained on differently-cropped training images — the invention uses a single CNN performing semantic segmentation, not multiple category-specific networks trained via this cropping scheme
- The claims are directed to container inspection (syringes, cartridges, vials) with defect classes like plunger defects, meniscus particles, flange defects, etc., a domain-specific context absent from the invention's general production-line surface defect inspection
- No claim recites a confidence-threshold-based grading/confirmation step for defect detections as in the invention
- No claim recites a pneumatic reject actuator or automated physical removal of defective parts
- No claim recites integration of inspection results with a Manufacturing Execution System (MES) database

Note: This patent's claims are centered on a specific method/system for efficiently generating training image sets (via cropping/subsetting container images to depict identified features, using template matching or blob analysis) to train multiple defect-specific neural networks for container inspection (syringes, cartridges, vials), and on subsequently using those networks for inspection. The invention concerns a line-scan camera feeding a single CNN doing pixel-level semantic segmentation, confidence-threshold grading, pneumatic rejection, and MES integration — a different overall architecture and problem focus (real-time production-line defect detection and rejection vs. efficient training-data generation for container defect classifiers). Only loose, generic overlaps exist around 'image capture via imaging system' and 'neural network-based visual inspection'; the claims' core distinguishing limitations (training image generation/cropping, multiple per-category networks, container-specific features) appear absent from the invention as described. Overall relevance is assessed as low given the divergent technical focus, though a fuller claim set and invention implementation details would be needed for a more definitive screening. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement citing claims 19/31 correctly notes the imaging system is generic, but the note doesn't flag the direction-logic issue: a generic 'imaging system' claim is actually broader and could more easily cover a line-scan camera, not less dangerous — the note's framing ('though the claim's imaging system is generic and not specifically a line-scan camera') is used as a mitigating/distinguishing factor, which is wrong-direction reasoning since broader/generic claim language is more likely to read onto the invention, not less.
- The distinguishing point 'No claim recites a confidence-threshold-based grading/confirmation step for defect detections' is technically true per the excerpt but is presented as a distinguishing feature; since the claims are method/system claims about training data generation and do not require confidence thresholds, absence of this limitation makes the claims broader in this respect (i.e., could still cover systems with or without thresholding) — using absence-of-limitation as a distinguishing/safety point is wrong-direction reasoning.
- Similarly, 'No claim recites a pneumatic reject actuator' and 'No claim recites integration...with MES' are used as distinguishing points based on absence of limitations, which is wrong-direction reasoning under FTO logic (absence of a limitation broadens rather than narrows claim scope).

3.35 CN113538323A — Defect detection method and system based on deep learning

Assignee: Hong Kong University of Science and Technology · Published: 2021-10-22 · Status: Pending · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's step of 'obtaining an original image of a device to be detected' is broad/generic image acquisition language that could encompass line-scan camera image capture as used in the invention.
- Claim 1's step of 'processing the cropped image through a lightweight convolutional neural network to detect defects... and label the defects' is a generic CNN-based defect detection/localization step that may overlap with the invention's CNN-based semantic segmentation for defect detection and localization, subject to equivalents analysis given differing architectures (lightweight multi-unit CNN with upsampling/fusion vs. semantic segmentation network).
- Claim 8 recites an apparatus with imaging unit, preprocessing unit, and detection unit performing the same broad functions as claim 1, which could overlap with the invention's camera + CNN inspection pipeline at a high level.

Appears to differ (AI reasoning):

- Claim 1 and claim 8 require a 'preprocessing' step/unit that produces a 'cropped image including defects' via cropping - the invention as described does not mention any edge/corner-based cropping preprocessing step prior to CNN analysis; if the invention processes full line-scan images without a distinct cropping stage, this claim element appears unmet.
- Dependent claims 2-3 require specific preprocessing via edge detection, corner detection, clustering, and mean-based cutting region - the invention's described pipeline does not include these specific steps.

- Dependent claims 4-7 require a particular lightweight CNN architecture with N≥2 sequential lightweight CNN units, selective upsampling of results 2 through N, and fusion of first and upsampled results - the invention's semantic segmentation network is not described with this specific multi-unit/upsampling/integration architecture.
- The claims are silent on confidence-threshold grading, pneumatic reject actuation, and MES data integration; however, since these are additional invention features not required by the claims, their absence in the claims does not constitute a distinguishing point (per direction rules) but is noted as claims not covering that scope.

Note: Claims text is available and reviewed. Relevance is assessed as medium: both concern deep-learning-based defect detection and labeling/localization in images, a conceptual overlap at claim 1's broad level, but the claims are anchored to a specific 'crop-then-detect' pipeline (edge/corner-based region cropping, lightweight multi-unit CNN with upsampling fusion) that appears structurally different from the invention's continuous line-scan semantic segmentation approach. No claim recites confidence thresholding, pneumatic rejection, or MES integration, meaning the patent's scope does not extend to those invention features, but this is not treated as a limiting/distinguishing factor under the stated direction rules since added features cannot avoid what is otherwise disclosed overlap. This is an informational screening note only, not a legal or infringement/FTO conclusion. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

3.36 CN101980797A — System and method for sorting polarization film

Assignee: Sumitomo Chemical Co Ltd · Published: 2011-02-23 · Status: Active · exp. 2029-03-26 · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's imaging mechanism that captures images of items moving/positioned for inspection is a generic camera-based image capture step, broadly analogous to the invention's line-scan camera acquisition, though patent specifies mark detection rather than defect detection
- Claim 1's sorting mechanism that physically separates marked vs unmarked film based on a decision output is broadly similar in concept to the invention's automated reject actuator removing defective parts based on a detection decision

Appears to differ (AI reasoning):

- Claim 1 requires a 'mark testing agency' that detects a pre-applied physical mark (a discrete indicator placed on film after prior inspection), not a CNN performing pixel-level semantic segmentation to directly detect and localize surface defects from image content — the invention's defect detection method is not required by or equivalent to the claimed mark-detection mechanism
- Claims 2-4 require film-interval detection signals and pulse-timing/pulse-overlap correlation logic between mark and interval signals on a time axis, which the invention has no counterpart for
- The claims require binary mark/no-mark judgment tied to a pre-marking workflow (film inspected and marked in a prior separate step), not a confidence-threshold-based grading of detected defects computed by the inspecting system itself
- No claim element corresponds to MES data integration/write-back of inspection results — this is absent from all claims
- The claims are directed to sorting pre-marked polarizing film sections into two bins (marked/unmarked), not to inline detection-and-removal of defective parts via pneumatic rejection during continuous production line movement

Note: This patent (CN101980797A) claims a mark-detection and sorting system for polarizing film segments that were previously inspected and physically marked; its core claimed technology is mark/interval signal detection and binary sorting logic, not automated defect detection via neural network segmentation or pneumatic rejection. Overlap with the invention is limited to generic 'camera captures image' and 'automated sorting/removal mechanism' concepts framed at a high level; the specific technical mechanisms (semantic segmentation CNN, confidence thresholding, pneumatic reject actuator, MES integration) are not recited in these claims. Relevance is assessed as low given the substantially different technical field (mark detection on pre-marked film sections vs. real-time surface defect detection via deep learning) and claim scope focused on signal-timing/pulse-overlap logic absent from the invention.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The MES integration distinguishing point ('No claim element corresponds to MES data integration/write-back of inspection results — this is absent from all claims') is technically true but reasoning in the wrong FTO direction: the absence of a limitation in the claims makes the claim broader, not narrower, so it does not serve to distinguish/avoid infringement risk the way the note implies.
- Similarly, framing 'the claims require binary mark/no-mark judgment tied to a pre-marking workflow... not a confidence-threshold-based grading' as purely distinguishing partially conflates lack of recitation with non-infringement; while the mark-detection mechanism is indeed different in kind (supported by claim text), the note should be careful not to rely on absence of the invention's specific implementation detail (confidence threshold) alone as the distinguishing rationale, since a broader 'judging' step could still read on various decision mechanisms.
- The sorting mechanism overlap statement is reasonably supported by claim 1 text ('sorting device' controlled by judgment result), so this is fine, but characterizing it as 'broadly similar in concept' to a pneumatic reject actuator is a stretch beyond what the claim specifies (claim does not specify pneumatic actuation), which is a minor overstatement rather than fabrication.

3.37 CN109239102B — CNN-based flexible circuit board appearance defect detection method

Assignee: Nanjing University of Science and Technology · Published: 2021-04-09 · Status: Active · exp. 2038-08-21 · Relevance: MEDIUM · [verify on Google Patents ↗]

Potential overlap (AI reasoning):

- Claim 1 uses a CNN model to detect and localize surface defects in images, broadly overlapping with the invention's use of a CNN for defect detection and localization.
- Claim 1's final decision step (comparing a computed score against a threshold S to determine defect/non-defect) is conceptually similar to the invention's confidence-threshold grading step, though the underlying decision function and score type differ (patch-classification probability score vs. segmentation confidence).
- Claim 5/6 describe classifying detected regions as defect or non-defect (or multiple defect types), which broadly parallels the invention's confidence-based confirmation of valid defect detections.

Appears to differ (AI reasoning):

- Claim 1 requires a specific patch-sampling methodology (sliding rectangular sampler G, counting defective pixels N(G), labeling via threshold T) and a defined decision function f combining per-patch probabilities into a whole-image score via Max(s(Gi)); the invention's semantic segmentation approach performs direct pixel-level classification without this sampling/patch-aggregation procedure, so this specific claimed method step does not appear to be present in the invention as described.
- Claim 1 is limited to flexible circuit board (FPC) appearance defect detection with manual pixel-level defect annotation for training; the invention is described generically for 'products' on a production line without this domain-specific training/annotation methodology being required or shown.

Note: This patent (CN109239102B) claims a specific CNN-based patch-sampling-and-aggregation method (FDNet/GoogleNet-based) with a particular decision-function threshold scheme, applied specifically to flexible circuit board (FPC) appearance inspection. The invention's semantic segmentation approach for pixel-level defect detection is a different technical implementation from the claimed sliding-window sampling and probability-aggregation method, though both fall under the general category of CNN-based visual defect detection with threshold-based confirmation. The claims do not address line-scan acquisition, pneumatic rejection, or MES integration, so no overlap assessment is made for those invention features. This is an informational screening note only, not a legal or infringement conclusion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The distinguishing point about the invention being described generically for 'products' vs. the patent being limited to FPC (flexible circuit board) is a valid distinguishing point, but framing it as 'the invention is described generically... without this domain-specific training/annotation methodology being required or shown' partly relies on the invention's features not matching the claim's specifics, which is legitimate narrowing (claim requires FPC-specific limitation), so this is acceptable and not wrong-direction reasoning.
- The first distinguishing point (patch-sampling/aggregation method vs. semantic segmentation) is properly reasoned as a claim limitation not met by the invention's differing technical approach, which is valid FTO reasoning (claim requires X, invention does not do X) rather than wrong-direction reasoning; however, the note should be cautious since claim 1 broadly recites 'CNN model to detect and localize defects' at a high level, and the overlap statement acknowledging this while claiming distinction based on implementation details is reasonable but borders on overstating the safety of the distinction given claim 1's specific mandatory steps (sampling, N(G), decision function f, Max aggregation) are indeed distinguishing and correctly identified as such — no issue here.
- The note's final paragraph statement that 'no overlap assessment is made' for line-scan, pneumatic rejection, and MES integration is faithful and appropriately cautious, not fabricated.
- Overall the note is largely faithful to the evidence, but the overlap section slightly overstates similarity by characterizing claim 5/6's binary/multi-class defect classification as 'broadly parallel' to confidence-based confirmation, which is a reasonable but somewhat loose analogy not strongly supported by claim text (claim 5/6 describe output classes, not a confidence threshold confirmation step like claim 1's S threshold).

3.38 CN111929309B — A method and system for detecting appearance defects of castings based on machine vision

Assignee: Cao Haoyu · Published: 2021-01-08 · Status: Active · exp. 2040-09-14 · Relevance: MEDIUM · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Line-scan image acquisition potentially overlaps with claim 1's use of 'line cameras (6)' as part of the L-shaped array combined with laser cameras, though the patent requires the combination of line camera plus laser camera rather than a standalone line-scan camera
- Semantic segmentation defect detection (CNN pixel-level) potentially overlaps with claims' 'algorithm model' trained on marked/labeled sample data to detect and localize (position) defects, since the claims are broadly drafn in terms of an 'algorithm model' without specifying architecture, which could encompass a CNN performing segmentation
- Confidence threshold grading potentially overlaps with claim 4's 'setting threshold parameters in the model' based on characteristic scale information used to confirm defect detections
- Automated reject mechanism potentially overlaps with claim 1/5's 'execution mechanism' that executes a 'sorting action' physically moving repairable parts to a rework hopper (7) and scrapped parts to a waste hopper (8), which is a broader/generic sorting actuator concept that could encompass a pneumatic reject actuator

Appears to differ (AI reasoning):

- Claim 1 requires a specific two-model architecture (first algorithm model for morphological-deviation defects, second algorithm model for morphology-and-color-deviation defects) explicitly trained and run in parallel; the invention as described uses a single CNN semantic segmentation model without this dual-model split, which the claims appear to require as a limiting structural element
- Claim 1 requires the vision system to combine a laser camera AND a line/linear-array camera in an L-shaped array specifically for capturing 3D, height-scale, and color/chromatic information together; the invention's line-scan camera alone (no laser camera or 3D/height sensing) appears to lack this combined laser+line camera limitation
- Claims 1 and 5 require classification of defects into repairable vs. scrapped categories based on defect type, size, and distribution position, with corresponding physical sorting into a rework hopper

or waste hopper; the invention's binary confidence-threshold-based reject mechanism does not appear to include this repairable/scrapped classification and dual-destination sorting logic

- Claim 5 requires a specific mechanical inspection station architecture (rotatable detection table, multi-axis manipulator, dual camera assemblies for multiple surfaces of a brake disc) which the invention's generic line-scan inspection station does not describe
- No claim recites MES/factory database integration; this invention feature is not addressed one way or the other by the claims and is not analyzed here since it does not implicate a claim requirement

Note: This patent's claims are directed to a casting (brake disc) appearance defect detection system/method using a dual-camera (laser + line-array) vision system and a dual-model (morphological vs. morphological+color) machine-learning architecture, with defect severity classification (repairable/scrapped) driving physical sorting into two hoppers. The invention's CNN-based semantic segmentation with confidence thresholding and pneumatic reject, plus MES integration, share general thematic overlap (line camera use, threshold-based detection, algorithm-model-based defect localization, automated physical removal/sorting) but the claims impose specific structural limitations (dual algorithm models, laser+line camera combination, repairable/scrapped classification with dual hoppers, specific mechanical inspection-station hardware) that the invention as described does not appear to include. This is an informational screening note only, not a legal or infringement/FTO opinion.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The claim requires the line camera to be combined with a laser camera in an L-shaped array; the note correctly notes this, but then also uses 'invention lacks the combined laser+line camera limitation' as a distinguishing point — this is proper claim-scoping reasoning (narrower claim element not met), not wrong-direction, so this is fine.
- The statement that claim 1's dual algorithm model requirement distinguishes the invention (single CNN) is correctly framed as a limiting structural element the invention lacks, which is valid FTO reasoning (accurate direction).
- The statement 'No claim recites MES/factory database integration; this invention feature is not addressed one way or the other by the claims and is not analyzed here since it does not implicate a claim requirement' is essentially correct but somewhat editorializes; not a fabrication.
- The overlap claim regarding 'confidence threshold grading' potentially overlapping with claim 4's 'setting threshold parameters in the model' is a stretch: claim 4's thresholds are for characteristic scale parameters used in training/model-setup, not a post-detection confirmation threshold for grading confirmed defects, so this equivalence is somewhat overstated.
- The overlap claim that the execution mechanism/sorting action 'could encompass a pneumatic reject actuator' is speculative but reasonably flagged as 'potentially,' consistent with the claim's generic language; this is acceptable but borders on overstatement since the claims specify two-hopper repairable/scrap sorting rather than a generic single reject action.

3.39 CN120790548A — Defect visual detection device and method for wet tissue processing

Assignee: Shandong Qingran Biotechnology Co ltd · Published: 2025-10-17 · Status: Pending · Relevance: LOW · verify on Google Patents ↗

Potential overlap (AI reasoning):

- Claim 1's initial step of using a camera (CCD camera) to scan products conveyed on a line and detect their condition is broadly analogous to the invention's line-scan image acquisition step, though the patent's camera is used for simple classification rather than pixel-level defect detection.
- Both systems involve inspecting products in-line on a production/conveyor system and taking an automated downstream action based on the inspection result, which is a general point of overlap at a high level of abstraction.

Appears to differ (AI reasoning):

- Claim 1 requires a specific mechanical sorting device (a classifying plate with a driving device and reversing device that moves the plate in three directions) to physically route products; the invention's reject mechanism is a pneumatic actuator that removes only defective parts, not a multi-directional classifying plate system, and the invention does not appear to include this required structure.

- Claim 1 requires a physical repair station with two smoothing rods that mechanically smooth/repair 'repairing products'; the invention has no repair or smoothing mechanism at all, so this claim limitation appears unmet.
- Claim 1 (and dependent claims 4-9) require additional specific mechanical structures (turning device with third conveyors, telescopic rods, rotating blocks, motors, gears/racks, steering arms, springs, etc.) that are entirely absent from the invention's described features.
- The patent's detection step (CCD scan classifying into qualified/repair/defective) does not use, and does not require, a convolutional neural network performing pixel-level semantic segmentation, a confidence-threshold grading step, or MES database integration — these invention features have no corresponding claim requirement, but conversely the claim's mechanical classification/repair limitations are not satisfied by the invention, which is the operative distinguishing consideration.
- The patent's action mechanism (mechanical diverting via classifying plate to three separate collection paths) differs from the invention's pneumatic reject actuator that removes only defective items from a single line; these appear to be different actuator/mechanism types rather than a clean overlap.

Note: This patent's claims are directed to a specific electromechanical sorting and repair apparatus for wet tissue processing (CCD scan plus a three-way mechanical classifying plate and a smoothing-rod repair station), not to a defect-detection algorithm per se. The invention's core distinguishing technologies (CNN-based semantic segmentation, confidence thresholding, pneumatic rejection, MES integration) are not addressed by these claims, but more importantly, the claims impose extensive specific mechanical limitations (classifying plate, reversing device, repair station with smoothing rods, and associated dependent-claim hardware) that the invention as described does not appear to include. Overlap is limited to the generic concept of camera-based in-line inspection triggering an automated downstream action. This is an informational screening note only, not a legal or infringement conclusion. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The note states 'the invention does not appear to include this required structure' and similar phrasing multiple times (classifying plate, repair station, dependent-claim hardware) as distinguishing points — this is correct direction reasoning (claim requires structure invention lacks, so invention likely doesn't infringe), which is actually correct FTO logic, not wrong-direction reasoning; however the note's framing that 'these invention features have no corresponding claim requirement... but conversely the claim's mechanical classification/repair limitations are not satisfied by the invention, which is the operative distinguishing consideration' correctly identifies that missing claim requirements do not help avoid infringement, so this part is properly reasoned and not an error.
- The claim requires specific mechanical structures (classifying plate, reversing device, repair station, smoothing rods) not present in the invention, which the note correctly uses to argue non-overlap — this is valid since claims require ALL elements to be present in an infringing product, so absence of these elements in the invention is a valid distinguishing point.
- The note's overlap statement that CCD camera scanning is 'broadly analogous' to line-scan image acquisition is a reasonable high-level comparison supported by the abstract/claims text.
- The note accurately reflects claim 1 and dependent claims 4-9 mechanical details as excerpted.

3.40 CN115236083A — Cylinder inner surface image acquisition device and defect detection method

Assignee: Suzhou Tuoda Kunwu Robot Technology Co ltd · Published: 2022-10-25 · Status: Pending · Relevance: LOW · [verify on Google Patents ↗]

Potential overlap (AI reasoning):

- Claim 1's camera unit uses an LED linear light source with a linear array (line-scan) camera for continuous image capture, which conceptually overlaps with the invention's line-scan camera acquisition, though the claim ties this camera to a specific cylinder-inspection apparatus.
- Claim 5's method uses a convolutional neural network to detect and localize defects (screening defect image blocks and marking detection frames with position coordinates), which is conceptually similar to the invention's CNN-based defect detection and localization, though the claimed network performs patch/block classification rather than pixel-level semantic segmentation.

Appears to differ (AI reasoning):

- Claim 1 (and dependent claims 2-4), which the method claim 5 requires ('using the image acquisition device of claims 1 to 4'), mandates a specific mechanical apparatus — alignment rack, transversely arranged slide rail, motor/transmission gear, cantilever rod with a counting assembly and counter, hydraulic rod, tray assembly, fixed chuck, and spindle box for rotating/positioning a cylinder body — none of which appear present in the invention's line-scan camera setup on a generic production line.
- Claim 5's CNN is explicitly a VGG-16-based classification network (13 conv layers, 3 FC layers, 5 max-pool layers, 2 dropout layers, softmax 2-class output as detailed in claim 8) trained for binary defect/non-defect image-block classification with bounding-box marking, which differs in architecture and task type from the invention's pixel-level semantic segmentation network for defect detection and localization.
- Claim 9's threshold usage relates to binarization of preprocessed images (gray mapping, Gaussian filtering, then threshold segmentation to produce a binary image), not to a confidence-based grading of already-detected defect instances as in the invention; no claim recites a post-detection confidence threshold for confirming defect validity.
- No claim in this patent recites an automated pneumatic (or any) reject actuator that physically removes defective parts from a production line.
- No claim in this patent recites integration or data write-back to a factory MES (Manufacturing Execution System) database.

Note: This patent is directed to a specialized mechanical apparatus and CNN-classification method for inspecting the inner surface of cylindrical bodies (e.g., pipes/barrels), not a generic production-line surface inspection system. While the general concepts of line-scan/linear-array image capture and CNN-based defect detection show conceptual overlap with the invention, the claims are largely apparatus-specific (rotating chuck, counting assembly, tray, spindle box) and method-specific (VGG-16 architecture, block classification, binarization preprocessing) in ways the invention does not appear to share. The invention's confidence-threshold grading, pneumatic reject mechanism, and MES integration are not addressed by any claim, so no overlap can be identified for those features. Overall relevance is assessed as low given the substantial differences in claimed apparatus and detection methodology; this is an informational screening note, not a legal or infringement opinion. ℹ PENDING APPLICATION (Google Patents): claims may change before grant — monitor for a granted version.

Adversarial auditor annotations (issues the independent audit agent flagged in the note above):

- The overlap statement describing claim 1's camera as enabling 'continuous image capture' is a slight overstatement; claim 1 describes a linear array camera with LED linear light source but does not explicitly state 'continuous' capture as a claim feature, though this is a minor stretch reasonably inferable from linear-array/line-scan camera operation.
- The distinguishing points about the invention's confidence-threshold grading, pneumatic reject mechanism, and MES integration not being recited in the patent's claims are technically accurate as factual observations, but framing them as 'distinguishing points' that reduce FTO risk is wrong-direction reasoning: claims that are silent on a feature are not narrowed by that absence and do not thereby avoid infringement risk on the elements they do recite. The note should not treat absence of these limitations in the claims as a basis for reduced overlap/relevance, since narrower invention features do not by themselves escape broader or differently-scoped claims. This reasoning pattern is at least partially misapplied in the note's concluding relevance assessment.

- The claim about the counting assembly, hydraulic rod, tray assembly, fixed chuck, and spindle box being absent from the invention is faithful and appropriately used to show the invention lacks these elements rather than to claim non-infringement by the patent, which is the correct direction; this part is fine.

4. Observations (small-sample impressions)

⚠ **AI REASONING — MAY BE WRONG.** Impressions from this small sample only — not a landscape analysis.

- Crowded: Deep-learning/CNN-based visual defect detection for industrial production lines and workpieces appears heavily represented, with many similar Chinese utility patents (e.g., CN113177924A, CN119023577A, CN118967672B, CN111179250B, CN109239102B, CN111929309B) covering generic machine-vision inspection pipelines
- Crowded: AI-based visual inspection systems combining image acquisition and neural-network defect classification are well covered by multiple assignees, including Elementary Robotics Inc (US11941799B2, US11954846B2) and Musashi Ai North America Inc (US12243216B2)
- Crowded: Automated inspection-and-reject systems for converting/production lines are represented multiple times by Procter and Gamble Co (US11051991B2, US10632022B2, EP2437706B1), suggesting this specific reject-mechanism combination has some prior coverage
- Open: No reviewed patent explicitly combines line-scan image acquisition with semantic segmentation defect detection in a single claimed pipeline
- Open: Confidence threshold grading tied directly to a pneumatic reject actuation trigger was not observed as an explicit combination in this sample
- Open: MES data integration appears in only one unrelated reviewed patent (US11754991B2, pharmaceutical manufacturing context), suggesting limited overlap with the present invention's MES-linked inspection/reject workflow
- Open: Semantic segmentation specifically (as opposed to general CNN classification or object detection) for defect detection is only clearly present in a couple of the reviewed patents (US12183010B2, US11256960B2), and neither ties it to pneumatic rejection or MES feedback
- The reviewed sample suggests the individual components (image acquisition, ML-based defect detection, automated rejection, MES integration) each have some precedent, but their specific combination as described in the invention was not directly observed among the reviewed patents
- Given the volume of machine-vision inspection patents in the sample, a detailed claim differentiation focusing on the semantic segmentation plus confidence-threshold-triggered pneumatic reject plus MES integration chain may help distinguish the invention
- Further review of full claims for US12183010B2, US11941799B2, and US11954846B2 is recommended given their thematic proximity to segmentation-based inspection triggering

5. Verification Log

Every deep-reviewed patent below was live-fetched from Google Patents structured data at generation time — patent number, title, assignee, dates, claims text and legal status all come from that fetch, not from AI memory, and the engine never estimates dates. Flagged-but-not-reviewed and claims-unavailable entries originate from the real search index (existence shown by the search hit itself); their claims were not analyzed.

Hard-fact ledger: 40 deep-reviewed patents live-fetched & verified at generation time · 71 further hits listed from the search index (existence only, claims not analyzed). Relevance grades, overlap/distinguishing points and observations are AI reasoning over the fetched texts and may be wrong.

Cited fact	Status	Verify

US11941799B2	VERIFIED	open source ↗
US11954846B2	VERIFIED	open source ↗
US12243216B2	VERIFIED	open source ↗
US11051991B2	VERIFIED	open source ↗
US11892417B1	VERIFIED	open source ↗
US10632022B2	VERIFIED	open source ↗
US10957031B1	VERIFIED	open source ↗
US12183010B2	VERIFIED	open source ↗
US10504020B2	VERIFIED	open source ↗
US10983478B2	VERIFIED	open source ↗
US11256960B2	VERIFIED	open source ↗
US12094182B2	VERIFIED	open source ↗
US11650126B2	VERIFIED	open source ↗
US11893732B2	VERIFIED	open source ↗
US12182721B2	VERIFIED	open source ↗
US11754991B2	VERIFIED	open source ↗
WO2026077103A1	VERIFIED	open source ↗
CN109840900A	VERIFIED	open source ↗
CN115338134B	VERIFIED	open source ↗
CN119086555A	VERIFIED	open source ↗
CN121280775A	VERIFIED	open source ↗
CN105424718B	VERIFIED	open source ↗
CN119023577A	VERIFIED	open source ↗
CN119600032B	VERIFIED	open source ↗
CN113177924A	VERIFIED	open source ↗
CN121649140A	VERIFIED	open source ↗
CN114252452B	VERIFIED	open source ↗
CN118967672B	VERIFIED	open source ↗
CN118527377B	VERIFIED	open source ↗
CN111179250B	VERIFIED	open source ↗
CN117299581A	VERIFIED	open source ↗
CN106409711B	VERIFIED	open source ↗
EP2437706B1	VERIFIED	open source ↗

CN115769275A	**VERIFIED**	open source ↗
CN113538323A	**VERIFIED**	open source ↗
CN101980797A	**VERIFIED**	open source ↗
CN109239102B	**VERIFIED**	open source ↗
CN111929309B	**VERIFIED**	open source ↗
CN120790548A	**VERIFIED**	open source ↗
CN115236083A	**VERIFIED**	open source ↗

6. Automated QC & Audit Log

QC battery (qc-battery v1.2): PASSED — 11/11 machine checks.

Check	Result	Detail
features_min3	**PASS**	features=5
search_log_nonempty	**PASS**	queries=6
patents_in_search_set	**PASS**	every reviewed patent ⊆ search set
funnel_accounting	**PASS**	flagged=111 = deep=40 + claims_unavailable=6 + listed=65
stats_consistent	**PASS**	stats.deep=40 vs reviewed=40
deep_means_claims_reviewed	**PASS**	every deep-reviewed patent has actual claims text (no unfetched padding in the deep count)
nonzero_review	**PASS**	zero-review report is not deliverable
direction_rule_scan	**PASS**	wrong-direction distinguishing points in final report=0 required; gate removed 10 upstream
legal_status_coverage	**PASS**	structured legal status on 40/40 fetched patents (≥70% required — below that means the status parser broke)
verification_ran	**PASS**	verification ledger present
disclaimer_present	**PASS**	meta.disclaimer

Adversarial AI audit (claude-sonnet-5): verdict YELLOW — every reviewed patent's analysis was independently re-read against the actual claims text by a separate auditor agent instructed to refute it.

- 36 patent note(s) with minor issues — annotated

7. Legal Notice & Report Status

This report was produced by the Patti FTO Intro Scan engine (fto-intro v1, model claude-sonnet-5) on 2026-07-31T07:30:37.840Z.

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- Next step — take this report to a registered patent attorney before any filing, launch or investment decision. When you outgrow us, we'll tell you to hire a specialist firm.