Solution Brief

Machine Vision
Artificial Intelligence

Eigen Innovations Unlocks the Power of Machine Vision and AI to Improve Manufacturing Processes

Eigen Innovations partners with Intel to make machine vision solutions easier to design and deploy, enabling manufacturers to prevent issues in production lines.

About Eigen Innovations

The team at Eigen Innovations is shaping machine vision for the smart factory. Eigeneers help manufacturers from all industries reduce variation, eliminate uncertainty, and accelerate productivity with standardized, scalable, and flexible software.

In a nutshell, they enable manufacturers to unlock the full potential of machine vision beyond quality inspection. Their software and solutions make it easy to design and implement vision systems that collect quality and process intelligence on all products.

For their customers, that means traceability on every part and the ability to anticipate issues before they occur.

Increasing expectations for faster production requires better quality control technology to keep pace and prevent losses

Manufacturers are finding themselves caught between their customers' expectations that products be produced and shipped at rapid speed while also remaining to spec and competitively priced. These can seem to be opposing forces, as traditional batch-level quality testing means either slowing down production by allowing machine downtime during the test and calibration process or wasting input material by trying to calibrate based on quality control testing that was done while the machine continued to produce. If that quality control test failed to meet spec, then both the source batch and the batch produced during the test are not fit for sale, which can amount to an enormous, unnecessary expense.

To delight customers with a consistent product at a competitive price, manufacturers need to reduce variation across their manufacturing processes in a way that maintains quality control while also maximizing equipment uptime and minimizing waste.

To address this problem and a labor shortage, many manufacturers have turned to machine vision (MV) to help them spot and identify issues in products as they move through manufacturing processes. Firms that have adopted MV are reaping the benefits of increased profit margins compared to non-adopters[1], but challenges exist with machine vision as well.

While machine vision systems can be found in many factories, efficient deployment and integration with other data streams remain a challenge.

What is machine vision in manufacturing?

Machine vision technology gives operators and engineers the ability to "see" what is happening with their industrial equipment in real-time and use that information to inform their actions and decisions. Increasingly powerful edge computing capabilities, combined with a growing library of artificial intelligence (AI) deep learning models, are radically expanding what machine vision can do, especially in the manufacturing industry.

The most common uses of machine vision in manufacturing are visual inspection and defect detection, positioning and measuring parts, and identifying, sorting, and tracking products.

Quality assurance is a prime example of a visual inspection and defect detection use case for machine vision. When a computer receives an image, or a video stream of images, it is analyzed by machine vision software that has been trained on hundreds (or even thousands) of images of both pass and fail examples. This process enables computers to recognize very subtle differences like minuscule pattern mismatches in fabric or microscopic flaws in circuit boards.

Machine vision applied to manufacturing can improve product quality and overall system efficiency, increasing the throughput of manufacturing lines, reducing labor costs, and freeing up staff to focus on higher-value work.

Common challenges with machine vision implementation in manufacturing include:

Use case specificity: Deployments are often highly customized and hard to scale because they require customizations to meet the specific needs of the customer.

Lack of actionable information: The detection data from MV tools isn't always actionable— much of the data needed to detect the quality of a part (temperature, humidity, etc.) can't be captured solely by a camera. The number of variables in play makes it difficult for most machine vision cameras to contextualize and analyze the data they deliver. Additionally, simple MV solutions can only detect problems, not prevent them. When a defect is detected, they often cannot identify exactly where in the process the problem occurred, as they have limited insight into the many variables that affect product quality, such as temperature, pressure, or feed speed.

Siloed Solutions: Lack of integration between machine vision and process monitoring solutions often leads to process and quality variation going undetected. When these standalone solutions detect issues, they unlock a whole chain of investigations that operators must conduct to try to figure out what went wrong in their process—detracting time from other valuable activities and increasing downtime for the affected machine or production line.

To address these deficiencies and enable manufacturers to extract the full value of their MV solutions, the Eigen Innovations team leveraged Intel technologies to create a solution that overcomes these hurdles. Their suite of services and tools helps manufacturers unlock the value of image and process data to reduce or eliminate product variability across their machines, lines, and factories.

Eigen Innovations: Shifting MV in manufacturing from detection to prevention at scale

Using their novel software, Eigen Innovations solution engineers design a vision system specific to a customer's process that captures raw image data from cameras as well as process data from PLCs. This data is combined to create traceable, virtual profiles of the part being manufactured. The solution's cloud software analyzes digital records to identify trends and generate insights that operators and engineers can use to tweak processes and prevent issues from occurring, shifting problem-solving from detection to prevention. This kind of continuous improvement and calibration can significantly reduce the cost of quality by reducing waste and maximizing machine uptime.

The system is also standardized and scalable, capturing the same data across any machines making the same or similar parts. With this standardized data, manufacturers can improve decision-making across their factories, scaling both efficiency gains and cost savings.

How Eigen Innovations Works

First, using machine and product CADs, the Eigen team designs the vision system and engages vision integrators to deploy the hardware. Then Eigen software installed on edge processors merges and enhances image data to generate a singular, standardized image of each product produced.

Process data is ingested by the same edge processors and is mapped to each part image to create a "digital twin" – a traceable record that unlocks ongoing quality and process monitoring. Eigen software then generates and deploys machine learning models that monitor for defects and quality drift.

After these models are in place, factory teams customize Eigen's cloud software for reporting and analytics, with the ability to add machines and lines as the system is scaled. Eigen's vision software service then analyzes digital records to identify trends and generate insights, which operators and engineers can use to streamline troubleshooting and root cause investigations, overcome process drift, prevent defects, and drive process improvement.

Key Benefits of Eigen Innovations:

Improve quality control – Prevent variation and eliminate uncertainty about your products with traceability for every part

Move from detection to prevention – Merge image and process data streams to connect the dots between drifts in product quality and changes in process parameters, pinpointing what factors cause issues downstream

Improve overall processes – Collate information from all of your machines to get a full picture of your operations

Increase production revenue – Reduce downtime of your machines and reduce waste from defective products

Leverage vision expertise – Tap into the knowledge wealth of Eigen's experienced engineers to design and quickly deploy vision systems that can be scaled across your operations

Services and Software

Engineering Services

Eigeneers leverage proprietary software to design vision systems and then guide factory teams and integrators through deployment, integration, and scaling.

Solution Design & Deployment Software

Vision Twin: Design a vision system that details the types, quantities, and positions of sensors for an initial deployment to serve as a blueprint for all similar machines and lines.

Image Twin: Merge and standardize image data by generating one product image that yields the required view for all machines making similar parts or products

Product Twin: Generate interactive 3D replicas of each part that combine critical image and process data

Ops Software

FactoryOps: Access converged image and process data records across machines and factories. Generate actionable insights that go beyond detection.

VisionOps: Automate alerts and insights that empower factory teams to avoid problems before they arise.

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Eigen In Action

Eigen Machine Vision has been deployed to address a wide variety of manufacturing use cases.

### Injection Molding – B Pillars

There are a host of defects that can occur during the production of injection molded plastic parts and components. While some of these defects can be detected with conventional machine vision and manual inspection, the risk of "escape" persists and neither method provides context around why the defect occurred.

Before

Human inspectors had difficulty visually identifying short shots, splay, and rib read-through defects. Parts were moved to an inspection area with enhanced lighting to confirm if defects were present. This manual inspection was subjective and happened at the end of the process, forcing engineers to react to issues rather than prevent them during the process.

After

The Eigen team used their machine vision software to design a vision system to make surface defects such as rib read through, splay, and short shot clearly visible. An Eigen-deployed algorithm monitors the molding process to detect all three defects in real-time. Operators leverage Eigen's cloud software to gain insight into the process variation on the injection molding machine(s) and adjust parameters in real-time to prevent issues from occurring.
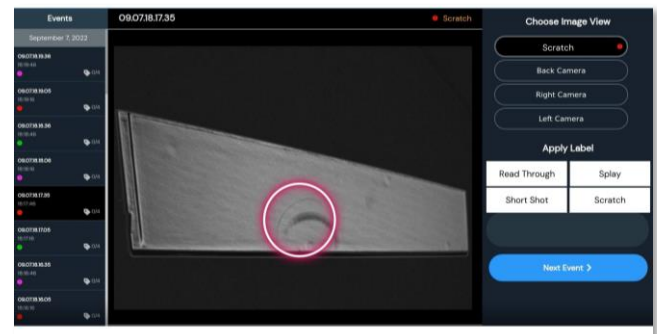
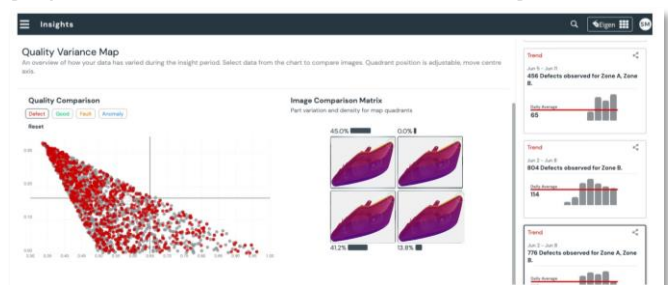### Plastics Welding – Automotive Lighting

Recent innovations and evolving styling and complexity have added massive value to automotive lighting. One manufacturer needed a high level of confidence in its welding processes to ensure it was meeting stringent OEM quality standards.

Before

The manufacturer experimented with various rules-based machine vision solutions that were inadequate for detecting process variation along the weld leg. Reliance on destructive testing meant data was only collected on destructed parts and left the manufacturer uncertain about the weld quality across all parts. Due to the increasing complexity of exterior lighting parts, a poor-quality weld could require the replacement of the entire assembly.

After

Using product and machine CADs, the Eigen team designed a system with multiple thermal cameras capturing views of each part during the welding process. Eigen's software generates a digital twin of the entire weld leg and process data ingested by the edge processors is correlated to each digital twin. Eigen-deployed machine learning models monitor critical process parameters along the weld leg and alert operators when issues are detected. Operators and engineers leverage insight and analytics from Eigen's cloud software to avoid issues, preventing parts with inadequate welds from moving beyond the weld cell and reducing the risk of defective parts from leaving the factory.

Eigen in action (continued)

Eigen Machine Vision has been deployed to address a wide variety of manufacturing use cases.

### Plastics Welding – Hermetic Seals

When it comes to safety-critical automotive parts, ensuring the integrity of welds is essential. One of the world's largest Tier 1 automotive manufacturers wanted to reduce their dependence on destructive testing and gain visibility to 100% of the welds on every product they produced.

Before

The manufacturer was removing several tanks from the line each shift for destructive, manual testing. This testing was highly subjective and meant that only lagging data from the tested tanks were being collected. The factory team had no easy way to correlate any detected quality issues back to the welding process.

After

The Eigen team designed and deployed a vision system that captures thermal images and correlating process data to generate a digital record of each inspected weld. Eigen-deployed machine learning models monitor variation in the welding process and flag inadequate welds with operators. Operators and engineers leverage insights and analytics to minimize process variation, minimizing the risk of parts with inadequate welds leaving their facilities. The manufacturer is scaling Eigen's vision system across its North American operations, giving operators and engineers greater confidence in the integrity of welds and the ability to leverage digital records and analytics to streamline troubleshooting and root cause investigations.
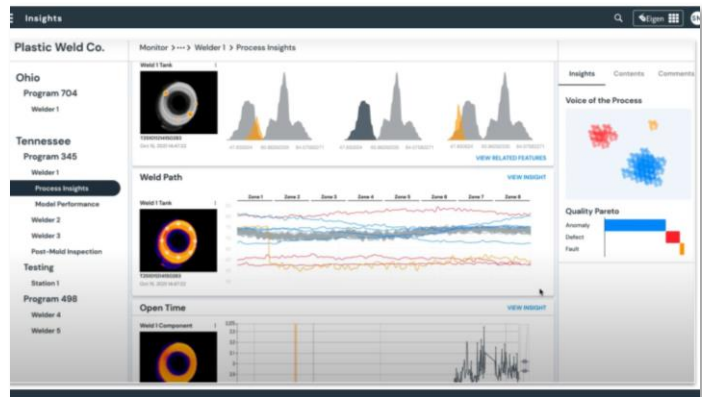
Paper and Packaging – Specialty Paper

Coating build-up during specialty paper production happens quickly, leading to quality issues and costly equipment damage. One leading manufacturer needed a machine vision platform that could quickly detect and respond before minor issues turned into significant problems.

Before

The manufacturer was unable to detect subtle changes in sheet characteristics. The coating could build up in under 10 seconds, making it impossible for an operator to react in real-time. Machines experienced dozens of events per year, resulting in damage and unnecessary downtime.

After

The Eigen team designed a vision system that delivered a real-time detection algorithm based on image and process data and operator input. The vision system is connected directly to the machine's programmable logic controller, opening machines upon streak detection. The Eigen team estimates that this saved the company up to $1M per year.

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Eigen Innovations leverages the capabilities of Intel® technology to deliver optimized performance

The Eigen Innovations solution uses high-performing Intel processors for versatility on the factory floor. **Intel® Core™ processors** deliver advanced responsiveness, connectivity, and graphics performance. Seated in fanless, ruggedized industrial gateways, these processors deliver powerful compute capabilities and can be trusted to perform in harsh manufacturing environments.

Eigen's machine vision solution utilizes these Intel-powered edge devices, optimized using the **Intel® Distribution of OpenVINO™ Toolkit,** to ingest image data from camera sensors and process data from machines and PLCs. Using the Intel® Distribution of OpenVINO™ Toolkit enables Eigen to provide the right hardware at the right cost to meet customer requirements.

The high-performance, deep learning inference toolkit provides a full suite of development and deployment tools. The toolkit offers deep-learning models, device portability, and higher inferencing capabilities to offer minimal disruption and maximum performance and enables developers to quickly build, optimize, and scale AI-based computer vision models.
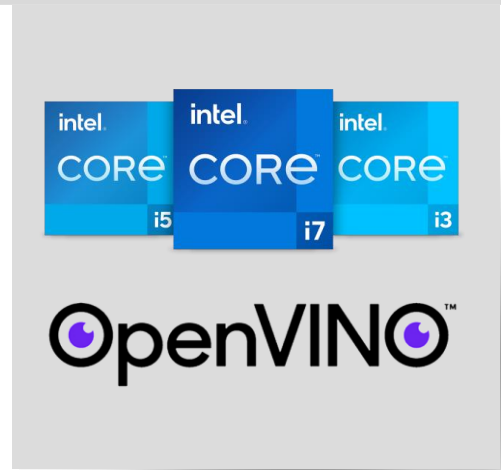
Conclusion

Eigen Innovations helps manufacturers from all industries reduce variation, eliminate uncertainty, and accelerate productivity with standardized, scalable, and flexible software. The company's services and software make it easy to design and implement vision systems that collect quality and process intelligence on all products, helping manufacturers unlock the full potential of machine vision beyond quality inspection.

Learn More

Eigen Innovations Website

Technology Brief: Moving Machine Vision from Inspection to Prevention

Intel® Distribution of OpenVINO™ Toolkit Product Page

Intel® Core™ Processors Product Page

> "
> *The Eigen System has provided us with an extra set of eyes into our process to help us better understand variation and risk. We call it the voice of the process.*
> – Engineering Manager
> T1 Automotive Supplier
> "

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Sources
1.   Sensors International, Exploring impact and features of machine vision for progressive industry 4.0 culture, 2022