Objective, Fully Automated Optical Pallet Classification

Hybrid sensor technology enables objective and precise inspection of pallets.

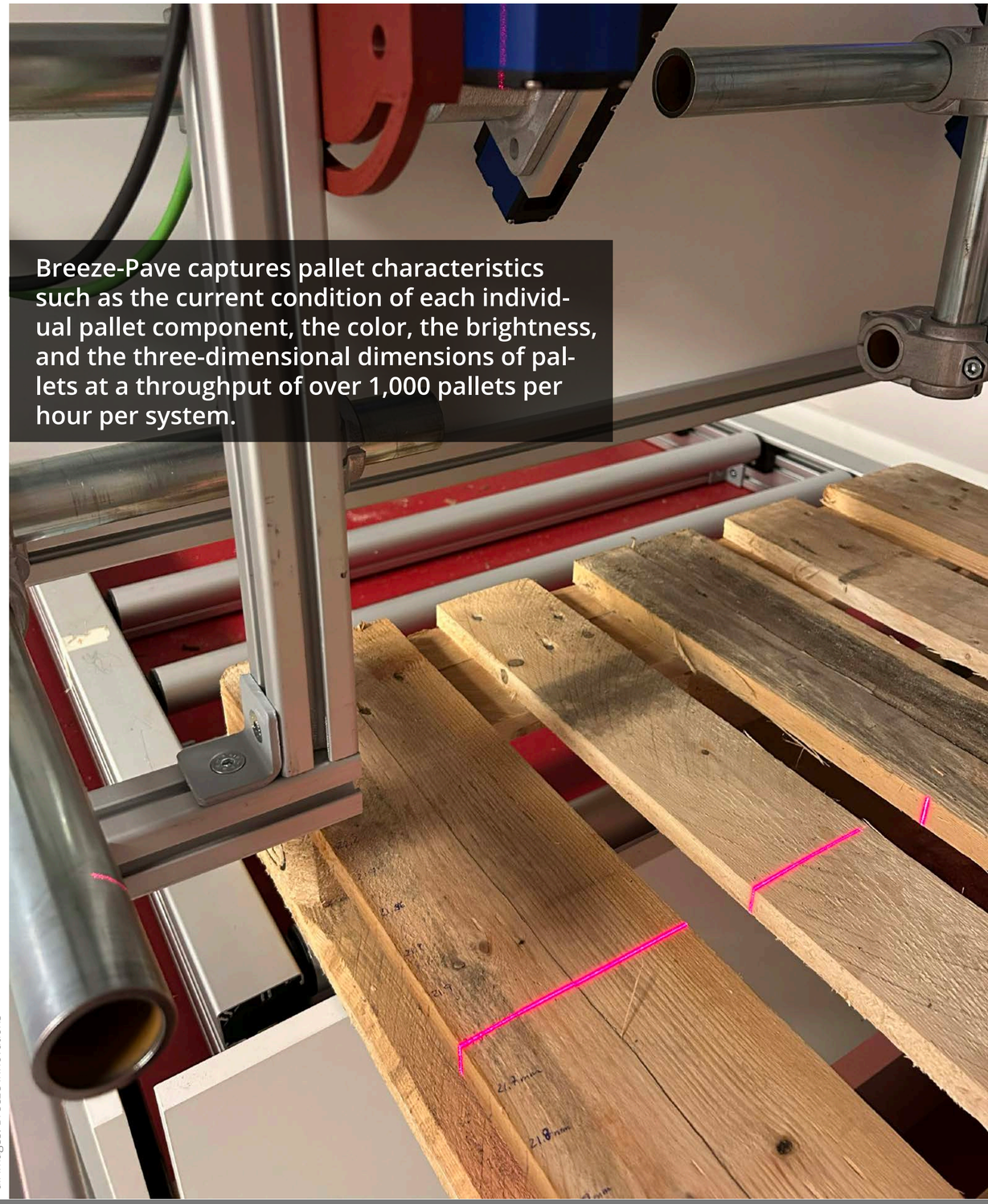
An automated system for inspecting load carriers replaces manual evaluation with fast, objective, and reproducible classification. Through 360-degree detection, digital evaluation, and flexible parameterization, quality, throughput, and transparency in logistics processes are significantly improved.

Pallets form the backbone of logistics, enabling the transport of goods worldwide in countless processes. Over the course of their life cycle, they often travel hundreds of thousands of kilometers and carry heavy loads — wear and tear is therefore unavoidable. The consequences of damaged pallets can vary greatly depending on the severity of the damage: protruding parts, the possible collapse of loads, or impaired machine capability and transport safety due to severely damaged pallets are risks that can cause major disruptions to logistics processes, complete operational shutdowns, or transport damage. Damage to goods may also lead customers to refuse acceptance. Logistics companies naturally want to avoid financial losses, such as potential penalties, scrap, or costly repairs, wherever possible.

Avoid manually checking empty pallets

For this reason, empty pallets are repeatedly inspected during pallet exchange — however, this is usually done manually, explains Dr. Michael Kleinkes, one of the founders and Managing Director of breeze innovations GmbH based in Haltern am See: “These inspections are physically demanding and often subjective, which frequently leads to discussions during the handover of inspected and classified empty pallets.”

Kleinkes and his partner wanted to fundamentally change this situation. “Our goal was to develop a classification system that allows the condition



Breeze-Pave captures pallet characteristics such as the current condition of each individual pallet component, the color, the brightness, and the three-dimensional dimensions of pallets at a throughput of over 1,000 pallets per hour per system.

all images: Breeze Innovations

Data capture via laser scanner produces a digital twin that serves as the basis for evaluating the scanned pallet.

of pallets to be assessed fully automatically, fast, reliably, reproducibly, and above all objectively, with minimal effort," says Kleinkes. With breeze-PAVE, such a solution is now available to the pallet market.

Capture all relevant characteristics using hybrid sensor technology

The system makes it possible to capture key pallet characteristics including the condition of each individual pallet component, color, brightness, and 3D dimensions, thus enabling the best possible assessment of pallet quality. The reliable classification of both color and brightness is extremely important: many pooling companies mark their own pallet inventory with a dedicated color to distinguish them more easily from rental pallets operated by competitors. Brightness detection plays a key role in the classification of exchange pallets. When checking component dimensions — deck boards, stringer boards, cross boards, and blocks — breeze-PAVE detects whether these elements comply with the specified geometric dimensions and required positions. If they do not, the corresponding areas are marked, and the pallet's quality rating is downgraded.

Breeze relies on a multi-sensor system for data acquisition, explains Kleinkes: "Pallets are scanned by breeze-PAVE in motion from all directions: top, bottom, sides, front, and rear using multiple laser sensors, while brightness is checked simultaneously. This combination allows us to achieve complete 360-degree scanning of the real objects, providing a solid basis for assessing the condition of the new and used pallets being inspected." The system also reliably detects chemical residues and contamination such as oil, paint, or adhering cardboard.

Automatic classification of inspected pallets according to individual specifications

From the captured information, a digital twin is created, which breeze-PAVE then analyzes in detail using software. In this step, deviations from predefined quality characteristics are automatically detected, the pallet is classified, and clearly classified into quality grades A, B, C, or "defective." The evaluation profiles can be flexibly adapted to the user's specifications and cover both common load carrier standards such as EPAL, as well as individual, customer-specific requirements.

"In addition, the software enables users to achieve customer-specific pallet classification using configurable parameter sets that are independent of common standards," explains Kleinkes. "This has the advantage that individual profiles can be created for any customer and selected at the push of a button in the software. This makes it possible to meet customer requirements in the best possible way."

Over 1,000 pallets per hour

Compared to manual pallet inspection, breeze-PAVE offers a range of advantages. The most important feature of the system is the objectivity of the automated process, which significantly increases process reliability. Another major advantage is the system's exceptional accuracy and speed: during operation, it captures several million 3D measurement points per pallet without impacting cycle time, evaluates them in less than one second, and detects not only obvious damage but even the smallest deviations.

Two Questions, Two Answers

inspect: For which companies is the inspection system best suited?
Dr. Michael Kleinkes: As a pallet classification system, it is suitable for manufacturers who use it for quality assurance, as well as for all pool operators, dealers, or repairers. Pool operators can use it to achieve a more consistent classification and thus higher quality, while dealers can perform customer-specific classifications and thereby increase their margins.

In addition to pure geometric inspection, however, the system also enables a detailed analysis of surface and material properties. Damage, deformations, contour deviations, and contamination are reliably detected and can be automatically classified. This makes the system suitable not only for incoming goods inspections but also for inline quality controls in production or logistics processes.

In general, it can be said that the system is particularly advantageous for applications where products must be captured and inspected in a continuous flow.

inspect: How high does the pallet throughput need to be for the system to be economically viable?
Kleinkes: The system is viable even at low throughput, as it offers the following benefits:

Human factor: Employees are significantly relieved of tedious and monotonous work. With appropriate preparation (removal of waste and extraction of scrap), human labor can be completely eliminated.

Objectivity and consistency: Classification is objectively based on the currently active parameters and remains consistent. This enables a more accurate classification by type than with humans, who have a higher error rate.

Adjustable: The criteria used for classification are defined as parameter sets and can be changed from batch to batch with a single mouse click. This allows the system to classify in a highly variable manner while remaining consistent within the current parameter settings. This is very difficult to achieve with human operators.

Speed: The system evaluates a pallet in well under a second, which opens up the possibility of increasing pallet throughput.

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Dr. Michael Kleinkes, CEO of Breeze: “With this system, we can digitize practically anything from reusable drinking cups to large objects and detect any type of geometric shape or positional deviation on any object.”