# Application Report

## 3D position detection over a wide measurement range

***Light-section sensors in rails of a robot application for door manufacturing***

**In the automated handling there are processes where objects have to be detected, located and gripped correctly. Leuze electronic has deliberately designed its LPS series light-section sensors for a large measurement range of 200 to 800 mm to be able to determine 3D gripping positions even for large-sized products. The compact structure of the LPS sensors enables the integration directly into the grippers. This is the ideal solution for robot applications at special-purpose machinery manufacturer G. Kraft Maschinenbau.**

As a 6th generation family-owned enterprise, G. Kraft Maschinenbau GmbH is based in Rietberg-Mastholte, Westphalia. It manufactures special-purpose machines for the wood processing industry and the production of radiators, wooden flooring, sandwich panels, packaging, doors and frames. The TCF 70 is a CNC machine that embeds fittings into doors and automatically installs the hinges. The entire processing takes place at just one station: a slider-controller carrier permits arbitrary machining of the entire door length.

**The door manufacturing process**

The unmachined doors are stacked on a roller conveyor (Figure 1). As the doors may be stacked manually, a displacement in position by ±100 mm and a twist angle of ±10° are permitted for handling. A robot scans the geometry of the door stack using a special module rail by G. Kraft Maschinenbau with an integrated sensor. From this data, twist angle and door center are computed. This lets the robot grab the doors at the correct position and deposit them into the CNC fitting embedder TCF 70 (Figure 2). After the first processing step, the robot grabs the door again, turns it by 180° and puts it back down so that the other side can be machined in the TCF 70. After completion, the door is placed on a roller conveyor.

Often, the stacked doors are not all of the same model, i.e., they do not have the same dimensions. They may not lie exactly on top of each other. Also, the stack decreases in height each time a door is grabbed. This means that the robot needs an intelligent position detection system for grabbing. "The robot must see within a short distance and position itself within just a few millimeters. The LPS light-section sensor is exactly the right product for this purpose," says Berthold Sudahl, head of the robotics department at G. Kraft Maschinenbau.

**Line profile sensors determine the position**

Line profile sensors (LPS) measure the dimensions or the position of static or moving objects. For these light-section sensors, Leuze electronic has selected a measurement range of 200 to 800 mm to cover a large area of applications that previously required over-dimensioned sensor solutions due to the lack of alternatives. The LPS light-section sensors are used wherever products are on a pallet or have a large variation in position, such as for example cartons in a box. With the dimensions selected, the distance between transmitter and receiver can be kept small. In the LPS 36, both of them are integrated into a single unit and are already adjusted (Figure 3).

In addition to its 160 × 74 × 56 mm compact construction (Figure 4), the LPS 36 is characterized by a response time of 10 ms, a 600 mm laser line at 800 mm distance and an Ethernet interface. With a 100 Hz measurement rate the sensor attains a resolution of 1 to 3 mm. "For the control it is a big advantage that the X-Z coordinates are already output in millimeters via Ethernet and don't have to be converted," says Berthold Sudahl about the calibrated measurement system. Furthermore, the sensor is equipped with an OLED display and a key pad. Its typical application areas include container commissioning, grabber control, measurement of surfaces of arbitrary shape and the 3D measurement of moving objects.

**Measuring according to the triangulation**

Leuze electronic's light-section sensor works on the triangulation principle (Figure 5). To detect the 2D profile data, a laser beam is expanded to a line and aimed at a measurement object. A position-sensitive area detector detects the light remitted by the object. As the position onto which the laser line maps on the area detector depends on the distance of the measurement object, 3D profile data result along the laser line. The optionally available encoder interface enables the synchronization of the measurement data acquisition with an object motion in Y direction. This permits the determination of the position and size of objects on a conveying belt (Figure 6).

**Advantages in the door production process**

"The LPS light-section sensor offers a lot of benefits especially for door manufacturing systems," Berthold Sudahl says. The sensor does not have any moving parts and its compact size - the smallest on the market - permits easy installation on the robot's grabber. "Since the robot knows the predominant location of the doors and both stacking surface and doors are level, we don't need a 3D scan as, for example, in the case of boxes from which something needs to be grabbed. A single shot directed at the corners of the

doors suffices for this application and also reduces the amount of data significantly," says Berthold Sudahl, explaining the reason for and benefit of the single shot operation.

Another positive aspect of Leuze's LPS light-section sensor is that the user can switch the visible laser line off. This is always sensible when there is no task at hand. However, when aligning the system the line must be visible. The alignment (Figure 7) is additionally simplified by the display. Like a bubble level, it shows three measurement values: left, center, right. "Center" in this context is the line on the level surface, i.e., the door. The values for left and right must also be in this plane. A tilt of the sensor would require a coordinate transform of the measurement values in process control. The integrated alignment aid on the display renders this step surplus to requirements.

## *Figures and captions*

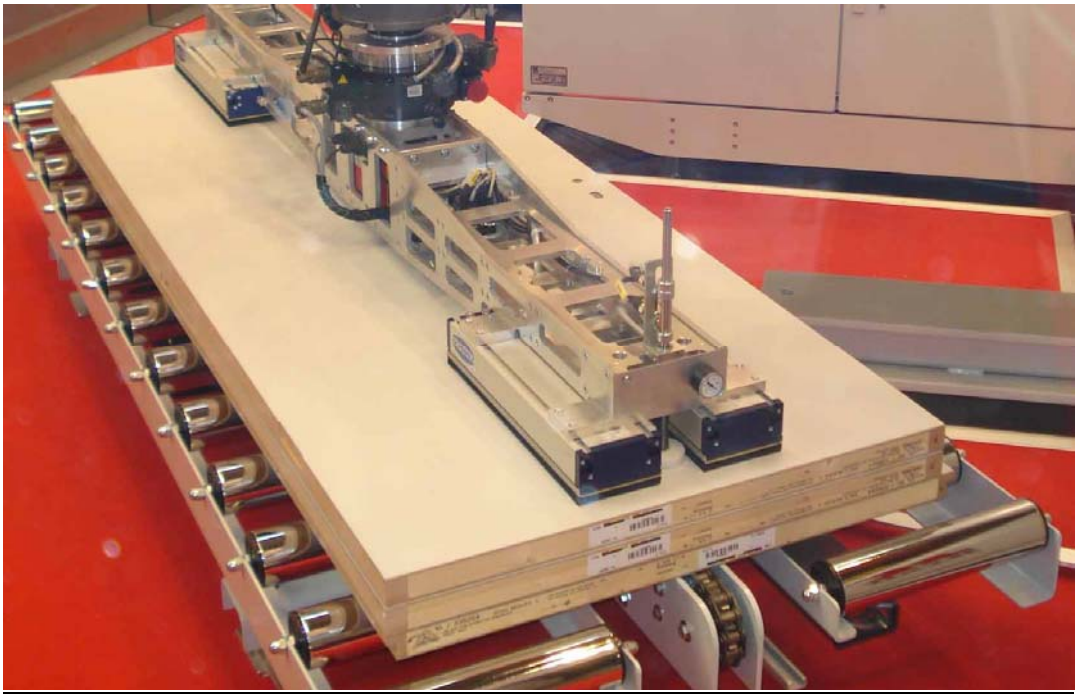

**Figure 1.** The hand-stacked doors exhibit a position offset which must be captured by the sensor.

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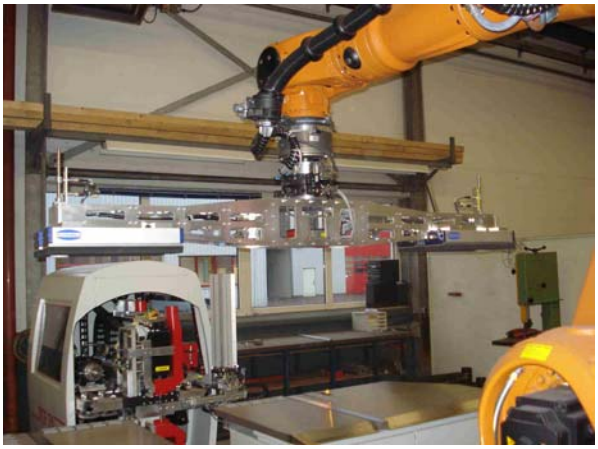

**Figure 2.** Robot feed system with automatic tool changer and vacuum suction rail with integrated light-section sensor LPS 36.

**Figure 3.** Transmitter and receiver are accommodated in a single unit in the LPS 36 light-section sensor and are thus already adjusted.

**Figure 4.** The LPS light-section sensors from Leuze electronic are characterized by their compact construction.

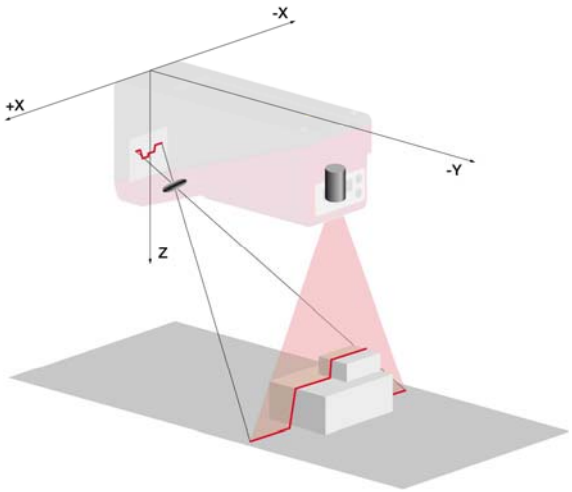


**Figure 5.** The light-section sensor includes a laser with beam widening optics as transmitter, a CMOS area detector and receiver optics.

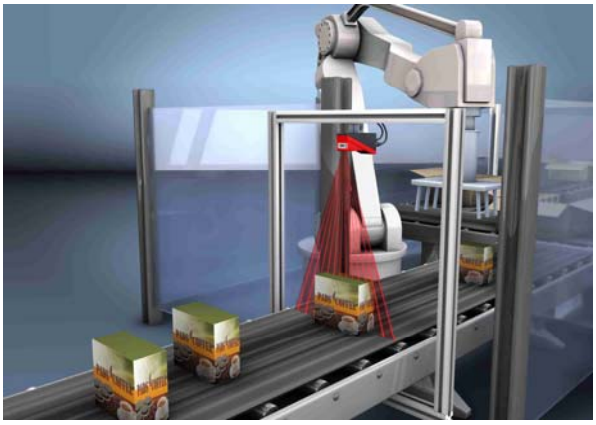

**Figure 6.** In this grabber control, the 3D data of the parts on the moving conveyor can be captured with the LPS sensor.

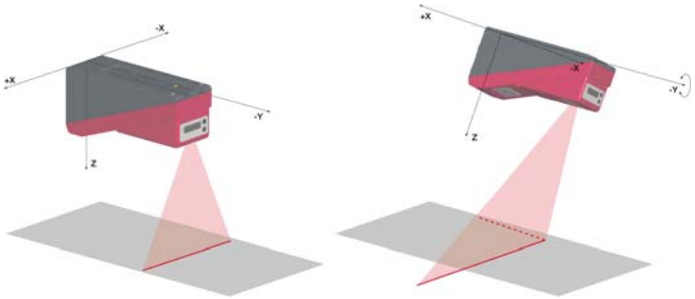

**Figure 7.** A rotation of the sensor about the y-axis distorts the entire coordinate system. The correct alignment of the sensor via its own display saves the coordinate transform in the process control that would otherwise be necessary.

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