Technical Report

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Long-range vision

Compact laser distance sensor measures objects in all colors up to 4m away

High-precision measurements of distant objects with guaranteed color independency over the entire measuring range is a tough challenge. Yet the new OADM 250 laser distance sensor from Baumer masters this difficult task. It measures objects in all colors – even black – with constant reliability over a measuring range of up to 4 meters. To meet these taxing demands, Baumer developed the sensor by blending the two known runtime measurement techniques. It combined the strengths of both methods to achieve even more reliable, fault-free measurements. Baumer engineers topped this feat by successfully fitting their technology into an extremely compact housing. The sensor is therefore a compact, precise solution even for considerable distances.

Laser triangulation sensors have already been established for several years as a reliable solution for highly exact measurements over distances of up to approx. one meter. However, equally precise measurements over greater distances of up to 4 m have remained a challenge. Yet high-precision sensors for such distances are increasingly required in many applications.

Sensors with a measuring range that covers the full depth of shelf compartments in small automated storage systems, for instance in pharmacies, are required to reliably detect empty and occupied shelf surfaces. Another complication is that some of the stored objects are very small and variously colored, so that accurate measurements depend on a sensor with a small measuring spot that functions with the greatest possible color independency. Moreover, a key purpose of this application is to raise throughput. The storage area must therefore be maximized, leaving very little space for sensors. To boost the efficiency of the system by avoiding malfunctions and downtimes, the application demands a compact sensor which can measure even small, varicolored objects reliably over considerable distances.

Similar demands are raised by package positioning in conveyor systems, where packages in different sizes and colors must be identified. The high speed at which the packages are transported on conveyor belts is an additional challenge. The employed sensor must therefore measure both very accurately and extremely quickly.

High speeds and virtually complete color independency combined with a long measuring range are also required in the printing industry. High-speed printing calls for sensors which can reliably identify the diameter of sometimes very large paper rolls in any color very rapidly.

Based on runtime technology, the OADM 250 laser distance sensor from Baumer is a new compact solution for these tasks. The miniature sensor is the smallest in its class. This makes it very easy to integrate into automated storage systems, where its measuring range of up to 4 m enables it to cover the entire depth of the store compartments without being moved or reconfigured. (Figure 5) In addition, it is guaranteed to function with complete color independency and recognize even small objects by virtue of its small measuring spot. Despite its high precision, the sensor has a very short response time of only 10 ms and therefore also meets the requirements of conveyor systems. (Figure 4)

Thanks to its color independency and high precision, the sensor is also an excellent choice for printing industry or packaging applications. Besides detecting paper roll diameters (Figure 3), it can also be used to monitor paper-web sagging and measure stack levels. The OADM 250 masters the high printing speeds with the required precision and reliably registers varicolored paper webs without additional parameterization.

Besides pure distance measuring, the OADM 250 is also used to determine, relocate or redetect positions, tolerances and limits. Areas of application include handling systems, for example. The sensor’s color independency, compact design and small laser spot benefit handling tasks such as positioning metal components for a welding robot or positioning automobile seats on an assembly line.

Combined strengths, minimized problems

The system chosen by Baumer for the OADM 250 laser sensor is a mixture of the two known runtime measurement techniques: pulse-runtime and phase-shift determination (see box text). Care was taken to avoid the respective drawbacks of the two techniques and combine their strong points. To ensure disturbance-free measurements, developers opted for pulsed light and immediately digitalized the received signal for secure further processing. This gave the sensor a short measuring rate of 10 ms. Interaction between a repeatability of +/- 5 mm, a linearity of +/- 20 mm and the measuring rate enables even moving objects to be measured precisely.

Besides fault-free operation, the combination of known techniques ensures high sensitivity and therefore allows even poorly reflecting objects to be measured at considerable distances. In addition, the immediate digitalization of received signals creates new scope for fading out soft targets such as dust, vapor etc.

Color-independent, compact, robust, easy to use

The sensor was specially optimized to function regardless of colors. It therefore achieves a measuring range of 4 m – for objects of any color. Users can therefore rely on the sensor to measure even dark objects accurately throughout its entire range.

The OADM 250 is very compact despite its long range. Its housing size of only 66 x 51 x 25 mm makes it up to 40 % smaller than other sensors of its class. It can consequently be easily and quickly integrated into a system design and can also be flexibly retrofitted. A further advantage is the robustness of its metal housing, which has no vulnerable LCD displays or small, sensitive buttons. These special features give the sensor a high MTBF (MeanTime Between Failures). Its robust metal housing, wipe-off glass pane and high IP 67 protection class ensure long life even under rugged industrial conditions.

An integrated alarm output is a standard feature of the OADM 250. The sensor uses this to report that received signals are too weak or it finds no object within its measuring range. This warns the user of soiling or objects which reflect too poorly, thereby helping to increase process reliability. In addition, a so-called trigger sensor is not required because the OADM 250 itself recognizes whether there are objects in its measuring range.

If necessary, Baumer's standardized, very easy 2-point teach-in procedure can be used to limit the measuring range. Its extremely easy operation speeds up commissioning and saves costs.

Great potential

The OADM 250 with its runtime technology is a laser sensor with great potential. Its very compact housing and powerful performance present new opportunities to measure over considerable distances even when installed in cramped spaces. It therefore optimally complements the wide spectrum of powerful Baumer laser distance sensors.

Box text:

Runtime technology: time-of-flight

Runtime (also known as time-of-flight) measurement is an indirect distance-measurement technique based on the time it takes a signal to traverse the measuring distance. In practice, a transmitter sends a signal packet (sound or light) which is reflected by the object and received by the receiver. The sensor evaluates the runtime and/or phase shift and converts it into a measured distance. (Fig. 2)

In pulse-runtime measurement, a single measuring pulse is transmitted. This triggers a counter in the sensor which is stopped when the returning pulse is received. The counter reading, and therefore the runtime, equates to double the distance to the object. Wide-bandbreadth amplifiers are needed for good reception of the short, steep-flanked pulses. Such amplifiers are costly and result in a reduced

signal-to-noise ratio. However, a good signal-to-noise ratio is an absolute must for precise measurements.

The phase-shift technique works by transmitting a continuous sinus signal instead of a signal pulse. The runtime causes a phase shift. The sensor compares the transmitted and received waves and uses this to deduce the distance to the object. However, the continuous signal transmission makes this technique prone to disturbances. Multiple measuring frequencies are needed to achieve high measuring accuracy, which increases the cost and effort expenditure. Moreover, measurements are also impaired by soft targets like dust, rain, spray or fog.

Number of characters including spaces: approx. 8'500 characters

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