Application report:

Measuring Sensors for Regulating Complex Industrial Automation Processes

Industrial equipment operators are constantly seeking ways to improve precision in the regulation of their automated processes. This in turn leads to more complex automation solutions, coupled with a need for increasingly detailed information related to every process state. Here, contactless measuring sensors provide a solution, as one sensor can provide a variety of information. A single sensor can detect a range of object positions, position changes, speeds and directions, and make this information available to the controller. With its broad standard portfolio of measuring sensors utilizing a wide range of technologies, Baumer can offer solutions for the most varied needs.

Fig. 1: A large standard portfolio of measuring sensors

The need for more precise regulation of automated processes and the associated increase in the complexity of the information required for this regulation run through every area of industrial automation, regardless of the materials, tasks, demands and environmental conditions involved. This diversity can best be illustrated by a few examples of specific applications.

Continuous Monitoring of Distances and Widths

One of the most common applications for sensors is the measurement of distances. Continuous detection of the distance to an object can also be used for measurements related to thickness or volume. For example, such a system can be employed in the manufacture of pharmaceutical products to detect the thickness of pills. In the packaging industry, measuring sensors are used to monitor stack heights or to regulate sagging. A further possible application is the precise positioning of objects on conveyor belts.

Photoelectric sensors are frequently employed for applications like these. Their measurement speeds and accuracy are both high, and their measurements are generally not affected by the nature of the materials being detected. Narrow light beams are particularly useful for applications in the handling industry, where sensors confined in very tight spaces must peer past numerous moving arms. Here, Baumer can offer a variety of sensors employing red light or lasers as a light source and covering a broad spectrum of accuracy levels and distances.

Fig. 2: Using photoelectric sensors to measure stack height in the printing or packaging industry

In the field of mechanical engineering, distance measurements often involve the detection of metal objects or machine components. For example, the thread tension of an automated loom is continuously monitored via the metal dancer to ensure the quality of the cloth and to avoid machine downtime due to thread breaks.

Inductive sensors are a clear choice for measuring tasks involving metallic targets. Their short response times and high levels of linearity and resolution enable very precise regulation. Baumer offers a variety of measuring inductive sensors which can be employed as a contactless measuring system.

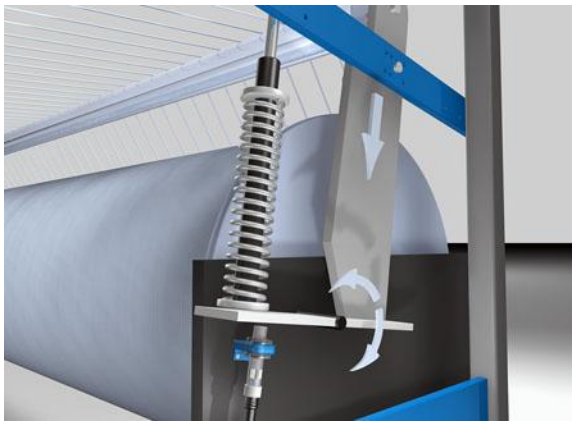

Fig. 3: Using measuring inductive sensors to control thread tension on an automated loom

For quality control purposes, wire or cable widths must be determined during production. Width measurements can also be used to regulate band edges precisely, as for example during feed operations in the textile, print or packaging industries. The precise positioning of packaging material is especially important during packing processes where the quality of the packaging reflects upon the quality of the product.

Baumer's line sensors present a solution for direct width measurement. These sensors quickly and precisely measure in a lateral direction and are also able to detect transparent objects.

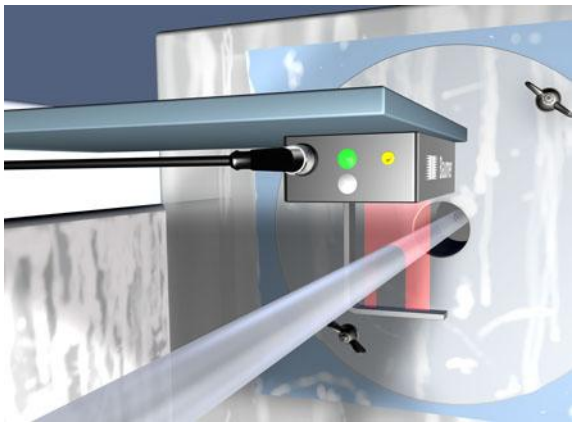

Fig. 4: Using line sensors to measure wire and cable widths for quality control purposes

Monitoring Fill Levels and Angles

Filling packages or containers with foodstuffs or cosmetics is yet another task that requires continuous monitoring in order to ensure a consistent level of quality. For these applications, a predefined fill weight must be accurately maintained. Sensors can also monitor fill levels for a variety of media in automated laboratory equipment where the sensors must be able to "peer" into small containers such as test tubes.

Here, ultrasonic sensors provide a reliable solution for contactless fill level measurement. These sensors can detect both solid and liquid media regardless of reflections, transparency levels or the materials involved. Baumer also offers a number of ultrasonic sensors with small sonic cones for the detection of particularly small objects or for "peering" into very small containers.

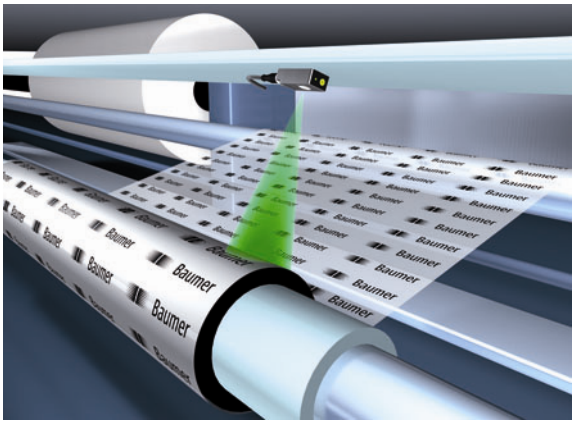

Fig. 5: Using measuring ultrasonic sensors to detect the diameter of a roll of sheeting

Angular measurement represents a particularly sensitive area. Wherever machinery is in motion, these movements must be precisely monitored. In the case of industrial equipment such as front end loaders or cranes, the rotation and tilt angles of buckets or beams are continuously monitored to ensure operational safety. Baumer's magnetic rotary encoders are ideal for these applications as they can detect angles around a full 360° absolutely with no dead zones. In addition, they can also control the inclination angle of dump truck loading equipment or regulate the movement of solar panels.

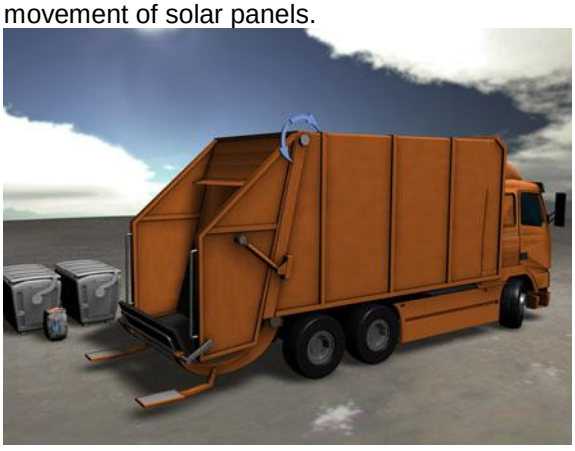

Fig. 6: Using magnetic rotary encoders to control the inclination angle of dump truck loading equipment

High Precision Measuring

Baumer emphasizes precision across its entire standard portfolio of measuring sensors. This results in highly accurate and reproducible measurements from temperature-stable sensors. For example, the OADM 12 photoelectric laser distance sensor provides measurements with a resolution of 2 µm. In the area of ultrasonic measurements, Baumer offers the UNDK 09 sensor with its special beam columnator. When measuring small objects or "peering" into small openings, this sensor achieves a resolution of 0.1 mm, which represents a volume resolution of up to 1 µl. Baumer's IPRM 12 inductive sensors provide a particularly high resolution level of up to 4 nm. For many applications, three different solutions are available – high resolution at high levels of linearity or for large measurement ranges, or a large measurement range with low temperature drift. For users this commitment to consistent high precision means high sensor reliability in every application.

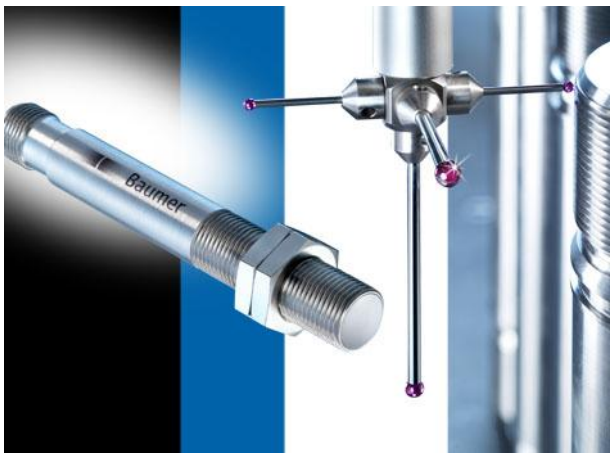

Fig. 7: High precision inductive measuring sensor offering 4 nm resolution

Powerful Standard Sensors

Alongside precision, Baumer's measuring sensors also stand out for their general high performance and their ability to provide solutions for a range of demanding applications. As a result, Baumer sensors can rightly claim to be unparalleled in their class.

Examples of these "best in class" sensors can be found in a wide variety of technologies. The thumbnail-sized metal housing of the IWFM 08 inductive sensor contains the unit's entire electronics. With a response time of < 1 ms and a resolution of < 1 µm, this sensor represents a very reliable solution, for example, for precisely measuring the eccentricity of shafts. Among photoelectric sensors, the OADM 13 is one of the smallest laser distance sensors with integrated processing electronics on today's market. Regardless of the color or the material involved, the sensor can measure with a resolution of up to 10 µm over distances up to 550 mm, and its response time for this task is less than 0.9 ms. This sensor is therefore particularly suitable for high precision positioning tasks or profile measurements. The UNDK 10 ultrasonic sensor is the smallest and lightest (4 g) sensor of its kind available in today's market. Its very narrow sonic beam angle permits fill level measurements of containers with small openings as well as measurements of very small objects – all this at measuring distances up to 200 mm.

Fig. 8: Powerful distance measuring miniature sensors

In addition, Baumer's comprehensive development know-how enables it to offer the types of rugged sensors that are increasingly in demand today. For example, sensors with an extended operating temperature range from -40 to +85 °C are especially well suited to outdoor applications, such as in wind turbines or on heavy-duty vehicles. They also introduced the first photoelectric sensors in hygienic design to the market.

Multiple Applications – a Single Partner

Applications in which increasingly complex processes must be regulated with ever greater precision are manifold. They can be found in an ever-increasing range of industries and machinery, and in both indoor and outdoor environments. Thanks to its considerable

development and production expertise, Baumer can offer a comprehensive portfolio of standard sensors for these wide-ranging applications. The firm strives continuously to improve its product range, and employs a staff of trained consultants to provide the best possible assistance to its customers.