Using inductive proximity sensors in rotational speed monitoring

In today’s industrial environments, there is rarely a process which is not monitored. Rotational speed monitoring takes place in many processes to monitor direction, speed and coordination. Many different technologies are used as input sources for rotational speed monitors, including inductive proximity sensors, photoelectric sensors, resolvers, encoders and tachometer generators. These devices are used to sense the pulse and/or direction of rotation or a series of rotating targets. The more coordination involved in the processes, the higher the overall production output. Unlike tachometer generators and conventional rotational pulse generators, proximity sensors require no physical connection to the driving element to perform motion detection. In most cases, the speed of rotating machine parts such as shafts, gears, cams, etc. is monitored directly so that special or additional control elements or actuators are not necessary. The measuring time is dependent on the digital input pulse train. The more input pulses per rotation, the shorter the measuring time.

When applying inductive sensors, the gap or air space between targets must be greater than or equal to the diameter of an embeddable proximity sensor.

**Tooth and gap widths: guidelines**

For embedable sensors:

\[ M \geq (3 \times S_n)^* \]  

For non-embedable sensors:

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\[ M \geq (3 \times S_n)^* \]  

For high speed applications, the sensor response time must be included in the calculations:

For embedable sensors:

\[ M = \frac{N \times d \times \pi \times T + D}{60 \, 000} \]  

For non-embedable sensors:

\[ M = \frac{N \times d \times \pi \times T + (3 \times S_n)^*}{60 \, 000} \]  

* Replace \((3 \times S_n)^*\) with \(D\) when \((3 \times S_n) < D\)

where:

- \(D\) = Diameter of proximity sensor (mm)
- \(M\) = Tooth/gap width (mm)
- \(d\) = Diameter of disc (mm)
- \(H\) = Tooth depth
  - Axial mounting \(H \geq D\)
  - Radial mounting \(2 \times S_n\)
- \(N\) = Maximum rotational speed or object (rpm)
- \(B\) = Thickness of disc
  - Axial mounting 1 mm minimum
  - Radial mounting: \(B \geq D\)

*Fig. 1: Guidelines for tooth and gap widths.*
Rotational speed monitors count pulses, but some are also designed to relay overspeed/underspeed conditions to control equipment. Overspeed monitoring gauges measure whether the pulses have exceeded certain parameters, e.g. monitoring a motor-driven belt. If the belt breaks, the motor subsequently runs faster due to an absence of torque against the load; the increased speed is detected by overspeed monitoring and, in turn, shuts down the system.

Underspeed monitoring occurs when parameters for safe point detection are implemented, e.g. in the detection and shutdown of a particular system. These methods protect against belt breakage, conveyor slippage and conveyor jamming among others, and aid in the overall synchronisation of the process.

In addition to monitoring pulses and direction, inductive proximity sensors are also used for directional discrimination where two sensors are used to determine the forward and reverse direction of a system. It obtains the direction of rotation by evaluating the sequence and by simultaneous damping (trigger) of both sensors for at least one millisecond.

Non-contact proximity sensors provide the user with many benefits in these applications as opposed to implementing encoders or tachometer generators. Since the sensor is not in contact with the application, it can be replaced quickly, with practically no maintenance, therefore causing less overall downtime – even if the process must be stopped.

Contact Rodney Topham,
RET Automation Controls,
Tel 011 453-2468,
rodney.topham@retautomation.com