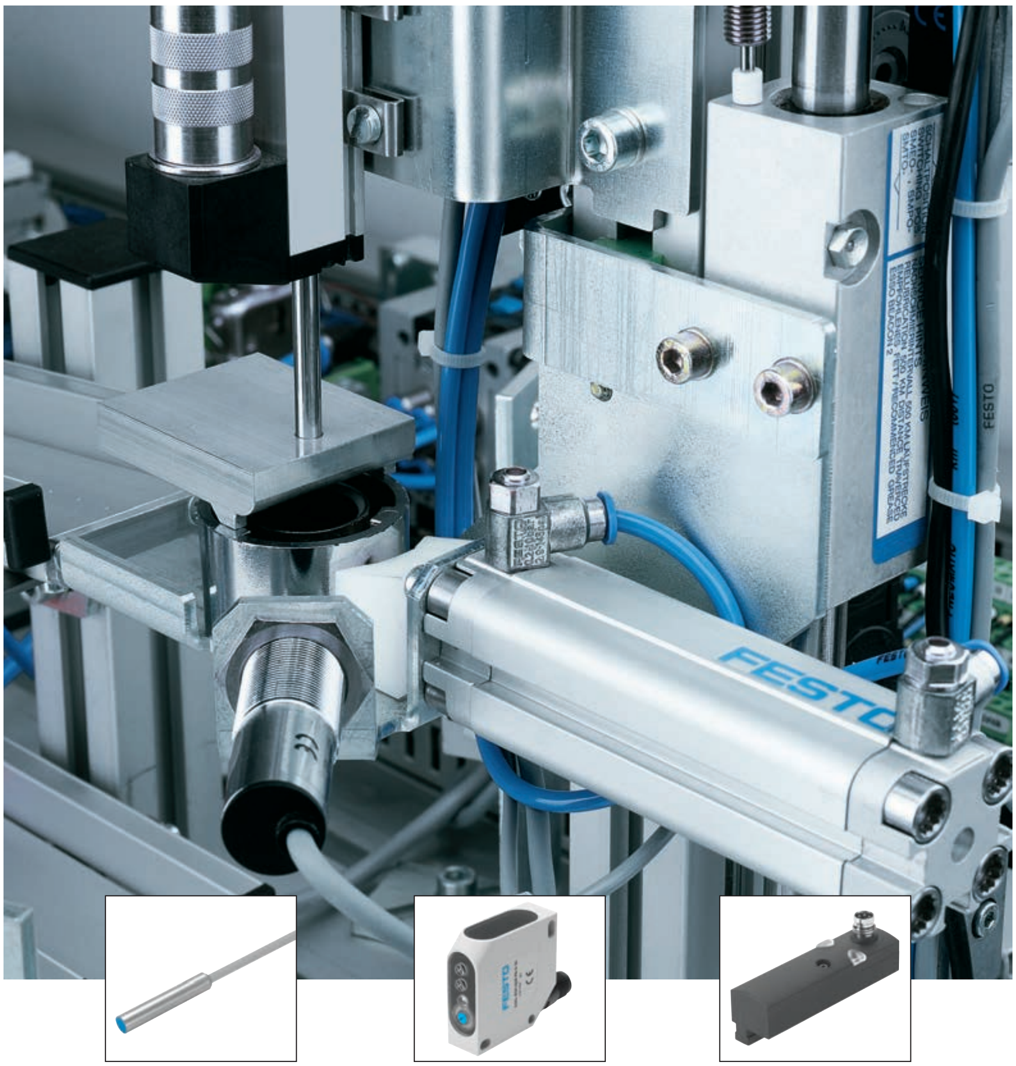
White Paper

Position Sensing and Feedback for Contouring Applications



Use of sensor feedback in today's modern contouring applications.
How to use optical, inductive and actuator feedback sensing technology in such applications.

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Position Sensing & Feedback for Contouring Applications

By Sachin Kambli, Product Manager, Festo Corp.

Position Sensing & Feedback are primary success factors when it comes to contouring applications in today's factory automation technology. With the advancement in micro-sensing technology, tasks which seemed relatively complex and overwhelming not so long ago, can be solved relatively easily with the use of inexpensive sensors, which not only perform the sensing portion but also have a relatively high degree of intelligence. This facilitates the sensing portion of applications to indulge in some degree of decision making and leave only the critical portions of the application and the number-crunching to the centrally-located intelligent device, thus relieving it of unnecessary overheads.

When it comes to contouring applications, there are three primary sensing technologies, which stand out:

1. Optical sensing
2. Inductive sensing
3. Actuator feedback

We will look at the individual technologies in detail, along with the type of applications, they can be used in. It is however important to note that the first two types of sensing technologies are non-contact sensing and the latter is contact sensing.

Optical sensing

The principal of optical sensors is simple physics. Like a typical light sensor which uses position sensitive detectors, these sensors transmit light to the object, evaluate the diffuse reflection detected by the sensor and thus calculate the distance. At the analog output there is a signal proportional to the distance between the object and the sensor. Such sensors are typically good for applications, where the sensor does not need to be distant from the object or surface that is being sensed, is more-or-less a clean environment and where a high degree of accuracy is required. Also, the light-path between the sensor and the object/surface being sensed should be relatively free of smoke or dust particles and should not have very poor ambient lighting. These factors if not taken into consideration can reduce the accuracy of the sensing application.

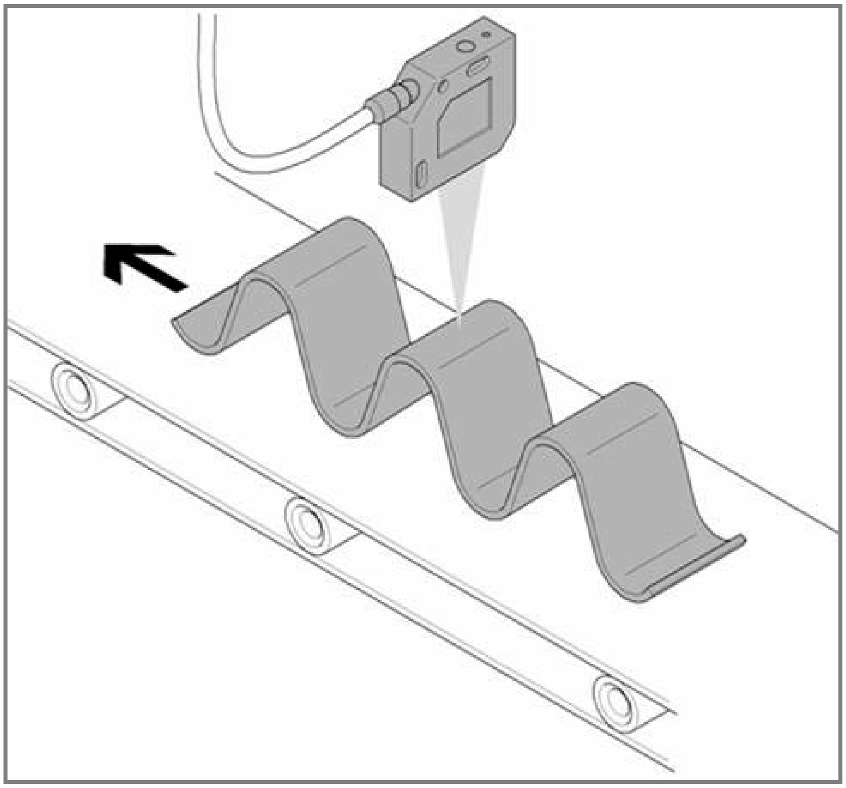
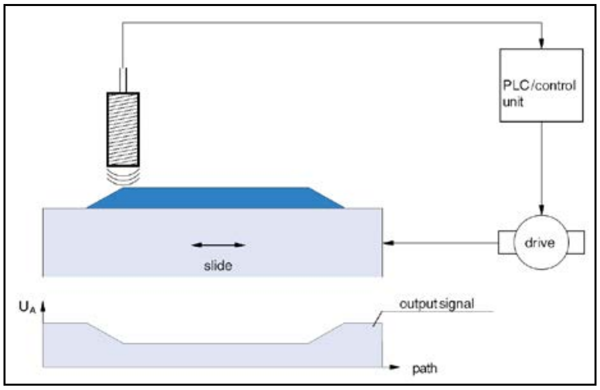


Figure 1: Distance sensing application for using optical sensors

Consider the distance sensing application shown in figure 1. The objective is to sense the distance between the sensor and the contoured work-piece along the length of the work-piece. The taught-in contour co-ordinates are already residing in the central PLC and the distance measurement is done on each new work-piece that needs to go past quality to pass production. At the point where the crest is detected, a metal saw is used to saw off the contoured work-piece precisely at that point.

Once the position of the sensor is fixed and the ‘crest’ points are taught in the sensor, detecting the crests simply becomes a repetitive task. Such sensing techniques deliver a high degree of accuracy to the application since displacement resolution of a thousandth of a mm is very common for such sensors today.

Inductive sensing



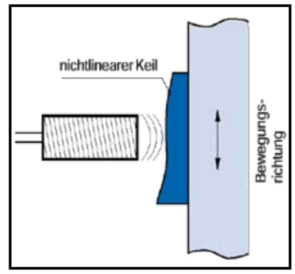


Figure 2: Distance sensing applications for using inductive sensors

Now let's look at the applications shown in Figure 2 left diagram. The concept is the same i.e. non-contact sensing for contouring applications. Only this time we are using inductive proximity sensors which respond without direct contact to the approach of a metal or galvanic object. The sensor itself consists of a coil carrying an alternating current which generates a magnetic field. When the approaching object/surface is within the magnetic field of the sensor, the sensor gives an analog output which is proportional to the distance of the object/surface from the sensor.

The first application shows the cross-sectional area of a metal plate placed on a slide. An analog inductive sensor is used to detect the slanting edges of the plate where some kind of molding is to be implemented. Depending on the feedback provided by the sensor, the central PLC directs the electric drive to move the slide in such a way so as to position the slide for the molding mechanism to do its job. Similarly, in the other application represented in Figure 2 right diagram, an inductive sensor is used to sense the distance of a non-linear surface and help position the below surface accordingly. Inductive sensors are relatively inexpensive and can be used in harsh environments where the ambient elements are not conducive for the health of optical sensors. They are good for applications where low accuracy and a high-degree of robustness and reliability are required.

Actuator feedback

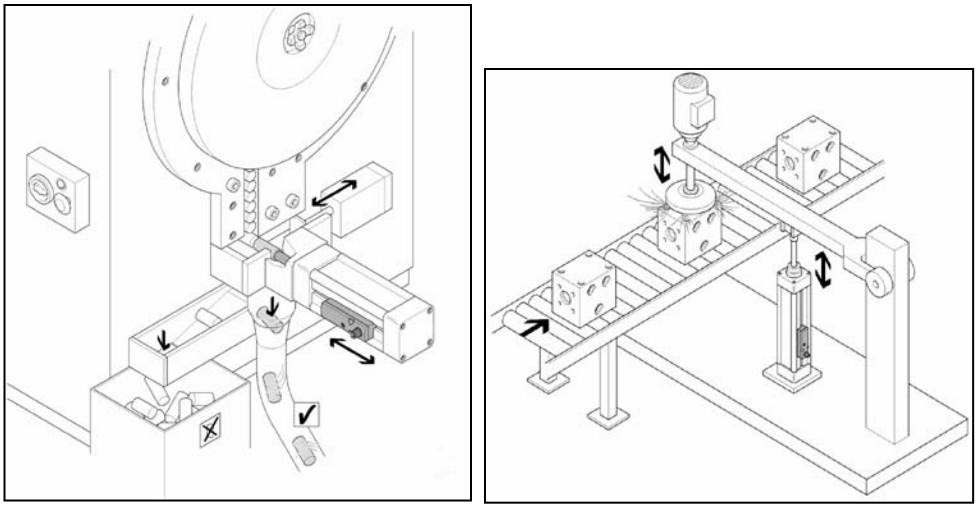


Figure 3: Position feedback using actuator feedback sensors

When using actuator feedback sensors, we can't really classify the type of sensing as contact or non-contact. The actuator feedback sensor is mounted on an actuator which usually comes in contact with the work piece to be sensed. Again the sensor gives an analog output which is proportional to the stroke of the actuator. Typical applications for such type of sensing are in process monitoring, clamping, quality inspection, wear monitoring etc.

In the first application above, left diagram, the length or thickness of the components is detected using an actuator feedback sensor and then sorted into "good" and "bad" bins. Similarly, the second application, right diagram, which is a grinding and polishing application, the feed motion of the grinding disc is monitored using the actuator feedback sensor. Actuator feedback sensors are not only robust but several manufacturers supply these as an actuator/sensor kit making assembly and set-up extremely easy.

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