Learning from mistakes

Ethercat Encoders with Condition Monitoring System

"If bees stay at home, rain will soon come. If they fly away, fine will be the day." This was our grandparent’s way of forecasting the weather. And indeed many things have always been depending on the weather forecast. If, 100 years ago, the peasants did not bring their harvest home in time, or if they brought it home too early, their existence could easily be threatened. Today, life is easier for them: whether it will rain or snow tomorrow can be calculated and forecast in an incredibly accurate way using special partial differential equations. A development that makes the life of farmers and foresters, as well as that of the aeronautics and aerospace specialists, easier.

The layman can imagine similarly the importance of a Condition Monitoring system (CMS) for monitoring the condition within an automated system. And, to remain with the chosen analogy between the forecast of the weather and that of malfunctions in machines: condition monitoring is as important for the maintenance of so-called B and C plant elements as it is important for a girl to know in the morning that she can wear her new summer dress. Therefore for the components that do not lead to standstills in case of malfunction and that thus do not necessarily entail expensive consequential damages. But the significance of the permanent condition monitoring of many critical applications is very different. Offshore wind power plants on the high seas are a good example. Simply harsh weather on the open sea can sometimes prevent the service teams from checking the plant regularly. If, in addition, a malfunction occurred and the plant stands still, it can take a really long time before the wind and weather conditions allow the repairs. Not to mention the costs incurred by the time-consuming trips or by the longer operation of faulty parts. Often, a defective bearing is only detected after it caused gear damages. For the operator, the consequences reach from simply expensive up to loss-generating, or even existence-threatening.

Sensors as key components

The more the plants are complex and the more the functions they perform are demanding, the more sensors become key components. Equipped with the latest protocols, they supply for condition monitoring a quantity and quality of data that never had been available before. The current load exerted on the elements is documented and wear is assessed reliably. The monitoring of the condition of the machine includes the acquisition of many parameters, the recording of trends and the setting of alarms. But, no matter how far automation progresses: even the most detailed monitoring is useless if there is no trained staff that is able to read the information and respond to critical developments. Drawing the right consequences remains the task of the men behind the control system.

With Ethercat to the PC control

CMS observes the physical values that can massively affect the operation of the elements of the plant: vibrations that affect the condition of the drive shafts, temperatures, force and e.g. also the condition of the lubricant. The combination of the obtained measurement and process data allows drawing reliable conclusions from change processes and deviations. Here, having both data packages in the same format is an advantage. OPC and Ethercat have proven themselves as a standard in the production environment. Ethercat offers a communication system that allows high-performance transmission of the obtained condition data to the PC control.
The latest Sendix absolute encoders generation is based on this high-speed field bus system. The mechanical multiturn encoders Sendix 5868/5888 Ethercat offer the performances and communication possibilities that the plant manufacturers need today for web-based maintenance.

**Encoder plausibility check**

With a position update within 62.5 µs, the Ethercat encoder Sendix absolute has currently the shortest bus cycle time for Ethercat on the market. This shorter phase allows using these encoders in highly dynamic systems. Combined with these top performances, their proven robustness and reliability are further assets. A temperature range from -40°C to +85°C, a high shock resistance of up to 2,500m/s² and a vibration resistance of up to 100m/s² ensure the suitability of these devices for industrial use. The encoders integrate the latest slave Ethercat stack from Beckhoff with version 5.01; they also implement the latest CANopen profile 3.2.10. These devices furthermore offer dynamic mapping. Besides the scaled position, the raw data position can be mapped as a process variable; the sensor temperature in degrees C and the speed calculation with the sign are also mappable values. Four units are selectable for speed calculation: steps/sec, steps/100ms, steps/10ms and RPM. In addition, the gating time allows setting the time interval with which the speed value is to be interpolated. Two work area state registers allow the calculation of work area states and thus very process-close results. A comprehensive plausibility check is carried out automatically when downloading parameters onto the encoder.

**All encoder data at a glance thanks to Ethernet**

The measured data acquisition module can be connected, thanks to Ethernet-based protocols, with a signal processing computer that transmits the key values obtained from the time series via Ethernet-based protocols to the control or directly to the superior control system. This way, all key functions of the encoder are under constant control. In addition, the prevailing ambient conditions are thoroughly analysed and coupled with the obtained values for the calculation of the service life time of the encoder. So the information relating to the load applied to the operating machine also plays a role in the calculation when monitoring the vibrations. Values determined when idling lead to other conclusions for the life expectancy of an element than values that appear under full load.

**Learning with CMS**

The control and monitoring system stores the detailed operating data in order to elaborate from it its own trend analysis of the prevailing vibrations, temperatures and of further influences. The longer such information is recorded and the more data can be stored, the clearer the view of the causes of malfunctions and of their future prevention, before a machine is put into service, or even before starting its construction. The consistent use of condition monitoring systems allows optimising for the long term the maintenance and repair costs of machines and plants.

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