Digitalization and decarbonization of electric actuators

Michael Piller

When managing the predictive digital availability of an actuator, the first question that naturally arises is the benefit for the user. The answer is obvious: on the one hand, intelligent actuators can help to prevent a high percentage of future malfunctions; on the other hand, the integrated intelligence makes a significant contribution to perfect execution and thus significantly increases availability - an important factor in sensitive applications in the process industry. An actuator with digital availability management makes it possible to anticipate relevant potential risks that are not visible. This is becoming more important nowadays as systems today are more complex.

COMPLEX PLANT SYSTEMS REQUIRE INCREASED SAFETY OF SUPPLY

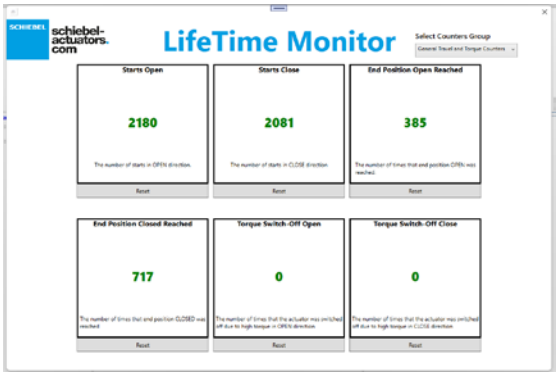
Management of digital availability of actuators in large networked systems brings sustainable advantages in continuous operation, especially if a possible future malfunction can be predicted and thus prevented in advance through maintenance and servicing measures.
With the help of new "machine learning" technologies and health indicators, it is already possible to narrow down a possible future error source in system components. The service support can be planned well in advance and carried out quickly. This is all possible before the service technician arrives and inspects the actuator or the affected system component. If only a single component is defective and needs to be replaced, the "built-in" intelligence recognizes this and identifies the faulty component. Service technicians can bring the spare part for replacement - reducing downtimes to an absolute minimum. On the one hand, this brings significant cost benefits for the user especially on difficult-to-access systems such as small power plants in alpine terrain or pumping stations in the desert. Normally, hardware failures can be detected before they come into play, so that the actual fault does not even occur. Schiebel's electric actuators also master this challenge. This makes them among the most reliable on the market.

LIFE-TIME-MONITOR COCKPIT FOR DIGITAL AVAILABILITY MANAGEMENT – HEALTH MONITORING

Innovative digital forecasting and health management systems make it possible to determine the health status and predict the remaining useful life of an actuator using health indicators defined by actuator technology know-how and operating conditions.

Source: SCHIEBEL Antriebstechnik GmbH

Figure 1: More complex systems with intelligent actuators.

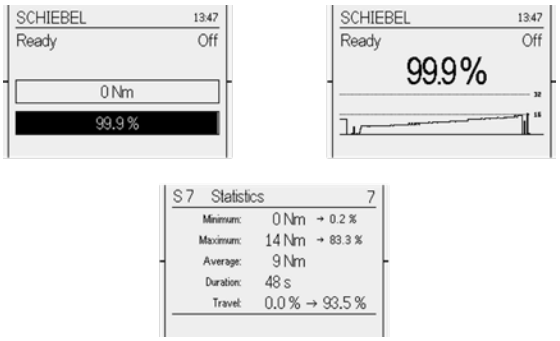


Source: SCHIEBEL Antriebstechnik GmbH

Figure 2: Life-time Monitor Cockpit with health indicators.

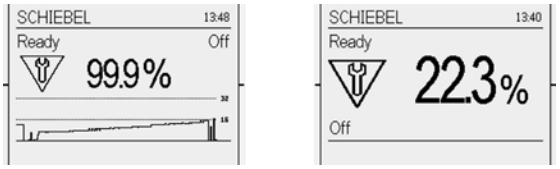
For the management of digital availability, a wide range of additional data is recorded, e.g. how often the actuator moved in the closing or opening direction and whether the end positions were reached successfully, how often a partial-valve stroke test was carried out and whether there were any problems. It also records, for example, how often the fail-safe function has responded or how often the actuator has been stopped due to the tripping torque being reached. In addition, the firmware provides detailed data on a torque classification which is accrued pro rata temporis in open/close during operation. Operating and switch-on times as well as availability are logged. But that's not all: the thermal load on the power electronics or the motor is also monitored and evaluated to determine whether or how often the temperature has exceeded a defined limit and what influence this has on thermal ageing. Finally, the occurrence of undervoltage events on the grid side is also recorded, analyzed and reported. A total of around 60 event logs are recorded via history warnings and errors, as well as the time sequences of internal variables such as current, torque, position, vibration, acoustics or future gearbox wear.

After a successfully completed learning process, the trained model is used to evaluate unknown data and status combinations that occur during the operation of a system which could negatively impact the future operation. Statements can be made about the availability or remaining useful life of the actuator. These predictions can be used to make better decisions on the safe operation of networked systems. The main objective is to automatically learn the behavior of an actuator without human intervention and adapt the actions accordingly. The development of these supervised machine learning models is an interactive process that is often repeated several times until the result has reached a certain quality. This gives operators a maximum transparency, predictability and availability of the entire system. In addition to the risk to supply safely, an unplanned plant shutdown is also an enormous financial loss.



Source: SCHIEBEL Antriebstechnik GmbH

Figure 3: Various Torque profiles



Source: SCHIEBEL Antriebstechnik GmbH

Figure 4: LCD display with NAMUR status symbol

DIGITAL RECORDING OF THE VALVE PROFILE

The firmware can now also be used to record and evaluate torque statistics for various valves during commissio-

Source: SCHIEBEL Antriebstechnik GmbH

Figure 5: Failsafe actuators have been developed and manufactured at SCHIEBEL for over 28 years

ning-for example, the direction-dependent torque curve as a function of position.

The result is a transparent load profile for the valve which is automatically scanned by the actuator during commissioning. This valve identification can be used as a reference curve. This feature provides information on the quality of the match between the pre-calculated and the actual operating torques of the valves and provides valuable information for optimum parameterization and efficient operation. It is also possible to compare a certain number of identical valves. During operation, the condition of the valve can also be assessed regarding ageing.

LOCAL EASY-TO-USE - SUPPORT FOR ON-SITE SERVICE ACCESS

Schiebel has packed a lot of intelligence into the actuator firmware. With guided commissioning, the actuator defines a wide range of parameters itself - these no longer need to be entered by the customer. The "easy to use" principle is based on Schiebel's extensive expertise in a wide range of applications, which can now be used directly by customers. One example: based on known torque values, the actuator automatically sets the end positions by itself when the switch-off torque is reached. Users are thus ultimately supported - commissioning is quick, problem-free and error-free. Another new feature is that service technicians now have access to the entire database of the respective actuator (checked factory settings, changes, etc.) at any time via a QR code scanned with a smartphone.

VISUALIZATION ON THE DEVICE CREATES CLARITY ON SITE

In addition to the guided commissioning according to the "easy to use" principle and the "Life-time Monitor Cockpit", the LCD display on the actuator has been equipped with further firmware enhancements. One focus here is the new visualization with easy-to-understand symbols in accordance with NAMUR, which graphically displays different statuses - maintenance, operation outside the specification, failure, function check - on the decentralized LCD display.

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