



PC-based Control: High computing power enables direct processing and analysis of measured data

Induction motors with integrated condition monitoring

The KONČAR – Electrical Engineering Institute, Inc., based in Zagreb, Croatia, has established comprehensive expertise and a distinguished reputation through its work developing the broad scope of solutions for electrical machines and installations, power plants and rail-based vehicles over many years. One of the strategic aims of the Institute is the development and production of Expert Motor Condition Monitoring (EMCM) systems for condition monitoring and error detection in systems with electric rotary machines.

The EMCM developed by KONČAR is a comprehensive online condition monitoring system for low-voltage and high-voltage induction motors of any size. It can be used both for squirrel cage and slip ring motors and enables monitoring and diagnostics of all key motor components, as well as long-term data storage and tracking of significant events.

By fitting an EMCM system to induction motors, users can access their machine at any time, so that developing malfunctions can be detected at an early stage. In this way, system management can be optimized: Unscheduled downtime is avoided, and investments can be better protected through predictive maintenance. Early error detection also enhances staff safety and environmental protection.

KONČAR offers two versions of its condition monitoring system, a headless version with a Beckhoff Embedded PC from the CX5010 series and a version with an integrated display via a Beckhoff CP6207 Panel PC. Data sampling takes place via high performance EtherCAT I/O modules. The core of the measuring systems is formed by the EL3632 Condition Monitoring Terminal, to which IEPE acceleration sensors can be directly connected. This advanced EtherCAT I/O

terminal's high sampling rates and fifth-order analog low-pass filters make it ideal for KONČAR applications. In addition to specimen vibrations it can also log the bearing temperature, motor current and magnetic field strength in the motor air gap. The EMCM is a modular and scalable system, which can also be retrofitted to existing induction motors.

The comprehensive development work of KONČAR, based on finite element calculations and sensors for detecting malfunctions in the rotor and stator windings, ultimately led to an innovative measuring method based on magnetic field measurements, which is integrated into the EMCM system and can detect the following damage types/faults:

- one or several broken bars of the rotor cage in squirrel cage motors
- broken rotor cage ring
- short circuits within the rotor winding in slip ring motors
- short circuits within the stator winding
- rotor eccentricity

The high computing power of the CX5010 or CP6207, both based on an Intel® Atom™ processor in the EMCM system, enables direct processing and analysis

of the measured data (a 2 GB Compact Flash card is used as storage medium). Intelligent memory management and event-driven data archiving enable long-term historical data monitoring. Users can also call up a trend overview. With just a few mouse clicks this function offers an overview of the main events in the "machine history" at different time resolutions, i.e. seconds, minutes, hours, days, months or years.

With the CP6207 Panel PC version, users have a local TwinCAT PLC HMI available for accessing the measured data. The visualization offers an efficient system overview, a list of alarm and warning messages relating to bearing vibration and temperature, error status and fast trend diagrams to track vibrations and motor current.

A multi-user web application was developed for remote access to the system, which is also available for the CX5010 Embedded PC. It enables access to measured data within the communication network.

The project manager at KONČAR, Dr. Ante Elez, describes the benefits of the Beckhoff controller: "The main advantage for our application is that we found an easily scalable solution. It enables us to complement the system with further EtherCAT measurement terminals, depending on the measuring task at hand. By leveraging the PC-based platform, we can also make better use of web technologies and database systems." According to Dr. Ante Elez, this system can detect virtually any defects in rotating machines. From the start of the project, the technological advances at KONČAR were supported by Krovel, the Beckhoff agency in Croatia.



From left to right: Damir Krovinovic, Managing Director of Krovel, the Beckhoff distribution partner in Zagreb, Jens-Olaf Brede, Beckhoff International Sales, Pascal Dresselhaus, Beckhoff TwinCAT Product Manager, and Dr. Ante Elez, Project Manager at KONČAR – Electrical Engineering Institute, Inc.

Further information:

www.koncar.com

www.krovel.hr

www.beckhoff.com/Condition-Monitoring



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KONČAR

The KONČAR – Electrical Engineering Institute, Inc. is a part of the KONČAR Group. The core business of the KONČAR Group is power generation as well as distribution and transmission of electrical energy in manufacturing and the rail transportation industry. The company was founded in 1921 and is based in Zagreb, Croatia. The KONČAR Group, which comprises 18 subsidiaries and associated companies, employs around 3,800 staff members. The KONČAR Group has supplied products and systems in more than 100 countries on all continents. In the rotary machines industry to-date, the KONČAR Group has produced 175 turbo-generators with a total installed capacity of 5,720 MVA, 450 hydro generators with a total output of 15,000 MVA, as well as numerous slip ring and squirrel-cage induction motors for low and high voltage up to 10 MW.

TC3 Condition Monitoring Library

A feature-filled Condition Monitoring Library is now available for the TwinCAT 3 automation software platform. The PLC library is characterized by straightforward application of complex algorithms. The current range of functions includes blocks for power spectrum, envelope, crest factor, average value, kurtosis, RMS calculation and classification. The software blocks can operate across tasks and cores, so that ample performance is available. The areas of application for this versatile software library are wide ranging. In addition to conventional monitoring of mechanical vibrations in machines, the library is also well-suited for energy grid analysis, for example, through the calculation of harmonics in the electrical grid.