LCM
K2-Center for
Symbiotic Mechatronics

Programme: COMET
Competence Centers for
Excellent Technologies

Programme line: COMET-Center K2

Type of project: MFP 3.3 Smart Data
Mining and Predictive Systems,
Smart Sawing, 2022–2026

© Tyrolit AG

PREDICTIVE MAINTENANCE IN-SITU: SMART FLANGE FOR MONITORING SAW BLADES

AN INTEGRATED SENSOR-SYSTEM AND EDGE PREPROCESSING CAPABILITIES ENABLE REAL-TIME CONDITION MONITORING AND OPERATIONAL ASSISTANCE

Modern condition monitoring systems frequently need to meet conflicting requirements. On the one hand they should achieve the highest quality in monitoring a component. On the other hand they should be as effective, simple, and non-invasive as possible. Within an ongoing cooperation between the Linz Center of Mechatronics GmbH with TYROLIT Construction Products GmbH, the challenge of designing such a system for intelligent monitoring of rotating saw blades for cutting reinforced concrete was successfully addressed. A smart flange demonstrator integrating sensors required for tool identification and condition monitoring by processing large-bandwidth raw data on the edge was developed and validated. The flange monitors high-quality rotary saw blades with diameters of up to 2 m, rotating at up to 1300 rpm, while cutting reinforced concrete. Moreover, the developed smart flange supports tool identification and raw data acquisition, which is then preprocessed on-edge and wirelessly transmitted to enable vibration sensing and the measurement of temperature and rotational speed. The data is used for monitoring tool usage as well as the state of the tool during usage — even under impacts and shocks of up to ±500 g.

Complex challenges

Despite the demanding circumstances such as intense g-forces and other harsh operating conditions, an almost completely metallic environment as well as cooling water present during operation, Radio

Frequency Identification (RFID) technology was successfully implemented for tool identification. Moreover, using customized hardware, Bluetooth Low Energy (BLE) was employed for reliable data transmission. To limit battery replacements to the machine's regular service intervals, an ultra-low-power concept was applied to the electronics design. Another key focus was placed on minimizing the required raw data rate and on developing efficient algorithms for preprocessing, which reduce computational demands and prolong battery life and operating time of the flange.
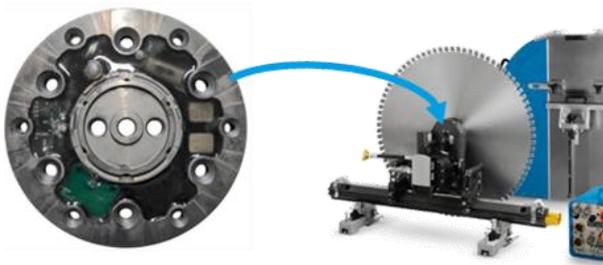

Smart flange to monitor an operating saw blade, © Tyrolit AG

Impact and effects

The successful implementation of the objectives of the project and the achievement of its ambitious goals were significantly driven by the close and strong cooperation of the project partners. Within the project, the smart flange was advanced to TRL 6 (*technology demonstrated in relevant environment*), and multiple valuable datasets were collected in several field tests under realistic operating conditions. The data provided a solid basis for developing robust algorithms for data-driven machine learning approaches, leading to a profound assessment of operational modes and the saw blade's condition.
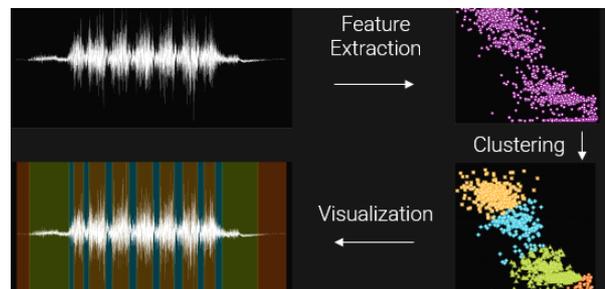
Schematic for detecting different operational modes © LCM GmbH

To summarize, the results achieved during this project enable the development of innovative products with new functionalities such as autarkic tool identification and smart condition monitoring.

—

Project coordination (Story)
DI Gerhard Kaineder
Sensors & Communication
Linz Center of Mechatronics GmbH
T +43 (0) 732 2468 6137
gerhard.kaineder@lcm.at

LCM - COMET K2-Center for Symbiotic Mechatronics
Linz Center of Mechatronics GmbH
Altenberger Str. 69
4040 Linz
T +43 (0) 732 2468 – 6002
office@lcm.at, www.lcm.at

Project partner

- TYROLIT Construction Products GmbH, Austria
- Linz Center of Mechatronics GmbH, Austria

Federal Ministry Innovation, Mobility and Infrastructure Republic of Austria

Federal Ministry Economy, Energy and Tourism Republic of Austria

Austrian Research Promotion Agency
Sensengasse 1, A-1090 Vienna
P +43 (0) 5 77 55 - 0
office@ffg.at
www.ffg.at