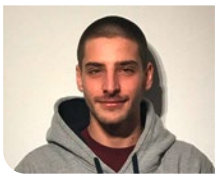
Compensation of temperature dependency in bearing vibration data

Graduate Candidates



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Introduction: Mechmine is a Swiss company which offers systems for predictive maintenance for industry.

They measure the vibration of critical components such as bearings with the help of different sensors, then the collected data is analyzed in the Mechmine Cloud with the help of machine learning and data mining.

The acceleration sensors are subjected to temperature variation from the environment and the components itself. These variations produce instabilities in the measures leading to a worse prediction.
Our task was to first improve the existing testbench by implementing an automatic controller for temperature and motor speed. Then we had to analyze the relationship between the acceleration and temperature. Finally, a correction algorithm to compensate this complex correlation was developed, implemented and tested to verify its effectiveness.

Approach: For regulating the temperature and the motor speed we used the hardware solution from Tinkerforge, which consists of different boards controlled from a main embedded system running Linux. As a programming language, we chose Python as it is already used by the company. The embedded system is responsible for controlling the motor controlle and the heater element and acquiring the surface temperature of the bearing. The motor speed and accelerometer temperature are accessed through the Mechmine hardware via SSH. With a command sent to the Mechmine hardware, it is possible to start an automated test cycle for acquiring vibration data from the accelerometer sensors at different speeds and temperatures.

After having collected enough data, we carried out research on the temperature correction algorithm and chose the one best suited for our requirements. Finally the temperature compensation was implemented and tested.

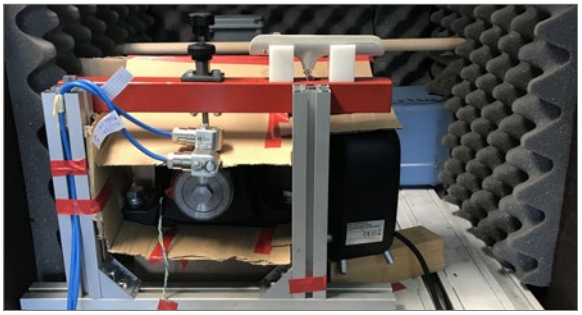
Conclusion: A fully automated system for collecting data at different speeds and temperatures was realized. The data collected is stored in a database and can be used for testing the system behavior for different conditions.

A correction function was implemented in order to adapt the acceleration data and reduce their dependency on temperature, improving the vibration analysis.

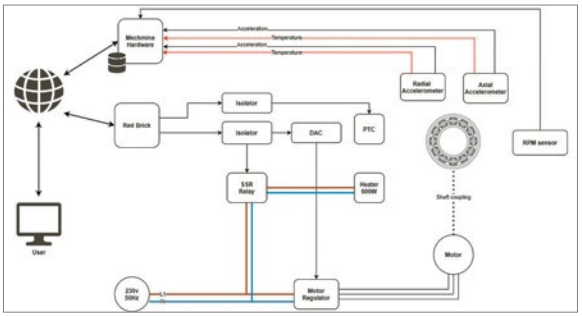
The acceleration RMS histograms before and after correction are reported in the graphics, the proposed algorithm is able to reduce the impact of the temperature.

The environments of industrial machines are strongly subjected to interference from different sources (motors, gearboxes, etc.) creating a high variance of the measured acceleration, therefore making temperature compensation a difficult task.

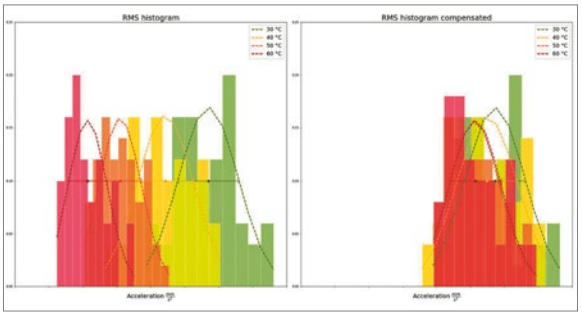
Testbench
Own representation



Testbench block diagram
Own representation



Acceleration RMS histogram (500 rpm) before and after correction
Own representation



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