



Fraunhofer

IIS

FRAUNHOFER INSTITUTE FOR INTEGRATED CIRCUITS IIS
DESIGN AUTOMATION DIVISION EAS



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SELF-LEARNING CONDITION MONITORING

To run an efficient business, most companies find it essential to have optimum availability of their machinery and systems at all times. Unplanned downtimes or unnecessary component exchanges create preventable costs and reduce productivity. Condition Monitoring Systems (CMS) can provide a very valuable service in these areas.

Early on, a predictive CMS approach furnishes meaningful information about the condition of wear on components like motors, pumps and bearings. It facilitates a reliable determination of maintenance and repair needs. The downside of such a CMS is the enormous amount of data it generates, consisting of sensor values and sometimes specific process data. This can complicate using such systems and make them rather difficult to control.

The Fraunhofer IIS/EAS approach for an intelligent and independent monitoring of system components eliminates this disadvantage. It provides a quick and user-

friendly solution, saving time, effort and thereby costs as well.

Your Benefits

- Early detection of possible damage resulting from wear
- Full maximization of the component's service life to increase the operating hours between maintenance
- Avoiding consequential damage because of unrecognized wear situations
- Shortening of maintenance related downtimes
- Reducing the company's spare parts stock
- CMS operation without the need for extensive prior technical knowledge
- »Learning« CMS with automated feature selection
- Automatic limit value selection or tracking through trend identification
- Cost reduction for commissioning a CMS



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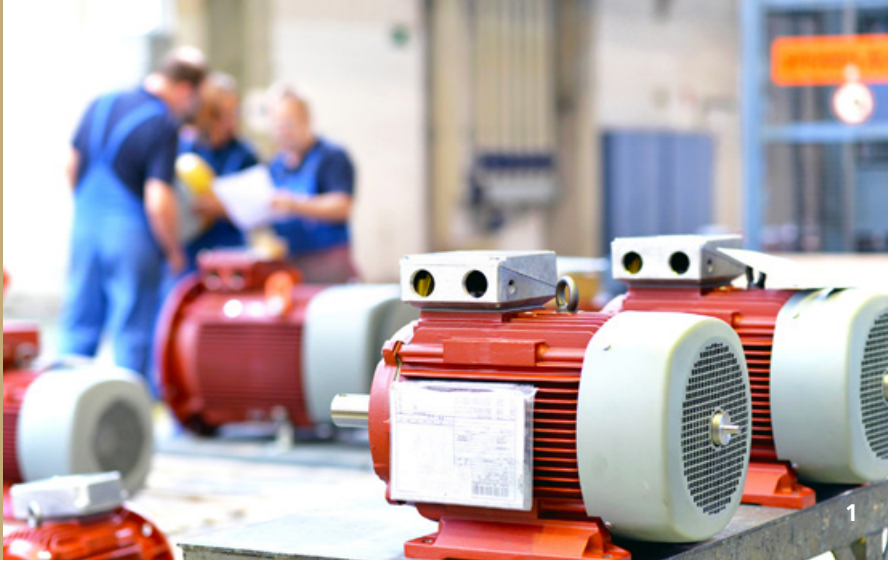


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The intelligent CMS

The key feature of the Fraunhofer approach is its significantly simplified operation, linking automatic data analysis with a self-learning classification. To do this, the Condition Monitoring System must establish settings, such as the limit values, automatically. This is achieved by means of mathematical algorithms, which evaluate known operating conditions of a plant. This is how the CMS »learns« the data characteristics of various conditions. Any changes in this data fingerprint are automatically detected. Outliers are filtered out, to eliminate false alarms. Once enough measurements are available, limit values can be set automatically. After completing the initial learning phase only minimum additional effort is required for operating the CMS.

The CMS executes regularly scheduled measurements of values which are relevant to wear monitoring. This results in a data pool, which is evaluated together with the respective process data. The ultimately relevant differentiators are obtained automatically by targeted selection from a wide range of statistical parameters. Each record represents a point in a feature space, which can then be captured visually. Multiple measurements of operating conditions form clusters. They initially represent different operating conditions. The first appearance of machine wear will change the form and location of the clusters. As a consequence, this can then be detected in the fingerprint and the diagnosed change is reported.

This is how the CMS expands its database step-by-step with measurements of various wear and operating conditions and monitors all previous classification features continuously. When they no longer represent the current situation, the differentiators of the data fingerprints will be recalculated and an adjusted set of specific features is established.

Our Services

We offer the following services against the background of our learning CMS solution:

■ Feasibility studies

Analysis of customer-specific requirements and recommendations for data recording

■ Data analysis for CMS users

Examining existing data for abnormalities and automatic generation of appropriate differentiators

■ Customized CMS solutions

Development and implementation of user specific methods to extract features and integrate algorithms, e.g. in embedded systems

■ Software development for CMS providers

Implementation of additional software modules for automated data analysis

1 An inexpensive and user-friendly CMS is especially important for electrical motors used in industrial plant systems.

Example of Various Clusters in a 3D Feature Space

The features used were determined in an automated process. Because of the large distance of the cluster in relation to each other (scatter) the conditions are easily separable. The features are therefore suitable for classification.

