

Data-oriented Unusual Conditions Signifier DUCSOnEX



Conventionally, device maintenance relies heavily on the skills of experienced maintenance staff. During patrols in the field, they make full use of their five senses to detect subtle abnormalities of devices or even their signs. However, this highly field-oriented approach and dependency on individual skills make it difficult to hand down and preserve experts' skills after their retirement. A device maintenance system that does not depend too much on human skills is increasingly needed. In response, Yokogawa has developed DUCSOnEX, a software package for automatically analyzing unusual device conditions. This edge computing system with a machine learning function learns the normal operating conditions of devices and constructs a monitoring model. When DUCSOnEX detects unusual device conditions during continuous monitoring, it outputs the degree of off-normality (degree of deviation from the learned conditions). This helps operators in the control room detect subtle changes in device conditions, which may be a sign of abnormality, without relying heavily on human skills, and is thus a great help for predictive maintenance.

MAJOR FEATURES

■ Continuous diagnosis with lean hardware

DUCSOnEX diagnoses device conditions at the edge (in the vicinity of devices and terminals). Although it collects and analyzes large amounts of data in real time, the system sends only analysis results to the host system, and thus large-capacity storage is not required.

■ Integration of data analysis and system configuration technologies
An analysis algorithm has been developed to effectively diagnose device conditions, based on pattern recognition and data analysis technologies that Yokogawa has honed over the years to help customers in the manufacturing industry to add value. A high-speed, agile machine learning engine has also been developed to run the algorithm on an edge computer.

■ Automated creation of monitoring models on edge computer
Machine learning technology helps create monitoring models automatically, easily, and quickly.

■ Highly reliable, available, and easy to maintain

Yokogawa's e-RT3 Plus or industrial PCs (Windows 10 IoT Enterprise LTSB) can be used as the platform.

With its analog and digital I/O functions and real-time performance, a single e-RT3 Plus can perform both data collection and analysis. This controller also features excellent robustness and ease of maintenance.

■ Major applications

Processing devices*: Forming machines, cutting machines, semiconductor equipment, and others

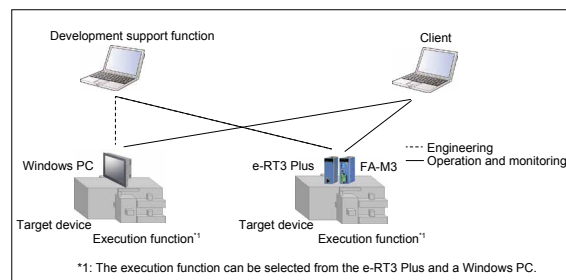
Conveying devices*: Conveyers, robots, automated warehouses, lifters, and others

* These devices operate in a short cycle time and quickly deteriorate.

SYSTEM OUTLINE

■ System configuration

This system consists of a development support function, execution function, and client (web browser).



■ Development support function

This function defines data collection (module) and analysis conditions. The defined contents are managed as an analysis project and exported to the execution function.

Function block	Function
Module definition	FA-M3 (AD, CX, HA), common memory
Segment definition ^{*1}	Starting trigger: Activated by external APs Ending trigger: Definite amount (sample number)
Characteristics definition	Univariable: Basic statistics, order statistics, frequency analysis, autocorrelation Multivariable: Correlation and covariance, cross-correlation
Monitoring model definition	Linear model: Independent feature model, principal component analysis Non-linear model: Data-oriented model
Post-process definition	Simple moving average

^{*1} Segment definition means the execution unit of analysis (extracting analysis data and executing analysis).

■ Execution function

This function follows the analysis project definition created by the development support function and repeatedly executes data collection and analysis at the edge (in the vicinity of devices and terminals).

■ Client browser

For the development support function, the definition process can be carried out sequentially in a wizard style. For the execution function, the degree of off-normality and characteristics trends can be checked.

For details of the DUCSOnEX algorithm, see "Edge-based Analytics for Detecting Anomalies in Manufacturing Equipment" in this issue.

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