OMRON

Artificial Intelligence Machine Automation Controller

NX701-Z□00 / NY5□2-Z□00

SYSMAC
always in control

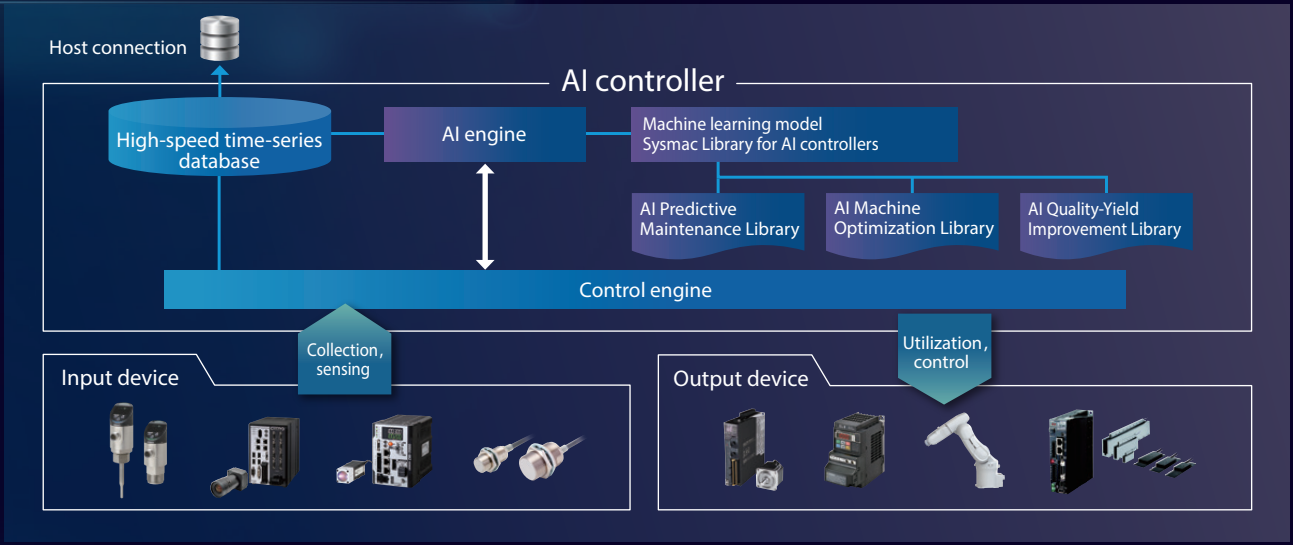
Manufacturing learns and evolves at intelligent manufacturing sites

AI and IoT help people and machines grow together at future factories

While manufacturing are rapidly becoming more advanced, the world faces a shrinking labor force and shortage of skilled engineers. Omron will realize a factory of the future where people and machines grow together by leveraging AI and IoT technologies at the machine level and converting tacit knowledge, such as intuition and experience of experts, into explicit knowledge.

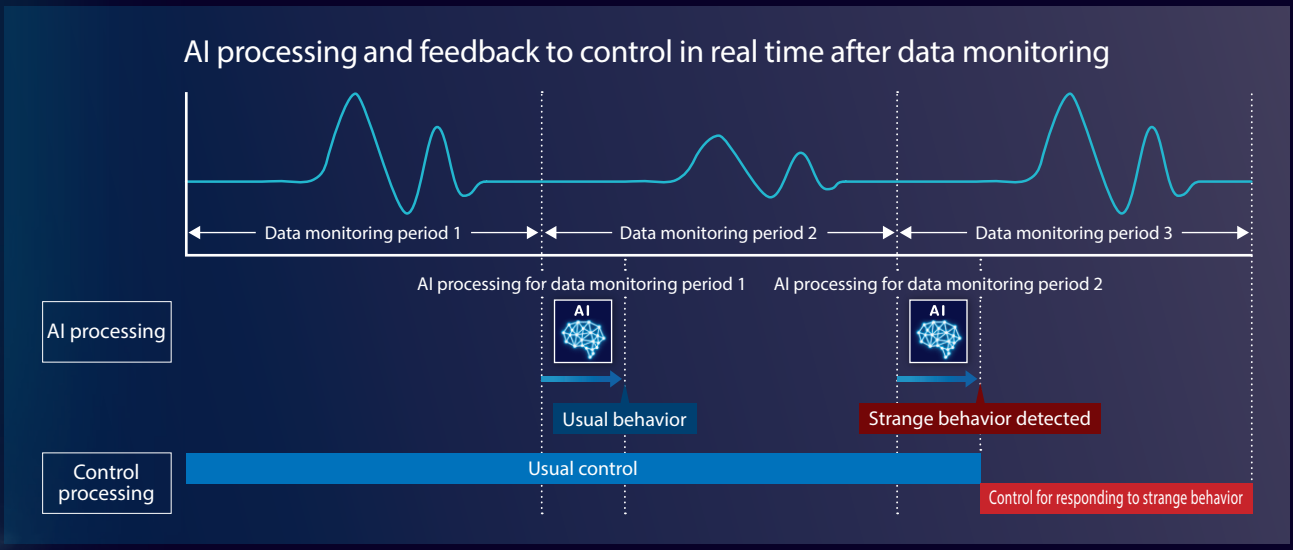
Omron is aiming for a future factory realized by our system using AI controller

Non-stop equipment | Equipment maximizing performance | Zero defect equipment



Ultimate AI edge controller born from the fusion of AI and control

The artificial intelligence machine automation controller (AI controller) integrates unique AI functionality into control, allowing you to leverage information at the machine level in real time. The AI controller can very quickly and accurately detect momentary irregularity of equipment and feed back to control in real time. As well as enabling trend monitoring at the machine level, this also prevents quality defects that occur on high-speed production lines within a very short time.



In addition, significant patterns which data scientists usually discover by mining data are provided as software functional components : Sysmac Library for AI controllers. The AI Predictive Maintenance Library to realize non-stop equipment is now available, and other libraries to realize equipment maximizing performance and zero defect equipment will also be available soon.

Predictive maintenance powered by AI realizes non-

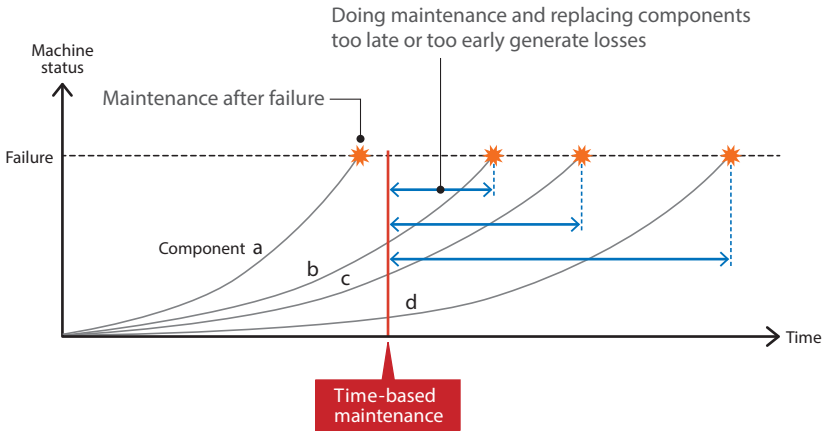
Innovative status-based maintenance

Strange behavior is monitored using machine data in real time,
which allows you to carry out maintenance based on machine status when it is really necessary.

From :
Reactive or regular maintenance

Reactive or regular maintenance by experts

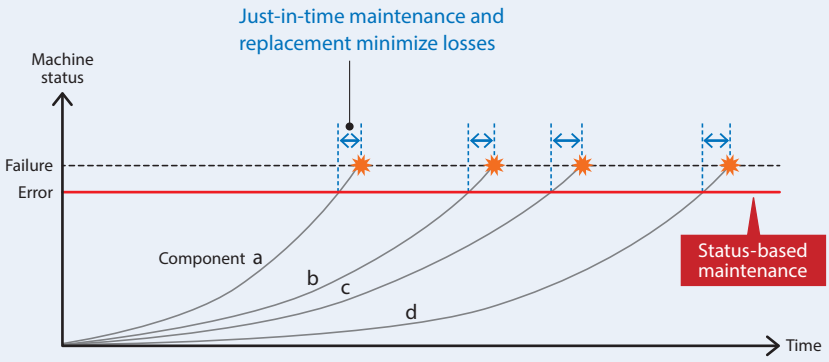
Skilled engineers perform maintenance based on their intuition and experience regularly or after failure has occurred (time-based maintenance).



To :
Predictive maintenance

Predictive maintenance using AI controller

AI monitors machine status using machine data.
Predictive maintenance is performed based on machine status when it is necessary (status-based maintenance).



Benefits expected from predictive maintenance

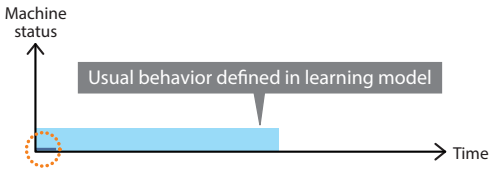
1. Minimized downtime reduces production losses
2. Just-in-time maintenance reduces costs
3. Replacing components when necessary reduces stock of components
4. Error locations can be identified without analysis
5. Maintenance work can be standardized without special knowledge and skills

stop equipment

Predictive maintenance procedure using AI

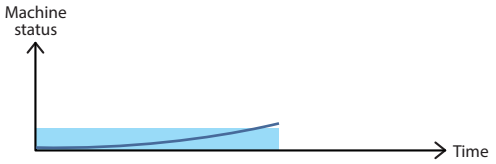
Step 1 Generating a learning model

A learning model including a threshold value is generated from current machine data.
(Usual behavior is learned.)



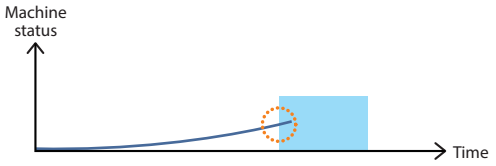
Step 2 Monitoring the machine

The machine is monitored based on the learning model.
If the machine status exceeds the threshold value, a notification is issued.



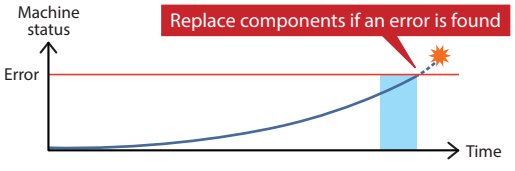
Step 3 Setting a new threshold value

The machine status is checked.
If no error is found,
a new threshold value is set.



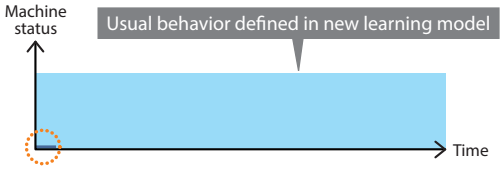
Step 4 Replacing components

An error occurs while threshold value setting and monitoring are repeated.
Components are replaced.



Step 5 Generating a learning model with new components

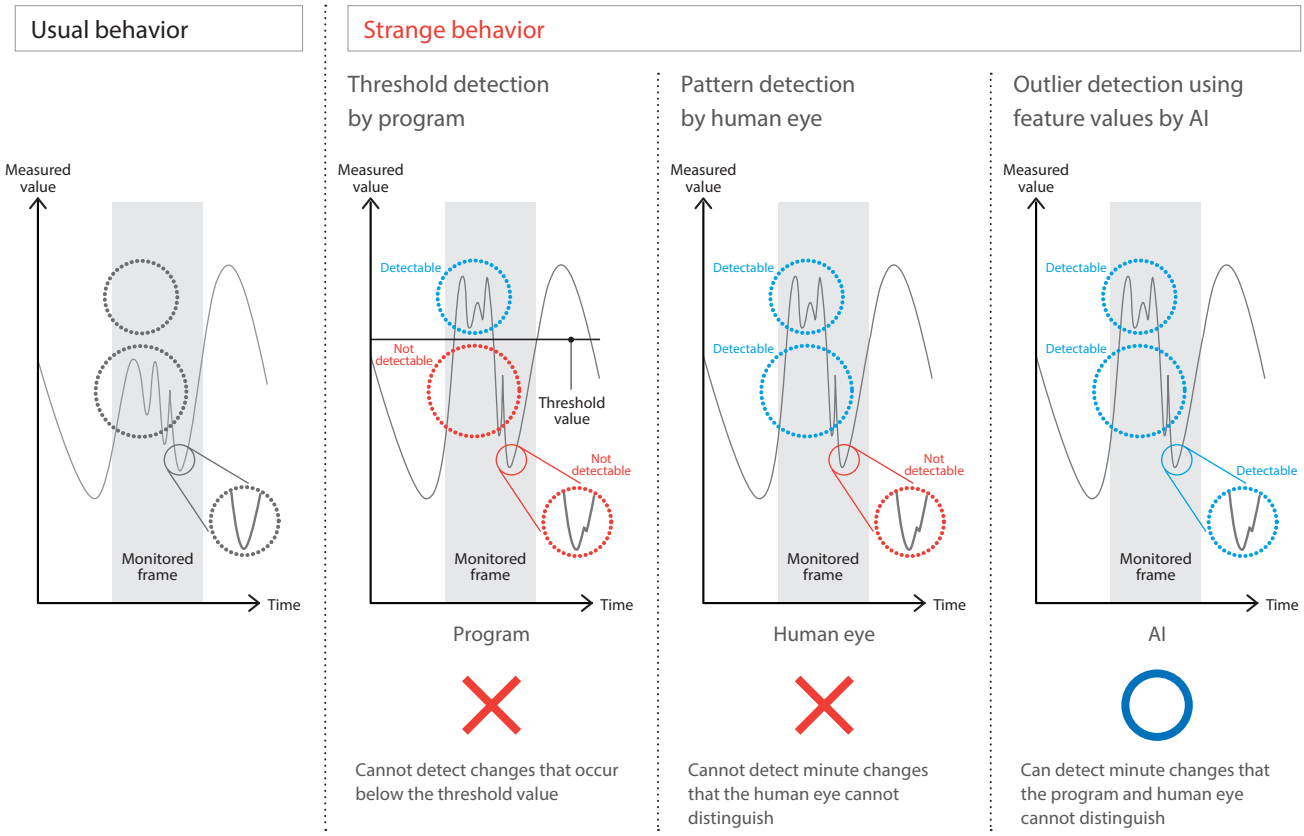
A new learning model including the threshold value is generated based on the previous error level after components are replaced. Repeating these steps makes status-based maintenance more reliable.



AI controller detects irregularity quickly and accurately

The unique data utilization functionality to provide ultimate edge control makes previously invisible machine status visible, which enables the AI controller to detect strange behavior of machines at the microsecond level.

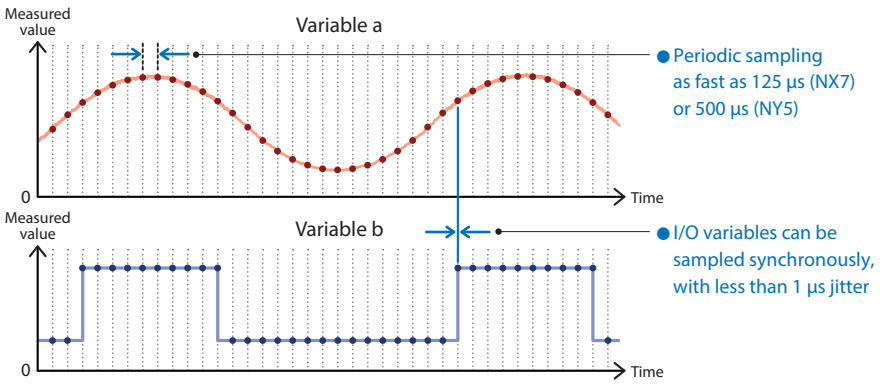
Comparison of detection capabilities between AI and conventional method
(time-series data such as voltage and current)



Functions to detect quickly and accurately

High-speed Time Series Database Function

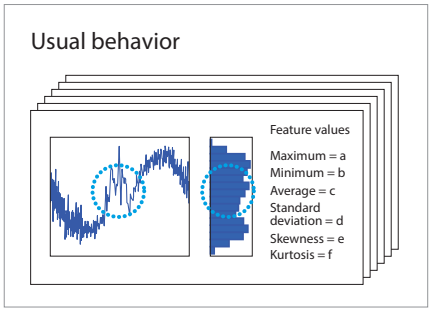
Collection and storage of time-series data are fully synchronized with the control cycle. The periodically sampled data is used to understand machine behavior, enabling creation of accurate learning models and judgment. Moreover, the host connection functionality allows the linkage of AI between the host and machine levels, which helps optimize the introduction of IoT to factories.



Data utilization to detect strange behavior

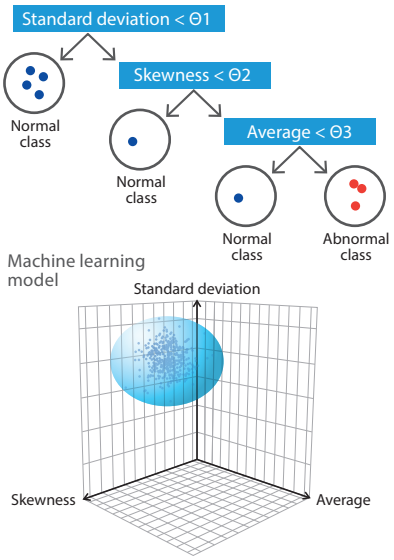
Data collection
Time-series data collection, feature value creation

Feature values are generated from data that is gathered when machine behavior is usual and strange.



Data analysis
Mining, machine learning

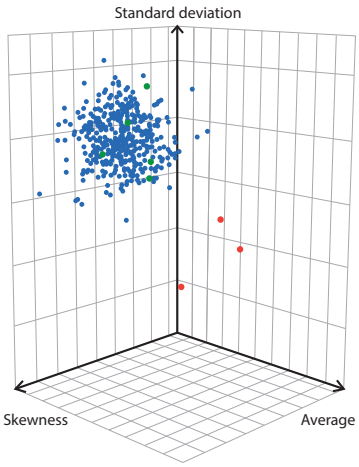
Feature values which are used to judge behavior to be strange are selected. A machine learning model is generated from the analysis result.



Blue : Learning data indicating usual behavior
Light blue : Threshold value

Data utilization
Real-time monitoring by AI

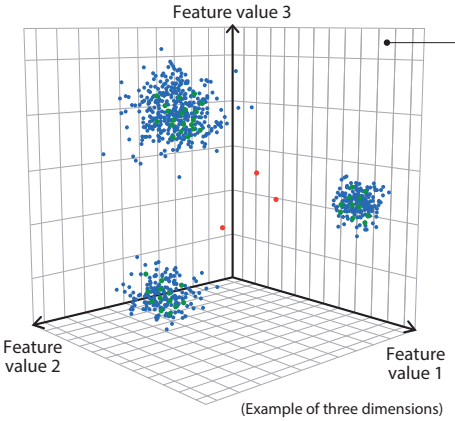
The machine learning model is transferred to the AI controller. Machine status is monitored in real time.



Blue : Learning data indicating usual behavior
Green : Judged as usual behavior
Red : Judged as strange behavior

Ultra-high-speed AI engine

The AI engine provides both speed and accuracy—Omron has developed an AI engine based on the machine learning engine Isolation Forest that is ideal for real-time processing and tuned it to increase detection accuracy. The algorithm applicable to multimodal data can be used for high-mix production lines where two or more operating modes are required.

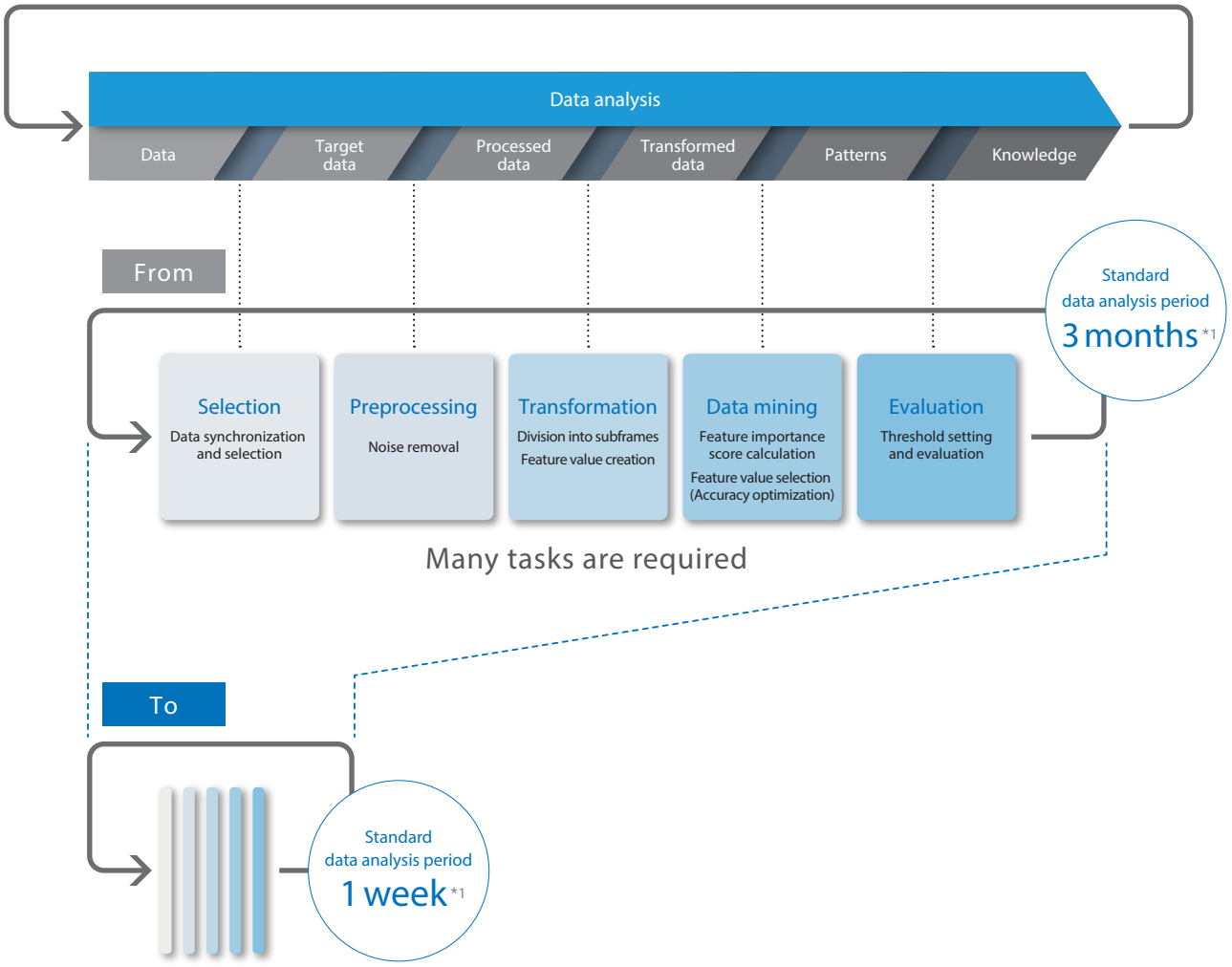


- Ultra-high-speed AI engine can calculate in several tens of microseconds
- One machine learning model can discriminate multiple operating modes
- Up to 16 feature dimensions

Data mining software facilitates analysis of manufacturing

A single click for easy data analysis

To resolve issues, manufacturers need to utilize data collected from machines in various scenes.
However, performing tasks for data utilization is sometimes time consuming and even difficult because it requires data science skills for data analysis and know-how of manufacturing machines for improvement.
The data mining software incorporating Omron's unique automatic analysis technology automates data science tasks, enabling even on-site engineers to easily analyze data.



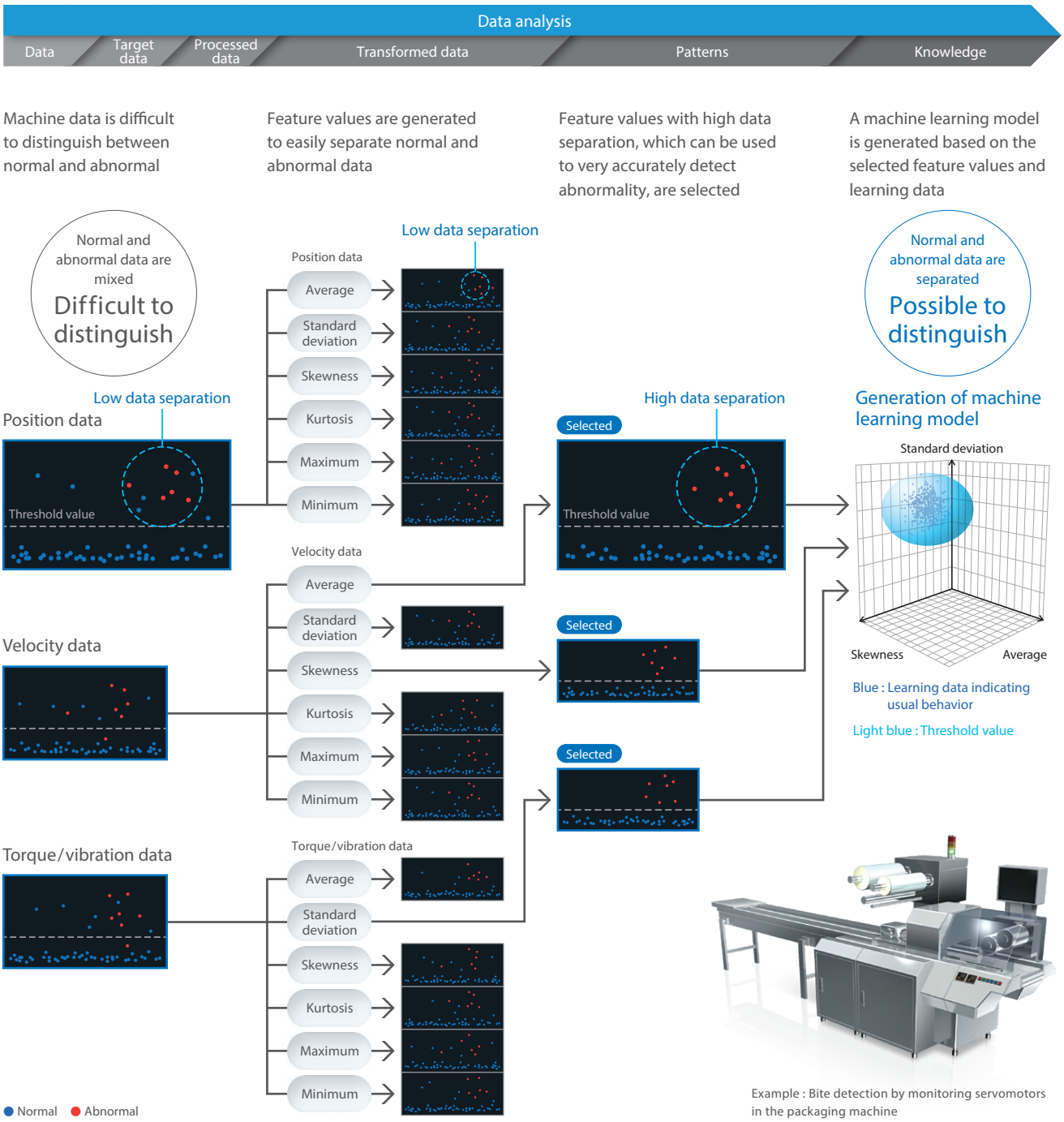
Omron's unique automatic analysis technology allows one click to perform all tasks

*1. Based on Omron investigation in December 2020.

site issues

Features of the Data Mining Software

This software automatically extracts feature data to detect irregularity from machine data that is difficult to distinguish between normal and abnormal, and generates a machine learning model.

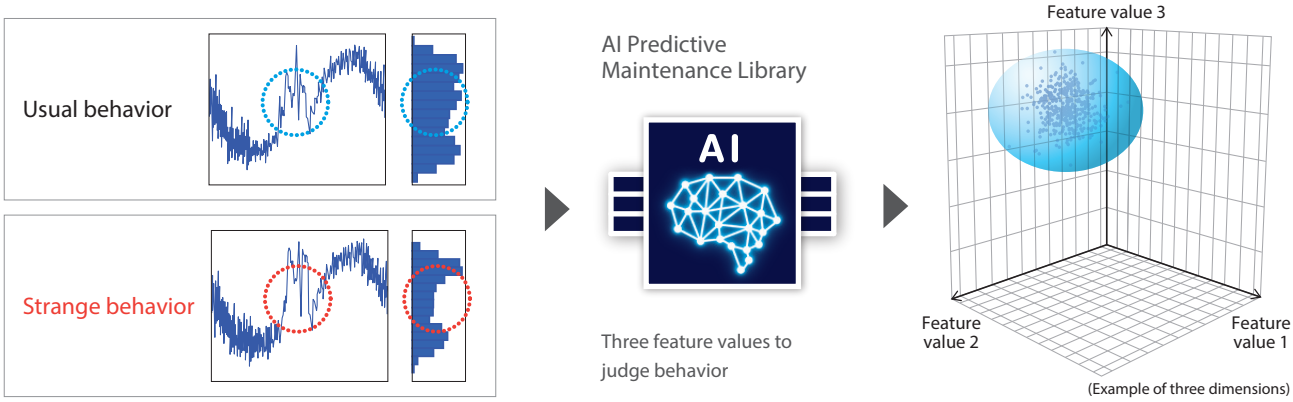


Example : Bite detection by monitoring servomotors in the packaging machine

AI Predictive Maintenance Library enables non-stop

Software components for accurate detection of strange behavior

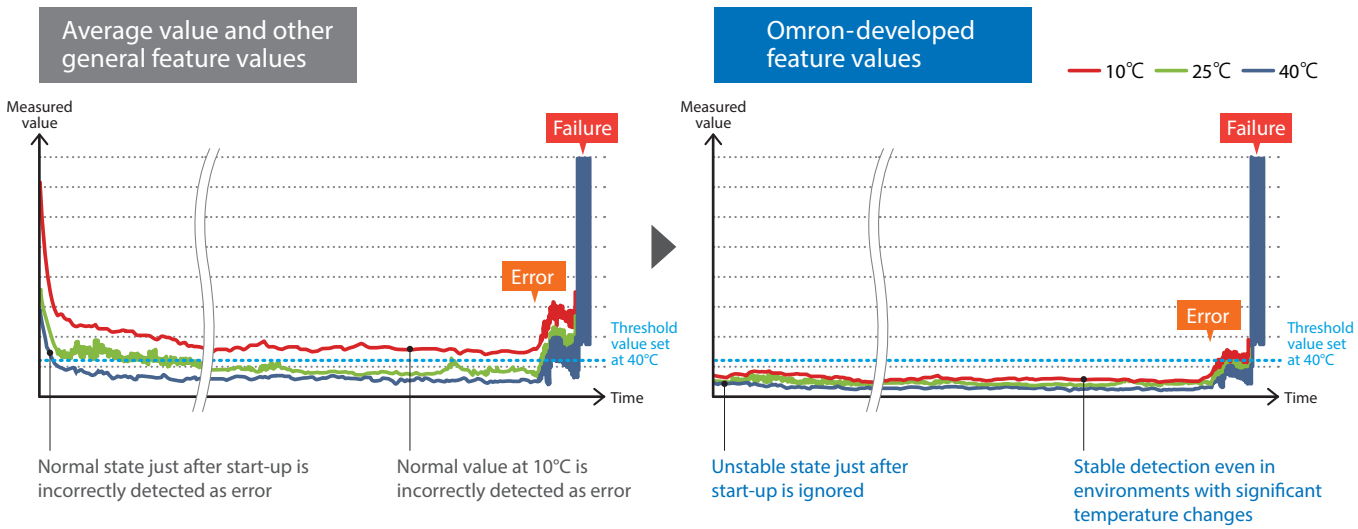
The AI Predictive Maintenance Library, a collection of software components, calculates optimal future values to judge behavior from data of operating mechanisms. You can now start to do predictive maintenance.



Note : You can choose from two options to set learning data and threshold values optimized for your machine: you set them using the Data Mining Software Model setting edition or Omron's service engineers provide support. Consult your Omron sales representative for details.

Robustness minimizes effects of environmental changes

Time elapses and ambient temperature changes throughout the day and year after the machine is started. Omron has developed its own feature values that minimize the effects of environmental changes, helping you stabilize your predictive maintenance activities.



*The above results were obtained under Omron's test conditions. The same results are not guaranteed for all conditions.

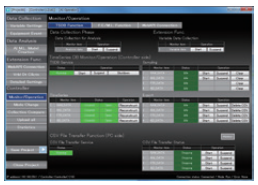
equipment

System configuration

Omron helps you perform predictive maintenance using AI.

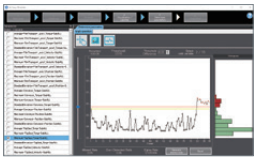
AI Controller Software

Configuration tool
AI Operator

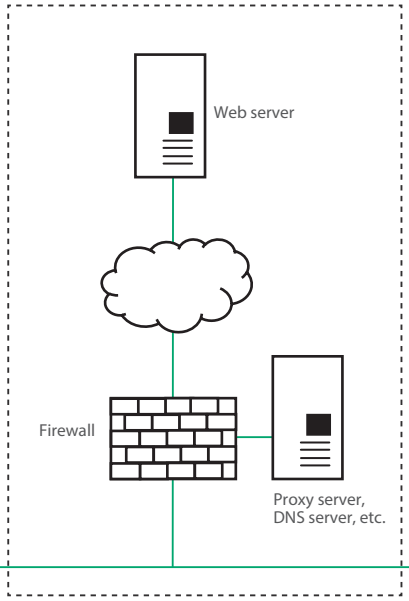


Visualization tool
AI Viewer

Machine learning model generation tool
AI Easy Modeler

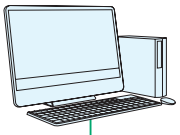


Install a web server if you want to transfer calculation results to it



[NX Series]
Install the AI controller software in the host computer
• AI Operator • AI Viewer

NA Programmable Terminal



EtherNet/IP

AI controller
• Time Series Database Function
• Feature Value/Machine Learning Function
• WebAPI Connection Function

[NY Series]
Install the AI controller software in Windows on the NY Series
• AI Operator
• AI Viewer

NY AI Controller

NX AI Controller

When Sysmac Library for AI controllers is used

or

When you analyze data

Sysmac Library for AI controllers

\+

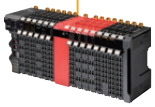
Data Mining Software Model setting edition

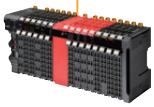
Data Mining Software*

* The Data Mining Software Model setting edition is included.

EtherCAT

EtherCAT slaves





Ordering Information

NX-series AI Controller

Product Name	Specifications			Current (Power) consumption	Model
	Program capacity	Memory capacity for variables	Number of motion axes		
NX701 CPU Units with AI function	80MB	4 MB : Retained during power interruption 256 MB : Not retained during power interruption	256	40W (including SD Memory Card and End Cover)	NX701-Z700
			128		NX701-Z600

NY-series AI Controller

Product Name	Specifications						Model
	Operating system	CPU type	Number of motion axes	RAM memory (non-ECC type)	Storage size	Interface option	
Industrial Box PC with AI function	Windows 10 IoT Enterprise 2019 LTSC -64bit	Intel®Core™ i5-7440EQ	64	32GB	128GB×2 SSD iMLC/pSLC	RS-232C	NY512-Z500-1XX445T1X
			32				NY512-Z400-1XX445T1X
			16				NY512-Z300-1XX445T1X
			64			DVI-D	NY512-Z500-1XX445T2X
			32				NY512-Z400-1XX445T2X
			16				NY512-Z300-1XX445T2X
Industrial Panel PC with AI function			64			RS-232C	NY532-Z500-112445T10
			32				NY532-Z400-112445T10
			16				NY532-Z300-112445T10
			64			DVI-D	NY532-Z500-112445T20
			32				NY532-Z400-112445T20
			16				NY532-Z300-112445T20

For details, refer to the data sheet of the AI Machine Automation Controller NX/NY-Series.

AI Controller Software

Please purchase a DVD and required number of licenses the first time you purchase the Sysmac Studio.
DVDs and licenses are available individually. Each model of licenses does not include any DVD.

DVD

Product Name	Number of licenses	Model
AI Controller Standard Software *1	— (Media only : DVD)	SYSMAC-AICSTE00D

Software license

Product Name	Number of licenses	Model
AI Controller Standard Software *1	1 license	SYSMAC-AICSTE01L
	10 licenses	SYSMAC-AICSTE10L
	30 licenses	SYSMAC-AICSTE30L
	50 licenses	SYSMAC-AICSTE50L

*1. The AI Controller Standard Software and one license are bundled with the NY AI Controller.

● Support Software

Software Name	Specification
AI Operator	The AI Operator is a tool to configure AI function settings of the AI Controller as well as to monitor the status. It works on Windows. The AI Operator also provides a function for transferring results of calculation performed by the Feature Value/Machine Learning Function from the AI Controller to a computer.
AI Viewer	The AI Viewer is a tool to visualize feature values and results of equipment events that are output by the Feature Value/Machine Learning Function. It works on Windows. The AI Operator reads out data transferred from the AI Controller and displays it on a computer for the users to view.

Sysmac Library for AI Controller

Download Sysmac Library for AI Controller to your PC using AI Operator. Install the library before you use it.

Target Mechanism	Software model	Specification
AI Predictive Maintenance Library (Cylinder)	SYSMAC-ZPA001000W	CylinderStatus generates mechanism state variables that reflect the status of the cylinder referenced by the feature value / machine learning functions.
AI Predictive Maintenance Library (Ball Screw)	SYSMAC-ZPA002000W	BallScrewStatus generates mechanism state variables that reflect the status of the ball screw referenced by the feature value / machine learning functions.
AI Predictive Maintenance Library (Belt & Pulley)	SYSMAC-ZPA003000W	BeltPulleyStatus generates mechanism state variables that reflect the status of the belt & pulley referenced by the feature value / machine learning functions.

Target Mechanism	Number of licenses *2	Model
AI Predictive Maintenance Library (Cylinder)	5 licenses	SYSMAC-ZPA001005L
	10 licenses	SYSMAC-ZPA001010L
	50 licenses	SYSMAC-ZPA001050L
AI Predictive Maintenance Library (Ball Screw)	5 licenses	SYSMAC-ZPA002005L
	10 licenses	SYSMAC-ZPA002010L
	50 licenses	SYSMAC-ZPA002050L
AI Predictive Maintenance Library (Belt & Pulley)	5 licenses	SYSMAC-ZPA003005L
	10 licenses	SYSMAC-ZPA003010L
	50 licenses	SYSMAC-ZPA003050L

*2. One license is required for each mechanism to monitor.

For details, refer to the data sheet of the AI Machine Automation Controller NX/NY-Series.

AI Controller Data Mining Software

Please purchase a DVD and required number of licenses the first time you purchase the Sysmac Studio.
DVDs and licenses are available individually. Each model of licenses does not include any DVD.

DVD

Product Name	Number of License	Model
AI Controller Data Mining Software	— (Media only : DVD)	SYSMAC-AICSTENGE00D

Software license

Product Name	Number of License	Model
AI Controller Data Mining Software	1 license	SYSMAC-AICSTENGE01L
	10 licenses	SYSMAC-AICSTENGE10L
	30 licenses	SYSMAC-AICSTENGE30L
	50 licenses	SYSMAC-AICSTENGE50L
AI Controller Data Mining Software Model setting edition *1	1 license	SYSMAC-AICMSENGE01L
	10 licenses	SYSMAC-AICMSENGE10L
	30 licenses	SYSMAC-AICMSENGE30L
	50 licenses	SYSMAC-AICMSENGE50L

*1. This edition is only available to the AI Easy Modeler for Model setting.

● Support Software

Software Name	Specification
AI Easy Modeler	The AI Easy Modeler is a tool designed to generate AI machine learning models necessary for the AI Controller's AI function, and used in a data analytic phase. The AI Easy Modeler makes data analyses easier for users with limited controller programming experiences and statistic knowledge. It works on Windows.
AI Easy Modeler for Model setting	The AI Easy Modeler for Model Setting is a tool designed to generate AI machine learning models necessary for the AI Controller's AI function, and used in an operational phase. It is specialized in threshold setting and machine learning model creation. The operation of the tool is streamlined and easy. It works on Windows.

MEMO

Note: Do not use this document to operate the Unit.

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Authorized Distributor:

CSM_4_1 Printed in Japan
Cat. No. P137-E1-04 1221(1018)