OMRON

Sysmac Library for NJ/NX/NY Controller

SYSMAC-XR018

Visual Feedback Alignment Library

Sysmac Library

Increase positioning speed and accuracy using cameras

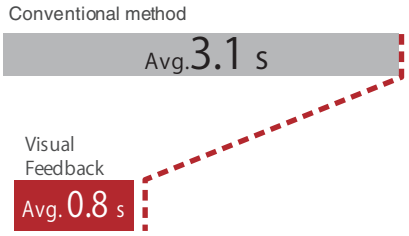
Issure 1	Retries caused by mechanical errors reduce positioning speed.
Issure 2	Sudden positioning failure occurs due to a positioning error or mechanical error.
Issure 3	It is time consuming to calibrate vision sensors accurately.

From positioning by “individually measuring” to positioning by “always monitoring”

This libraryoffers solutions.

Fast and accurate

Alignment positioning with an accuracy of ±1 μm at an average speed of 1 s or less.

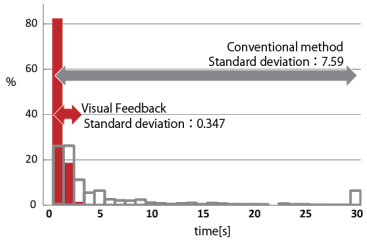


(Measured under our specified conditions)

Robust

Variations in objects (e.g., warping) and mechanical errors are absorbed to avoid reducing speed and failing in positioning.

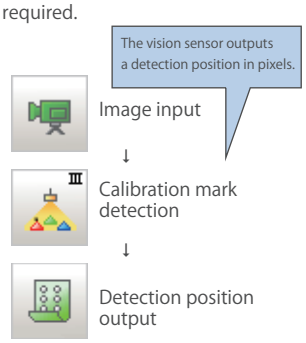
Distribution of positioning times with an accuracy of ±5 μm



(Measured under our specified conditions)

Quick

No vision sensor calibration is required.

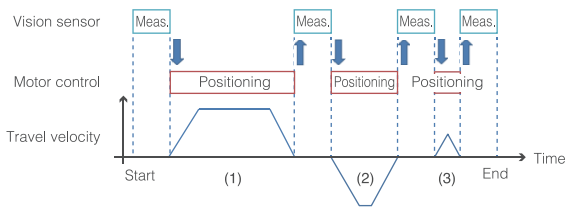


Mechanism for Visual Feedback

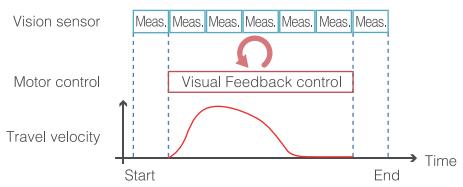
Generally, to perform vision-based positioning, a camera measures the position of an object, and a motor is driven based on the measurement result. A high level of accuracy is required for the camera and motor because individual operations are performed separately.

Visual Feedback uses coordinate data from the vision sensor for the current position of the motor. The current position is fed back to control the motor in every measurement cycle, enabling positioning by eliminating the difference between the motor position and object position.

Conventional method

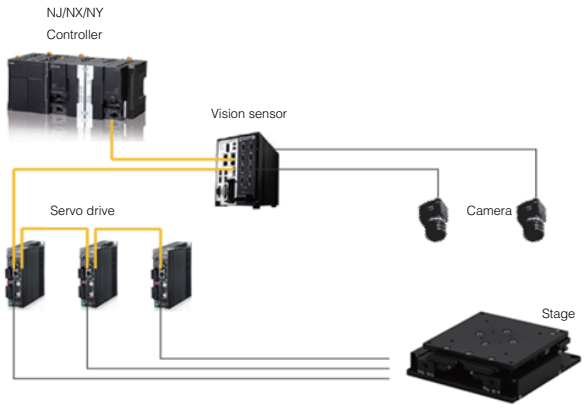


Visual Feedback



sysmac always in control

System Configuration



Compatible Models

Name	Model	Version
Automation Software Sysmac Studio	SYSMAC-SE2□□□	Version 1.18/ Ver1.25 or higher *1
Machine Automation Controller NJ/NX CPU Unit	NJ301-□□□□	Version 1.08 or later
	NJ501-□□□□	Version 1.08 or later
	NJ101-1□□□ *2	Version 1.10 or later
	NX701-1□□□	Version 1.10 or later
	NX1P2-□□□□	Version 1.13 or later
	NX102-□□□□	Version 1.30 or later
Industrial PC Platform NY IPC Machine Controller	NY5□2-□□□□	Version 1.12 or later
FH Vision System	FH-5□□□ / FH-2□□□ *3	Version 6.10 or later

*1. Varies according to FH controller type.
FH-5□□□ / FH-2□□□: Ver. 1.25 or later
*2. When you use this library with NJ101-10□□, you can use a maximum of two real servo axes.
*3. The connection to the controller must be an EtherCAT connection. That is the only supported connection method. Connection via EtherNet/IP™ or TCP socket communication cannot be used.

Function Block (FB) Specifications

Name	FB name	Description
Coordinate conversion	AffineTrans	Converts the reference or measurement mark position output from the vision sensor from the XYθ coordinates of the camera coordinate system to the XYθ coordinates of the stage coordinate system based on the calibration parameters. It is possible to convert up to 4 coordinates at the same time.
Position and Angle Calculation	CalcPosAngle	Calculate the position / angle (XYθ coordinates) to be used for alignment control from the 1 to 4 reference mark position, or measurement mark position points converted to the stage coordinates. To calculate the position, use the *midpoint of the target point*.
Multipoint Position and Angle Calculation	CalcMultiPosAngle	Calculate the position / angle (XYθ coordinates) to be used for alignment control from the 2 to 4 reference mark position, or measurement mark position points converted to the stage coordinates. To calculate the position, you can select from two methods, *least squares method* and *Maximum Error Minimization* method.
Stage Control	CtrlStage	Alignment control is performed to make the reference XYθ position align with the measurement XYθ position. Visual feedback control is used for axis travel distance calculation and axis movement control.
Travel distance calculation	CalcMovement	From the input reference XYθ position, measurement XYθ position, stage position XYθ position, calculate the travel distance on the X, Y, and θ axes on the virtual XYθ stage coordinates.
Reverse kinematics calculation	CalcInverseKinematics	Performs Reverse kinematics calculation to convert the travel distance of the XYθ axis on virtual XYθ stage coordinates to the target positions on the X/U axis, Y/V axis, θ/W axis, and R axis.
Forward kinematics calculation	CalcForwardKinematics	Perform a Forward kinematics calculation to convert the current position of each axis of the stage to the coordinate position on the virtual XYθ stage coordinates.
Axis velocity calculation	CalcAxisVelocity	The axis movement velocity for each task period is output from the travel distance of each axis on the Virtual XYθ Stage coordinates and from the current stage position. Since the task period of the controller is shorter than the calculation time of the vision sensor, in the task period where the measurement result is not output from the vision sensor, the axis movement velocity is output by interpolation calculation.
Alignment control complete judgement	JudgeAlignmentComplete	In-Position judgement performed for the measurement mark position with respect to the reference mark position. This is the means for judging completion of alignment control. Also, it is the judgement to determine whether to ultimately output the measurement trigger output from the Generate trigger FB (GenerateTrigger) to the vision sensor.
Trigger generation	GenerateTrigger	A measurement trigger is generated and it instructs the vision sensor to perform a measurement.
Generate calibration parameter	GenerateCalibParams	Generate calibration parameters used for coordinate conversion (AffineTrans). By executing this instruction, it is possible to generate up to 4 mark positions.

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