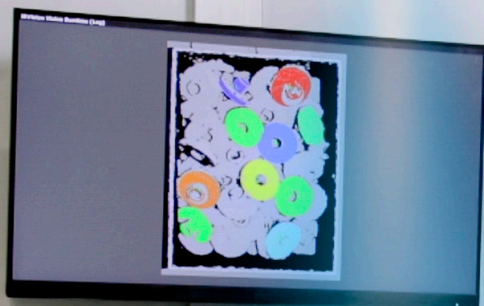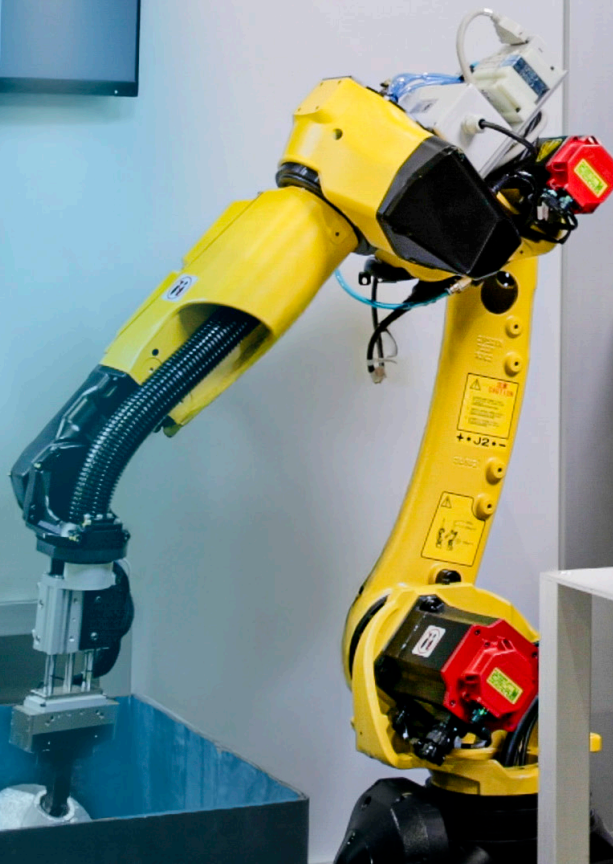# Advanced Sensor Technologies

Provides the robot with the senses of touch and sight

Like a human hand, **Force Control** provides the sense of touch and **Vision** provides the sense of sight. Achieve greater flexibility and efficiency by combining both Force Control and Vision for your automation needs.

WWW.FANUCAMERICA.COM

The Automation of Work

FANUC robots, outfitted with advanced sensors from FANUC, can automate intricate tasks that would typically require master craftsmen or elaborate fixtures.
By automating these complex tasks, you will increase productivity, enhance quality, and reduce costs.

Force Control

Features
Force Control is a system that operates in a closed loop. This system uses force and torque data from a sensor attached to the robot's wrist to guide the robot's position and trajectory, all while maintaining a specified force.

Benefits
A variety of Force Control functions make it possible to perform intricate tasks such as deburring, polishing, and assembly, which were previously performed by skilled workers or specialized machines.
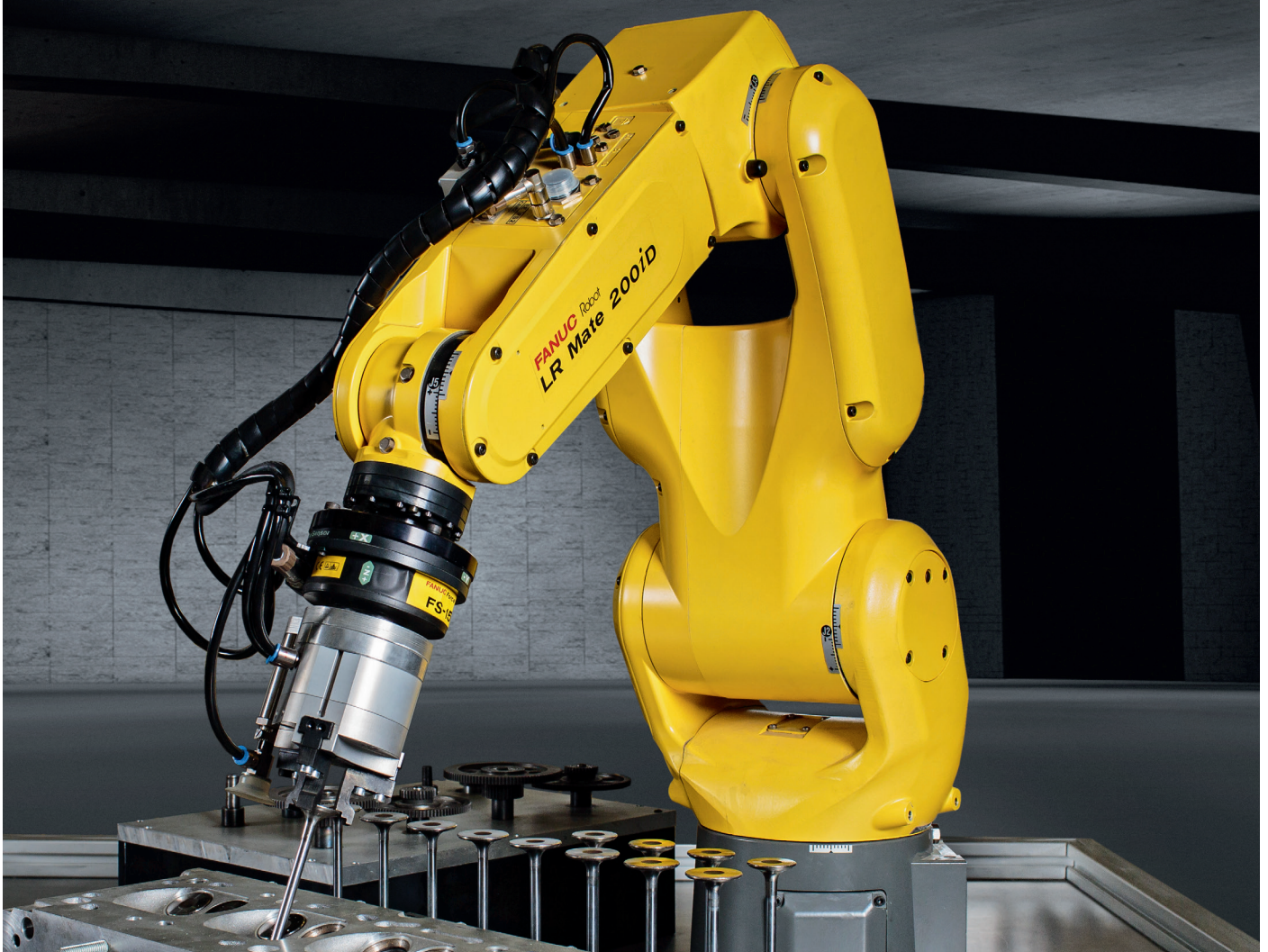
Vision Sensor

Features
Vision allows the robot to accurately locate a workpiece in a variety of scenarios using both fixed and robot-mounted cameras and 3DV sensors. Vision provides offsets to guide the robot and adjust for workpiece movement.

Benefits
Utilizing vision gives robots greater flexibility and eliminates the need for fixturing when staging workpieces. Vision allows robots to perform applications such as bin picking, depalletizing, line tracking, inspection, pick and place, and assembly.

Vision Sensor Functions

Easy connection

The FANUC vision system is fully integrated into the controller. Cameras and sensors connect directly to the controller. Integrated vison software allows vision to be seamlessly integrated into robot programming and to be taught through the robot teach pendant without the need for a PC.


Robot or Fixed Mounting

Vision sensors

Teach pendant

Controller

Easy teaching

Camera port
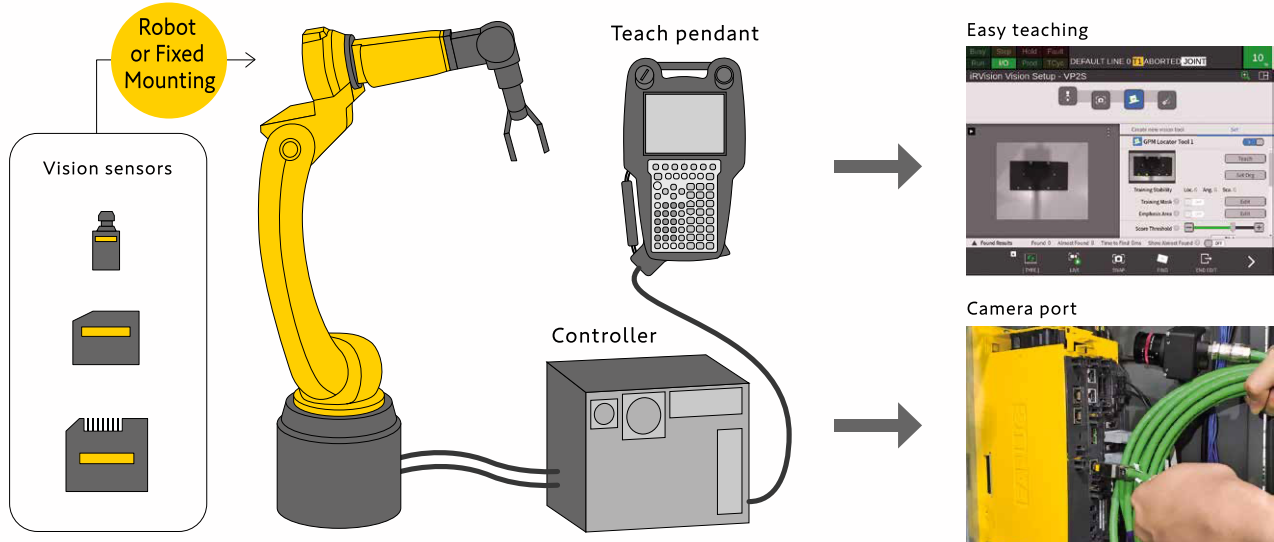
Fixed frame offset

Locates loose workpieces using a 2D camera or 3D Vision Sensor and provides the workpiece position to the robot.

Fixed frame offset

2D Camera   3DV Sensor

or
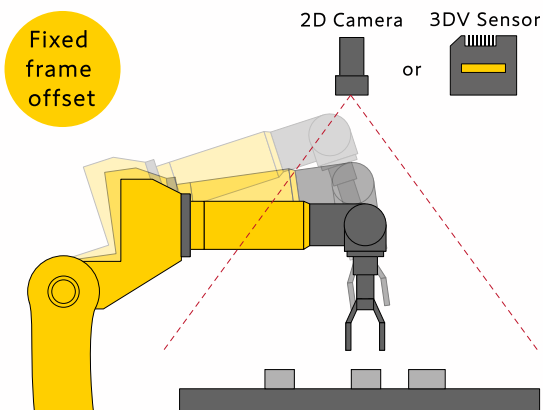
Tool offset

Locates the workpiece relative to the gripper and provides an offset to correct for deviation in picking.


Tool offset

3DV Sensor

or

2D Camera
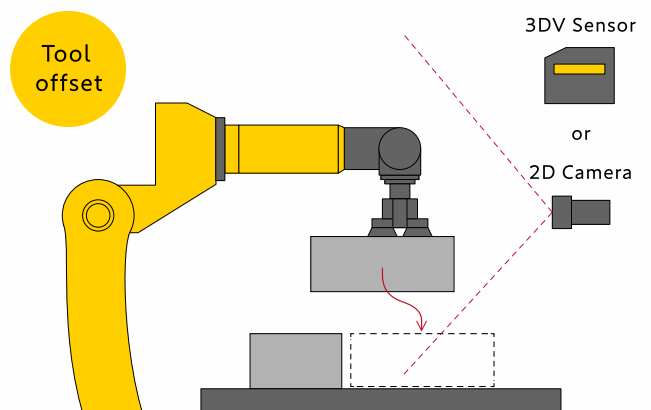
AI Error Proofing

AI learns to differentiate between OK and NG workpieces using operator labeled images. This can be used to determine Pass or Fail of a process, workpiece presence or absence, and part orientation.

Pass

Learning

OK

Fail

Register

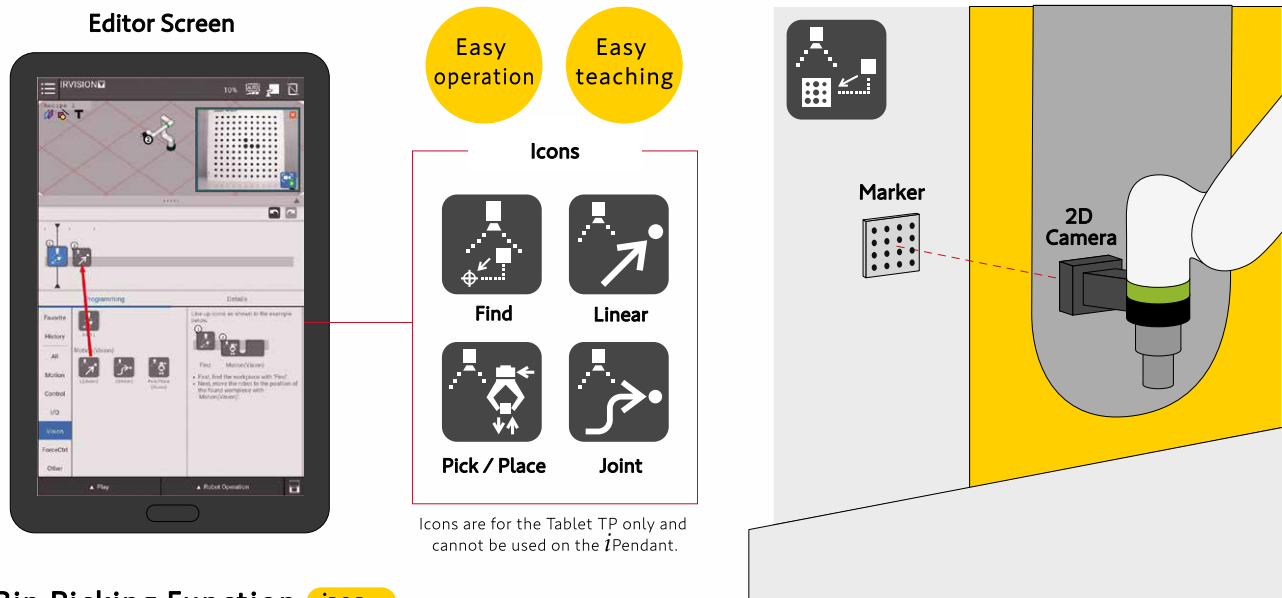Controller

Differentiation
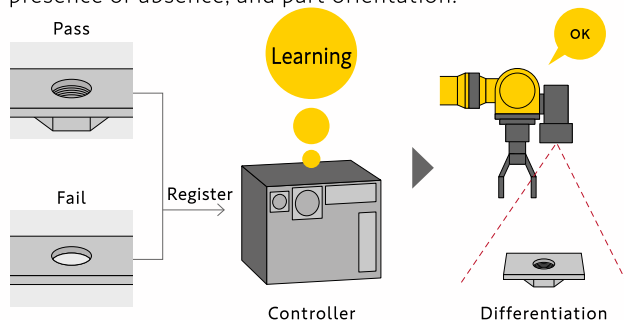
AI Box Locator   *i*PC Box

Pretrained AI is able to detect boxes of various sizes on a pallet. AI training can be improved by the user to detect special boxes.

3DV Sensor

Detects tightly-spaced boxes

*i*PC Box

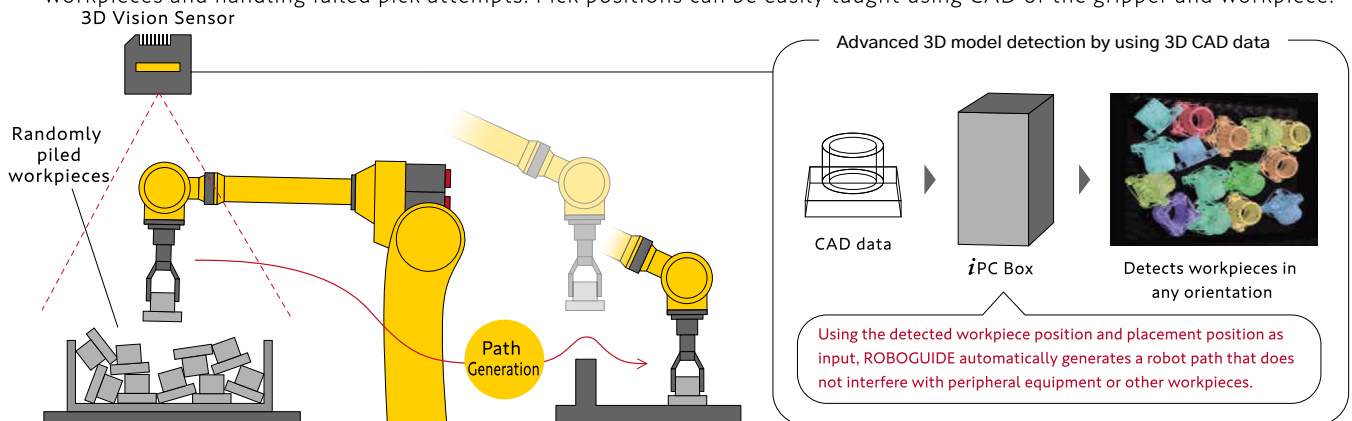Controller
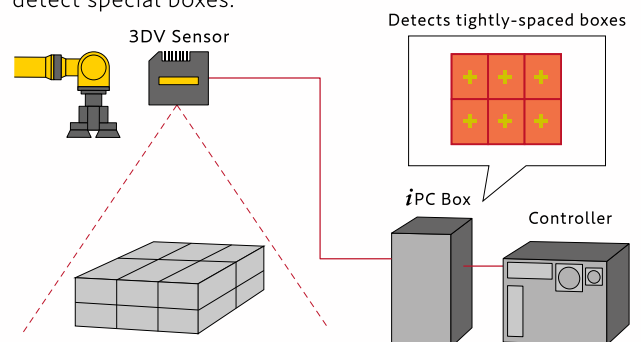
Vision Sensor Functions

Easy teaching

Icon-based programming on the Tablet TP allows for easy programming of the robot and vision in a single interface. Easily create programs to locate and pick workpieces or locate machine tools for machine tending.

Editor Screen

Easy operation **Easy teaching**

Icons

Find	**Linear**
Pick / Place	**Joint**

Icons are for the Tablet TP only and cannot be used on the *i*Pendant.

Marker

2D Camera

Bin Picking Function *i*PC Box

Pick randomly loaded-workpieces from a container using a 3D Vision Sensor. Integrated Interference Avoidance prevents collisions between the robot and the container or workpieces. The integrated Part List Manager allows for picking multiple workpieces and handling failed pick attempts. Pick positions can be easily taught using CAD of the gripper and workpiece.

3D Vision Sensor

Randomly piled workpieces

Path Generation

Advanced 3D model detection by using 3D CAD data

CAD data → *i*PC Box → Detects workpieces in any orientation

Using the detected workpiece position and placement position as input, ROBOGUIDE automatically generates a robot path that does not interfere with peripheral equipment or other workpieces.

Visual Tracking Function

Enables the robot to track workpieces on moving linear or circular conveyors. A pulsecoder enables the robot to track the workpiece found by vision along the conveyor.

3D Vision Sensor **2D Camera**

or

Conveyor feed direction →
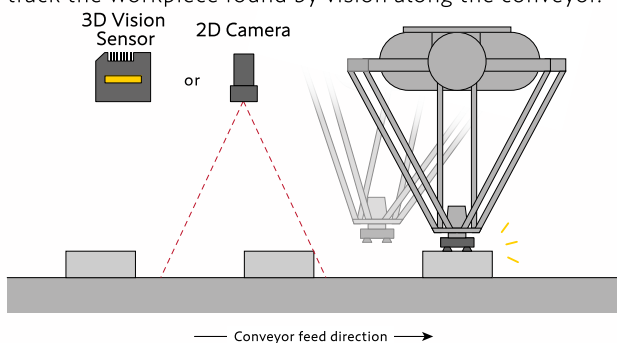
Realtime Visual Tracking Function *i*PC Box

Enables the robot to track workpieces without the use of a pulsecoder by using a vision camera, allowing the robot to perform assembly operations.

Tracking
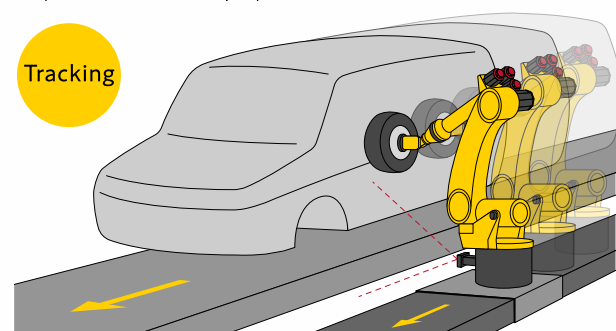
Vision Sensor Functions

iRCalibration

*i*RCalibration functions are based on *i*RVision, but it is a stand-alone service tool to simplify the initial setup and to speed up the entire integration, which results in an improvement of the application accuracy. Additional solutions based on vision systems are the *i*RVision Weld Tip Inspection, which prevents wear and tear of the weld tip, and the *i*RTorchMate, which inspects the ArcTorch, calculates and corrects a possible misalignment.

Camera

Target mark

Camera

Target mark
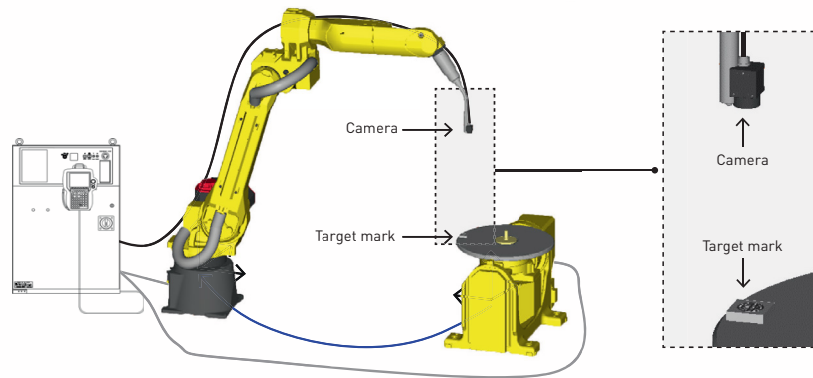
Vision Mastering

This function calibrates the robot mechanics. It improves the positioning accuracy of a robot, contributing to an accuracy improvement of TCP setting, vision application and easy utilization of offline programs.


Vision TCP Set

This function allows you to set a tool frame automatically which was conventionally done by manual operation of the robot. It helps to set TCP accurately.

Vision Shift / Vision Frame Set

This function guides the robot to measure reference points on a part or its fixture automatically and adjusts programmed points. It helps to save both time and manpower for robot system relocation and offline program utilization. It can also be used to set a user frame automatically by the measured reference points data.


Reference point
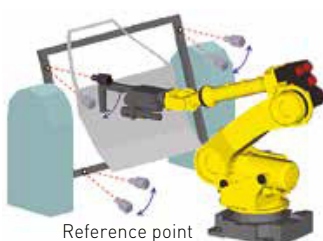
Vision Multi-Cal

This function calibrates relations between multi-group robots which are under coordinated control. Both two-arm configuration and one-arm and one-positioner configuration are supported. It helps to improve the coordinated motion accuracy.

Force Control Functions

Easy connection

The FANUC Force Control system is fully-integrated with a force sensor that is connected to the controller, eliminating the need for a personal computer.

Force sensor

Easy connection

Teach pendant

Controller

Force sensor

6-axis control

My
Fy
Mx
Fx
Mz
Fz
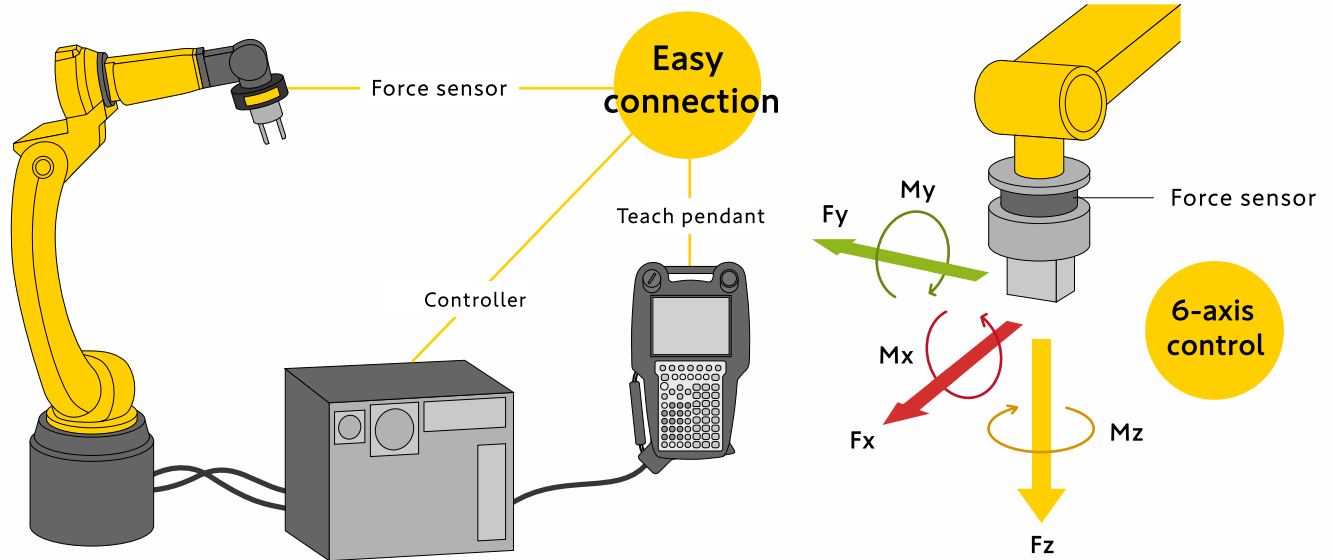
Precise insertion

Designed for applications that insert a component to a depth. A practical example is the insertion of a shaft into a hole with a fit tolerance of 10 micrometers or more.
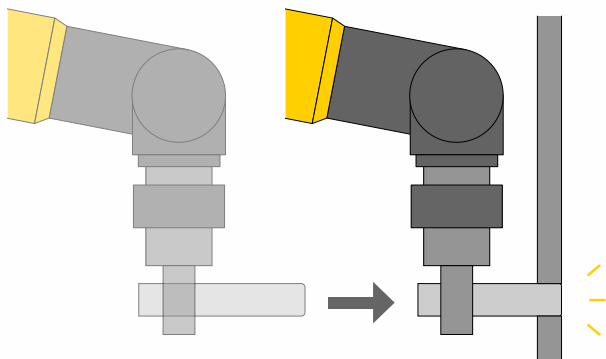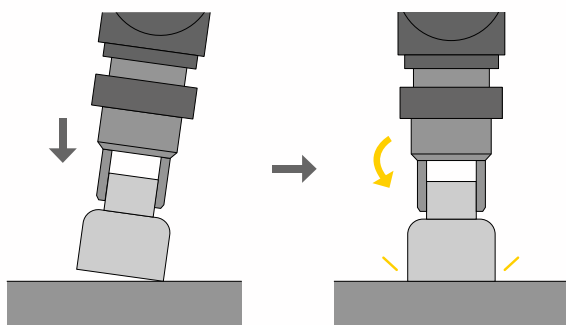
Insertion with phase-matching

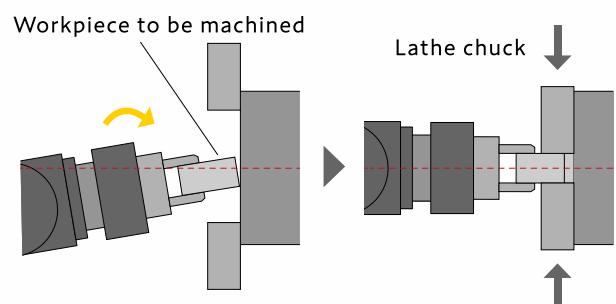Designed to ensure the alignment of a keyed shaft with a keyway, facilitating gear engagement.

Insertion with phase-matching
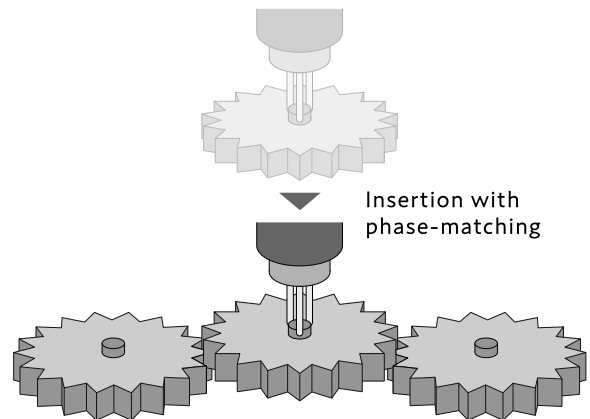
Face matching

Designed to match two flat surfaces.

Centering

Designed to accurately center and align parts with a lathe chuck.

Workpiece to be machined

Lathe chuck

Force Control Functions

Easy teaching

The process of creating force control programs can be effortlessly accomplished by sequentially setting the force control parameters. Force control parameters can be easily set using auto-tuning. The CRX is also designed to accommodate both integrated sensors and external force sensors.

Program editor

Setting

Parameter setting

Easy operation

- 1 Sensor setting
  Sensor: External force sensor ▼
- 2 Insert start position
  Touch Up
  Position No. 1 ▼
  Comment
- 3 Force control coordinate setting
  Force coordinate 1:sample ▼ | New setting
- 4 Phase matching settings
  Insertion depth
  10.000 mm
- 5 Automatic tuning | Execution
 Phase matching test | Execution
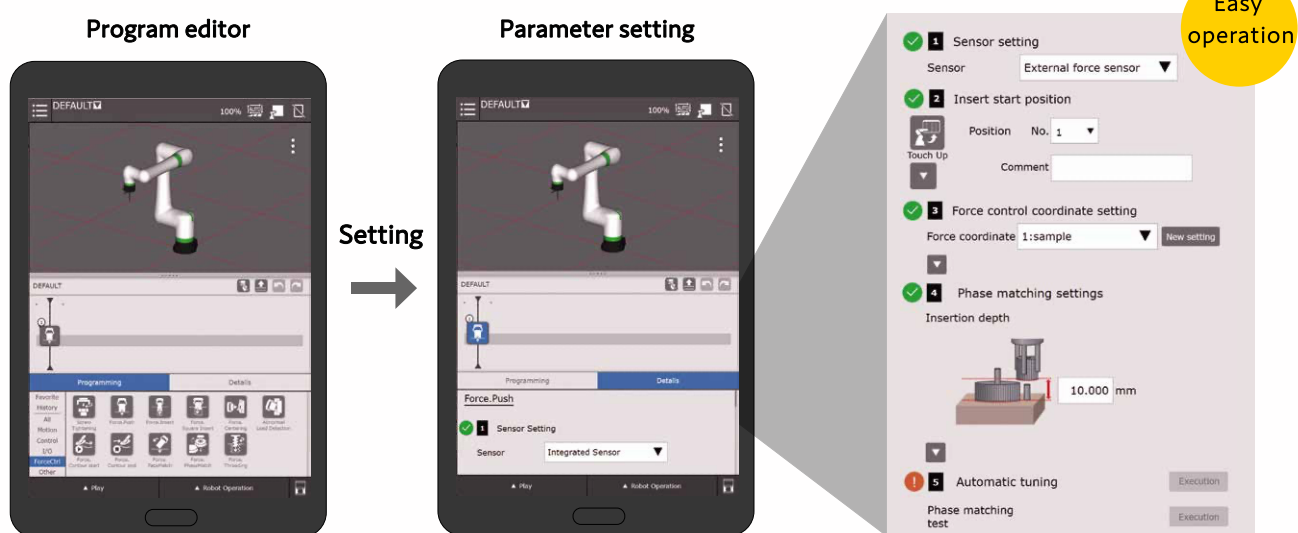
Contouring (deburring, polishing)

The purpose of contouring is to apply a constant force relative to the component's surface while following a programmed path. Contouring is commonly used for tasks such as deburring, sanding, grinding, and polishing.
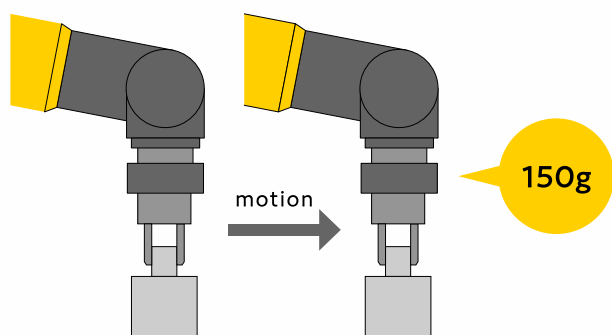

Vertical

Vertical

Workpiece
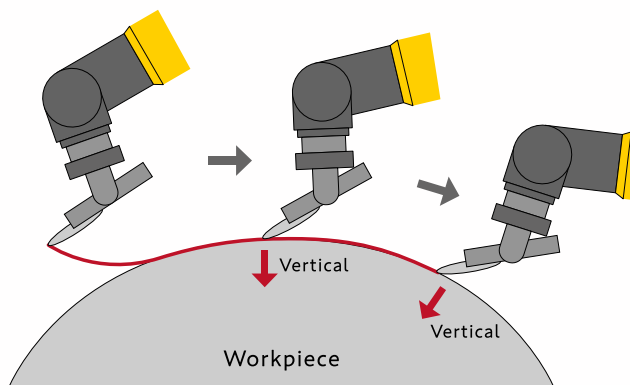
Threading

Threading is designed to correct errors in position and orientation while tightening a screw.

Correct the tilt of the screw
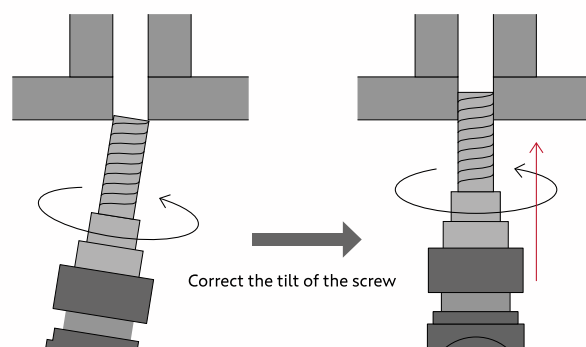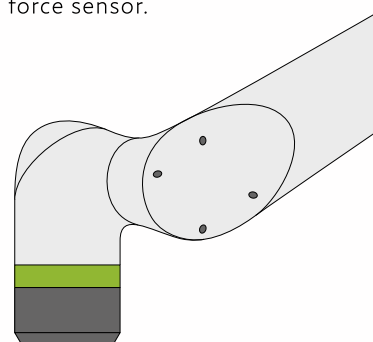
Weighing on-the-fly

This function weighs a component while the robot is moving.

motion

150g

Force control with integrated sensor `CRX series`

Force Control with integrated sensors is exclusive to the CRX series of collaborative robots, and does not require an external force sensor.

integrated sensor

Specifications

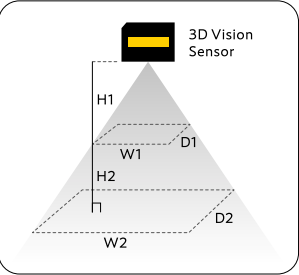Complete product lineup for a variety of force control and vision applications

Vision sensor

Items	2D Camera
Image Type	Grayscale/ Color
Image Resolution [pixel]	Grayscale 2432×2048 Color 1216×1024
Focal Length [mm]	8 / 12 / 16 / 25
LED Light for 2D Detection	Red/White/None
Max. Number of Cameras	Up to 28
Robot Mountable	Yes
Outer Dimension[mm]	75×75×123
Mass[kg]	0.6
Protection Class	IP67
Operating Temperature[℃]	0 to 45

Items	3D Vision Sensor 3DV / 70, 3DV / 200, 3DV / 400, 3DV / 600	3D Vision Sensor 3DV / 1600
Measurement Method	Single Snap 3D Imaging	
Maximum 3D Points	3DV / 70 : 870×950 3DV / 200 : 1060×950 3DV / 400 : 1104×950 3DV / 600 : 1104×950	1104×960
Measurement Range[mm]* W1 x D1x H1, W2 x D2 x H2	3DV/70 : 55×70×167,83×92×56 3DV/200 : 123×123×302,219×198×190 3DV/400 : 268×262×646,527×460×500 3DV/600 : 575×499×1247,805×698×500	Near mode 806 x 814 x 1000, 1491 x 1380 x 700 Standard mode 1245 x 1178 x 1448, 3203 x 2797 x 2000 Far mode 1491 x 1380 x 1700, 3740 x 3239 x 2300
LED Light for 2D Detection	Blue	
Max. Number of Sensors	Up to 16	Up to 4
Robot Mountable	Yes	
Outer Dimension[mm]	156×123×51	234×198.2×70
Mass[kg]	1.1	3.2
Protection Class	IP67	
Operating Temperature[℃]	0 to 45	

*i*PC Box

Items	
Input Voltage	100V AC to 240V AC Single-phase
Outer Dimension[mm]	500×200×320
Mass[kg]	19
Protection Class	IP54
Operating Temperature[℃]	0 to 45

*Measurement Range

Force sensor

Items		FS-15*i*A	FS-40*i*A	FS-100*i*A	FS-250*i*A
Rated load	Fx, Fy, Fz	147N	392N	980N	2500N
	Mx, My, Mz	11.8Nm	39.2Nm	156Nm	500Nm
Static overload	Fx, Fy, Fz	1570N	3920N	9800N	25000N
	Mx, My, Mz	125Nm	392Nm	1560Nm	5000Nm
Resolution	Fx, Fy, Fz	0.39N	1.0N	2.0N	4.9N
	Mx, My, Mz	0.016Nm	0.029Nm	0.08Nm	0.25Nm
Accuracy		2% or less of the rated load	2% or less of the rated load	2% or less of the rated load	2% or less of the rated load
Outer Dimension[mm]		φ94×43	φ105×47	φ155×59	φ198×85
Mass[kg]		0.57	0.87	3.2	6.9
Protection Class		IP67			
Operating Temperature[℃]		0 to 45			