

# Micro robot & Mechatronics Lab.

< Keyword; mechanism, micro robotics, precise positioning, control, micro manipulation >

## Precise Mobile Robot

Internal camera

XYθ mobile robot

Tools

Circuits

50 mm

## XYθ Mobile Robot

XYθ Stage

Z-axis PA

Inner Leg

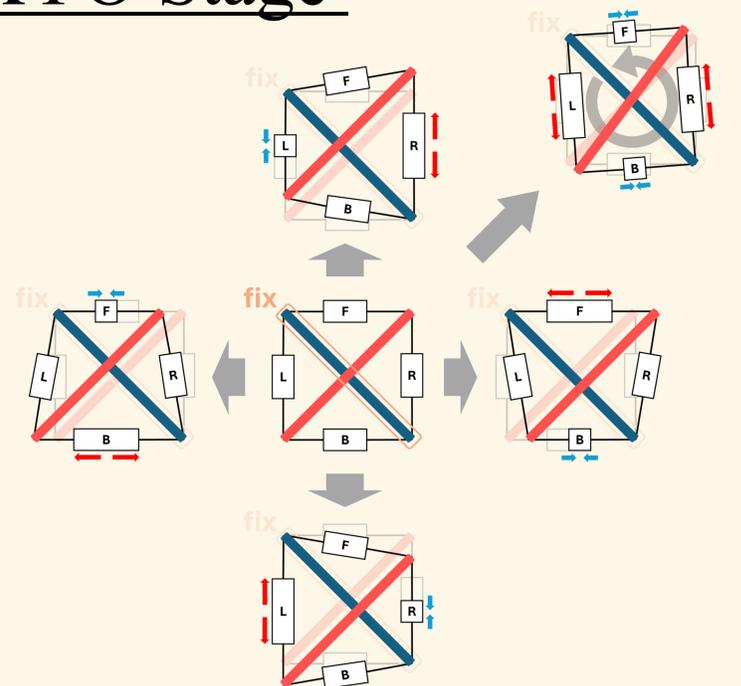
Outer Leg

50 mm

| Size [mm]    | Weight [kg] | Load capacity [kg] | Resolution [nm] |
|--------------|-------------|--------------------|-----------------|
| 90 × 90 × 19 | 0.1         | ≤1.0               | 10              |

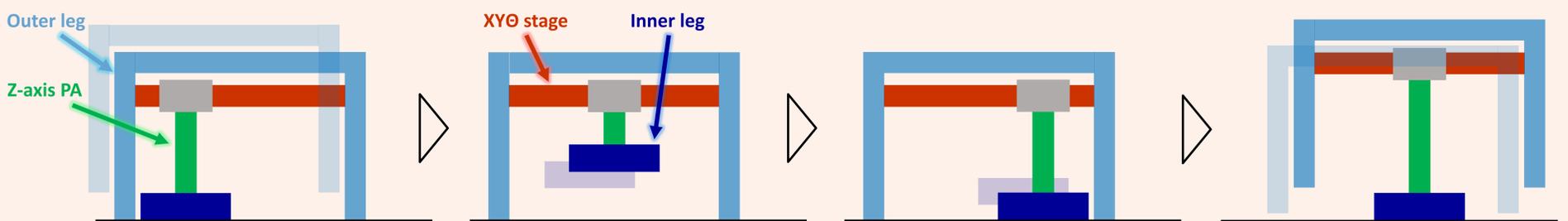
PA : Piezoelectric actuator

## XYθ Stage



F, B, L, R : Piezoelectric actuator

## Continuous walking motion



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## Measurement and Control by Camera

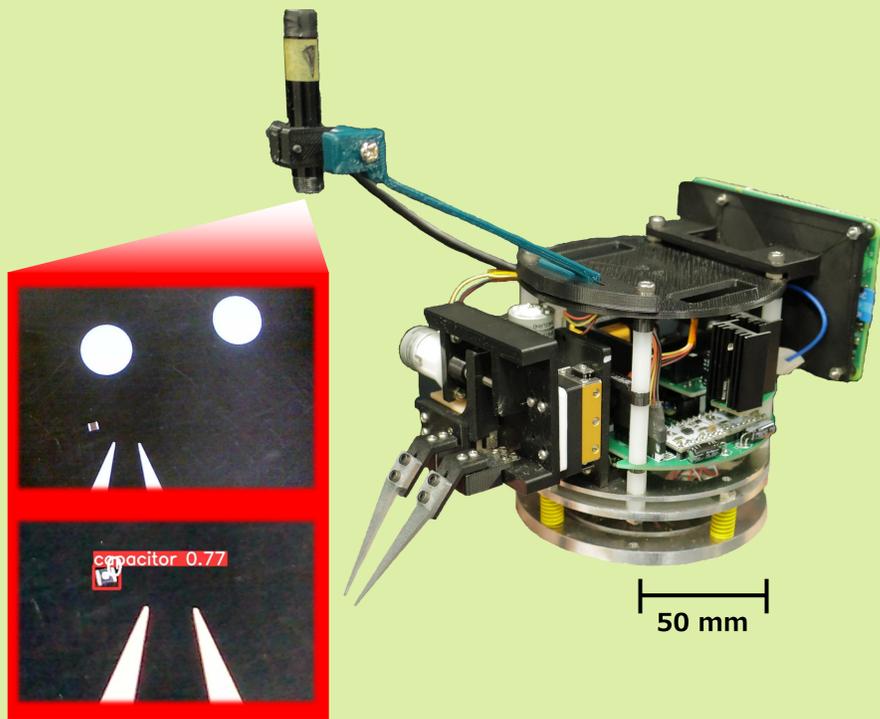
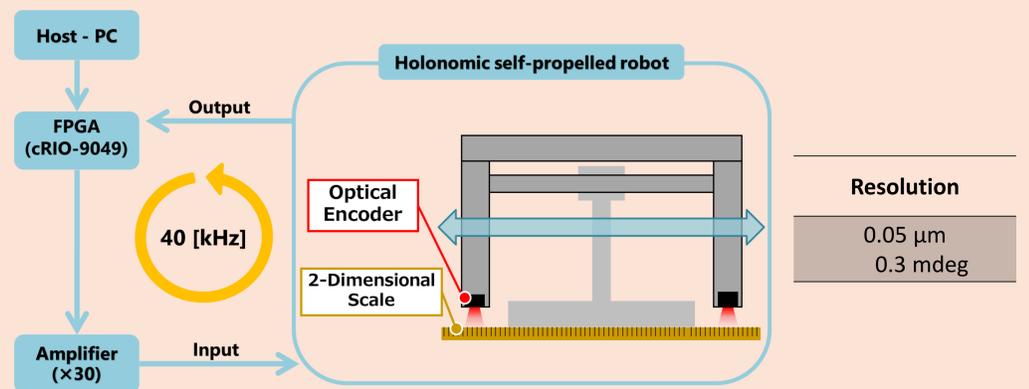
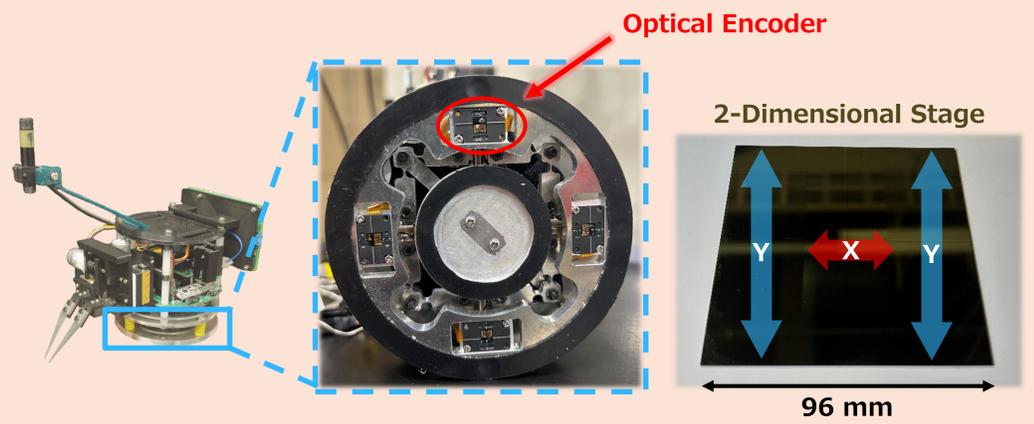
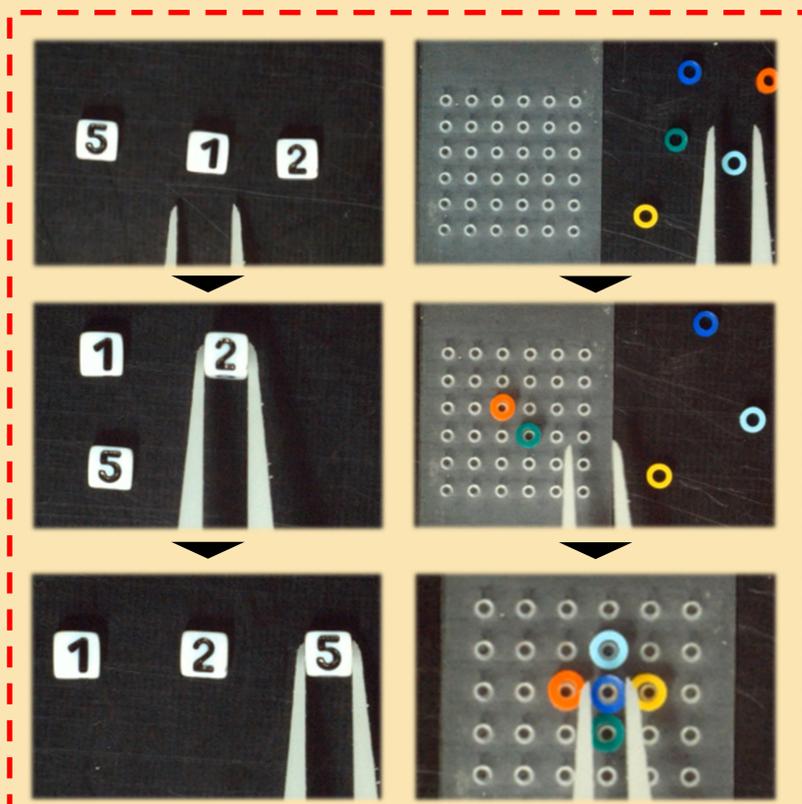


Image recognition  
by machine learning

## Measurement and Control by Encoder



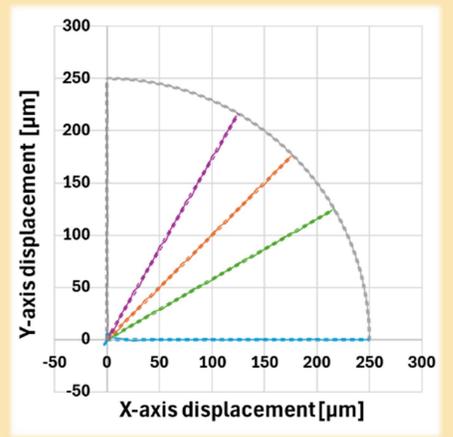
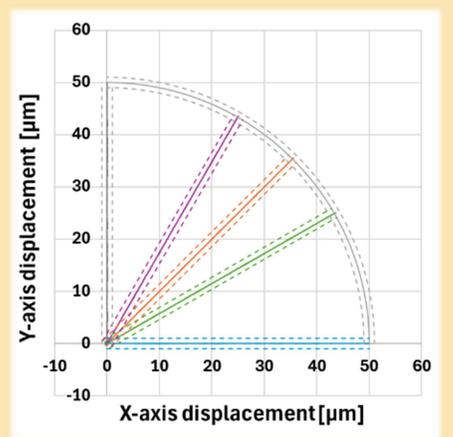
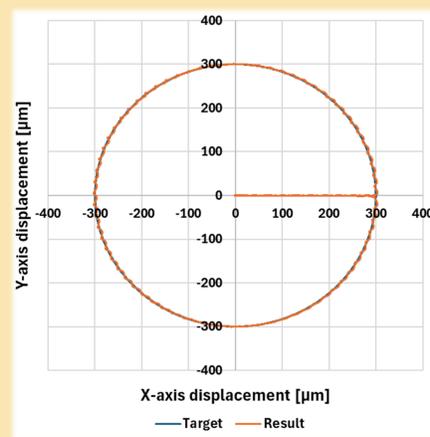
## Experimental result



Camera

Object

Scale

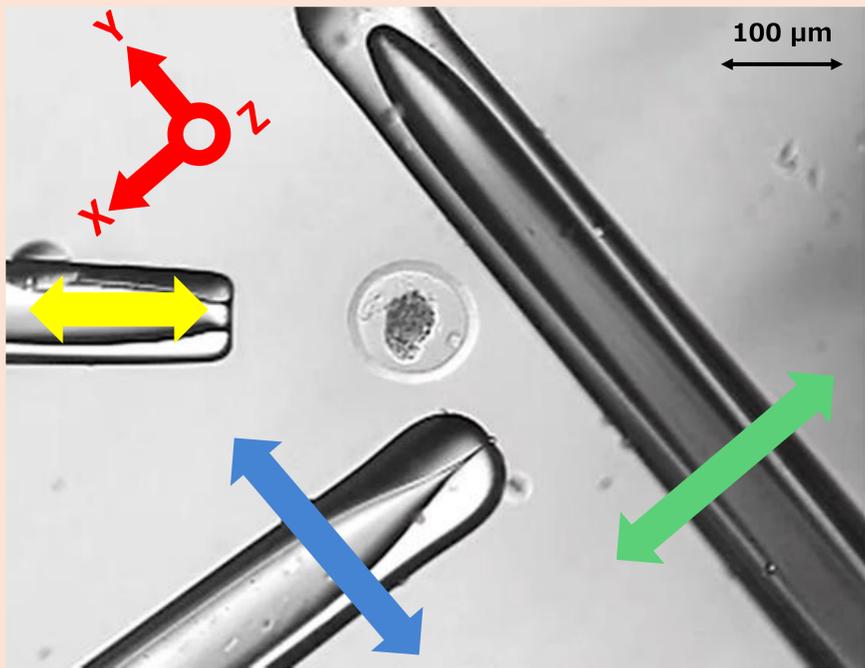


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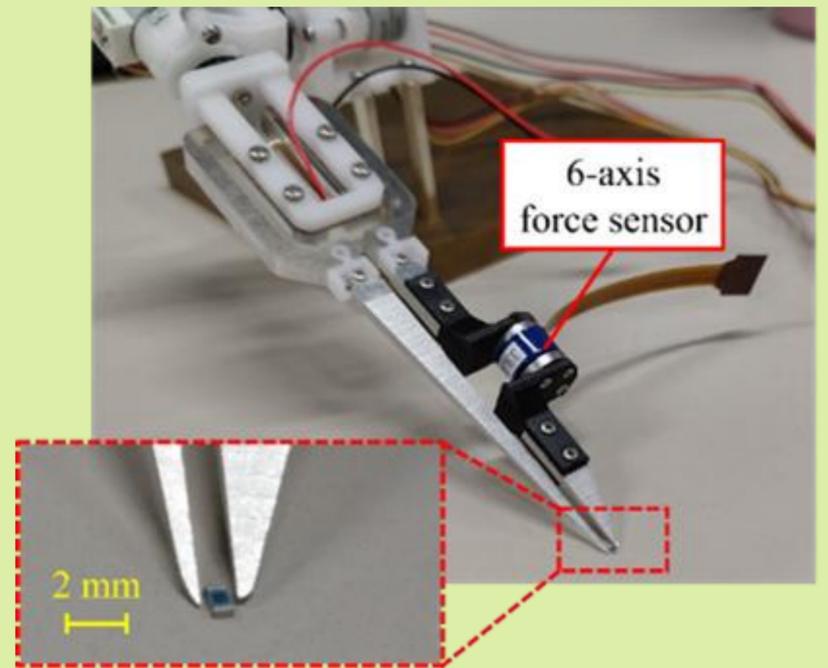
## Tools for micro manipulation

### In-Liquid manipulation



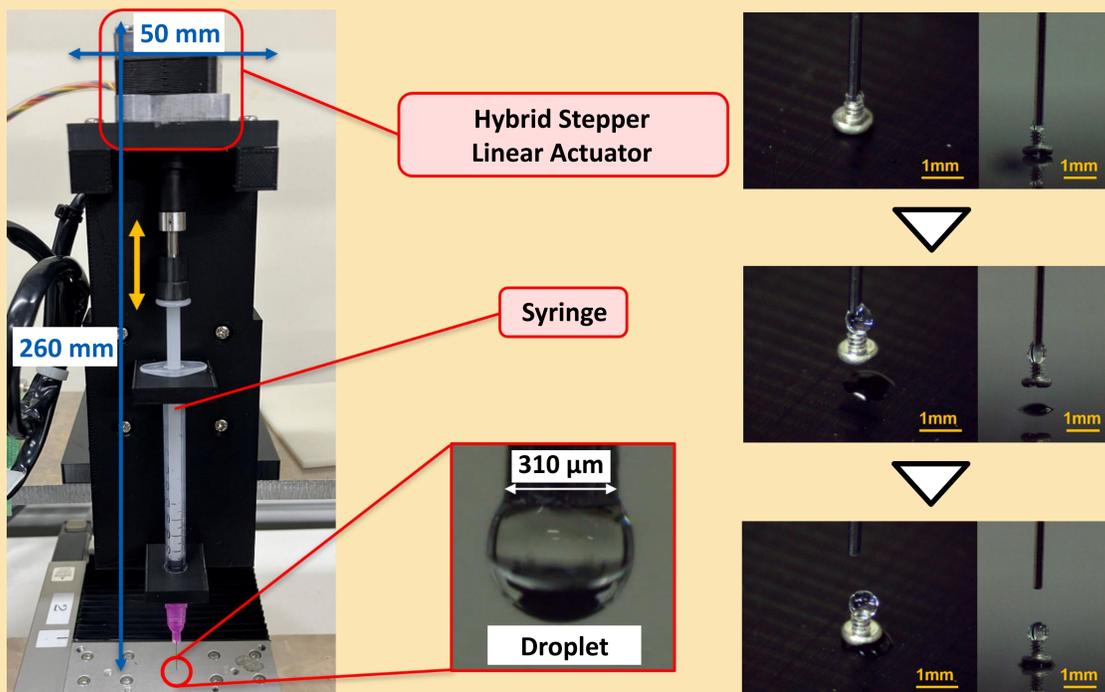
<Applications>  
Multi-axis operation of Cell, Microorganism etc.

### 6-axis force-sensing gripper



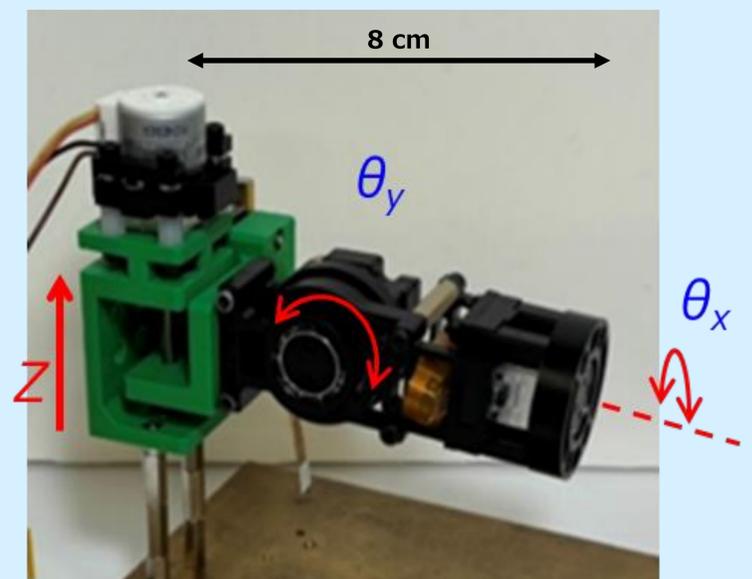
<Applications>  
Grasping of flexible and tiny materials

### Capillary force gripper



<Applications>  
Positioning of complex and microscopic objects

### Ultra-compact robot arm



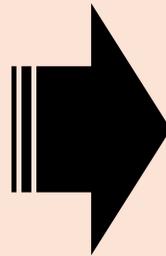
<Applications>  
Screwing, Multi-axis operation

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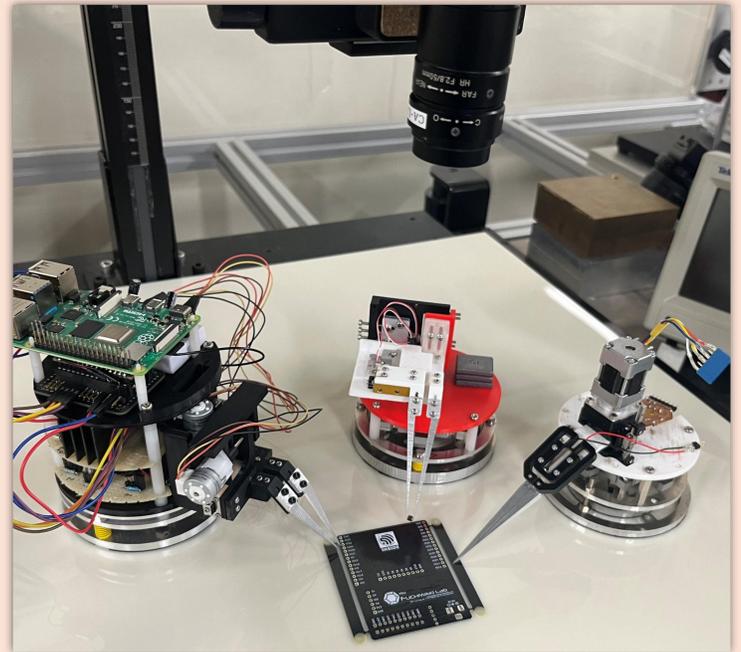
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## Our vision

### Concept

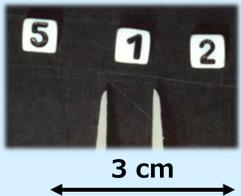


## Micro robotic factory with multiple robots



## Targets

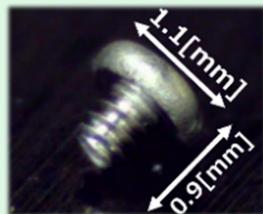
Small Objects



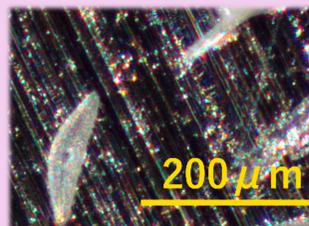
Circuit Implementation



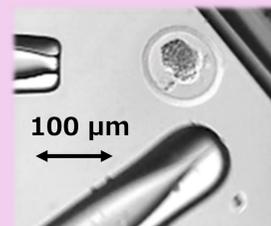
Precision Machinery



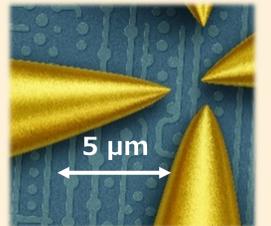
Diatom



Cell



Precision Probing



1cm

1mm

100μm

10μm

1μm



Automatic Holonomic Mobile Micromanipulator for Submillimeter Objects Inspired by the Rhinoceros Beetle



Untethered Autonomous Holonomic Mobile Micromanipulator for Operations in Isolated Confined Spaces



Autonomous Machine Learning-Based Classification and Arrangement of Submillimeter Objects Using a Capillary Force Gripper



Fuchiwaki Lab.

公益財団法人 三菱財団  
THE MITSUBISHI FOUNDATION

公益財団法人  
高橋産業経済研究財団

公益財団法人 NSKメカトロニクス技術高度化財団

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MAST  
Robot Manipulator for Space and Industry

KEIRIN