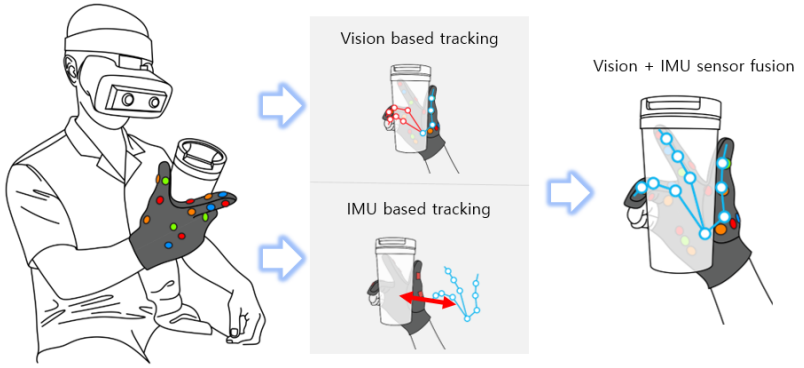
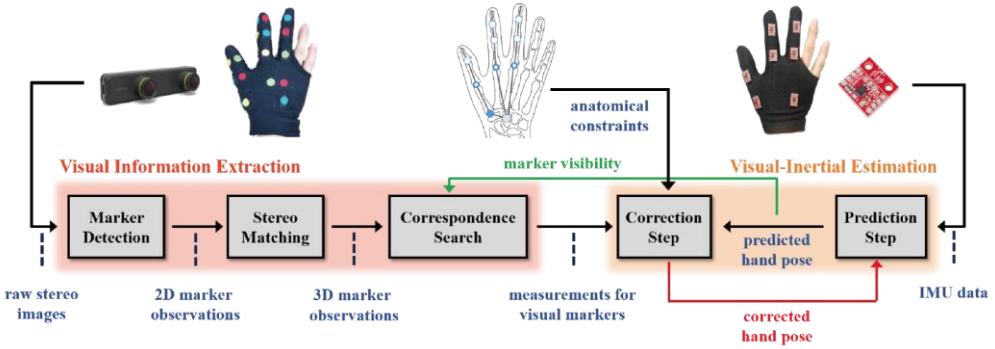
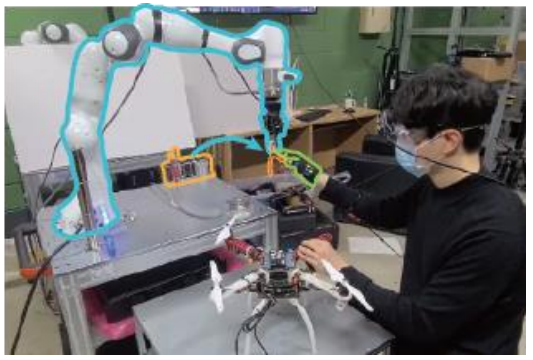
Wearable Visual-Inertial Hand Motion Tracking Interface

- Motivation
  - Limitation of vision based tracking system: occlusion, dataset-dependency.
  - Limitation of wearable based tracking system: magnetic interference, lack of global position tracking, irritating calibration due to sensor bias.
- Contribution
  - Developed a filtering-based state estimation algorithm by opportunistically fusing visual and inertial sensor information.
  - Achieve robust hand tracking system by fusing complementary properties of both sensors which can be utilized as a Human-Robot Interaction (HRI) interface.



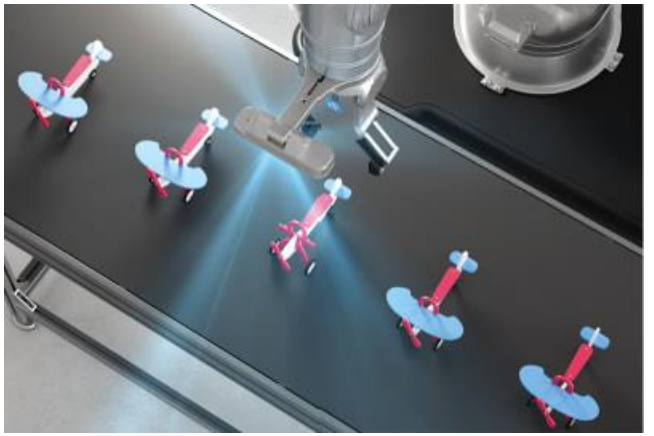




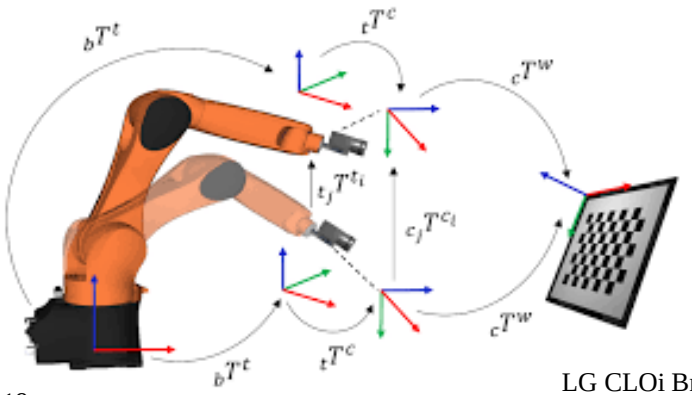
▲ Visual-Inertial Hand Motion Tracking with Robustness against Occlusion, Interference and Contact, Science Robotics, 2021.

AI-Vision-based Robot Manipulator Development & Control

- Motivation
  - Time-consuming procedure of manually manipulator trajectory assignment.
  - Limitation of manual teaching of robot manipulator to grasp various types of products in Robot Production System.
- Contribution
  - Developed 6-DoF collaborative robot for various purposes such as automation of Food & Beverage business or Robot Production System.
  - Developed the autonomous and optimal vision calibration method enabling vision-based control of robot manipulator.
  - Achieved object detection / classification through pose estimation algorithm. (Yolact, DenseFusion, EfficientPose, etc.)



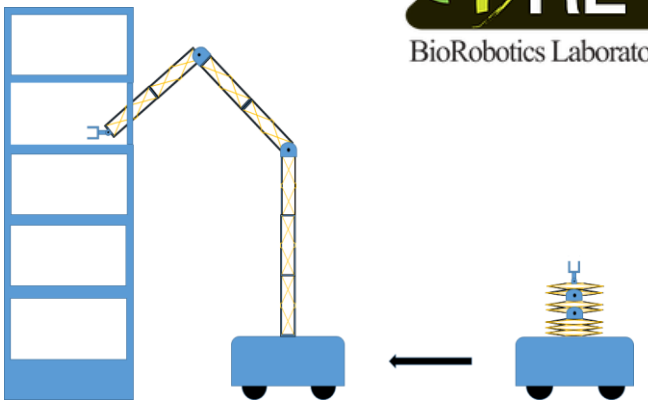
▲ Yolact: Real-time Instance Segmentation, ICCV, 2019

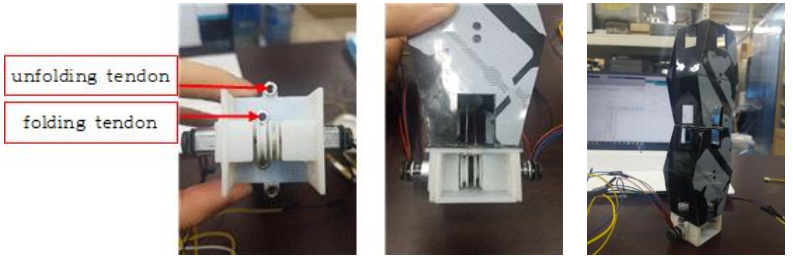


LG CLOi Brista robot at the 2020 Consumer Electronics Show (CES) ▲

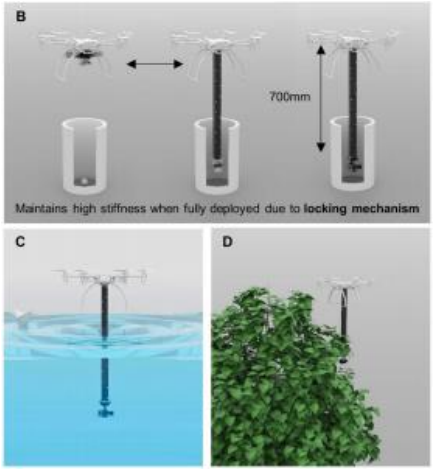
Origami-inspired Multi DOF Robotic Arm

- Motivation
  - Lack of unfolding mechanism of [1] limited to drone robotic arm.
  - Necessity of volume-efficient and human-interactable lightweight robotic manipulator in warehouse.
- Contribution
  - Designed elongated folded line to avoid over-folded state applying origami perpendicular principle.
  - Accomplish folding and unfolding mechanism which is applicable to mobile robot manipulators increasing mobility with folded state and enhancing manipulability with unfolded state.





▲ Origami-inspired Multi DOF Robotic Arm

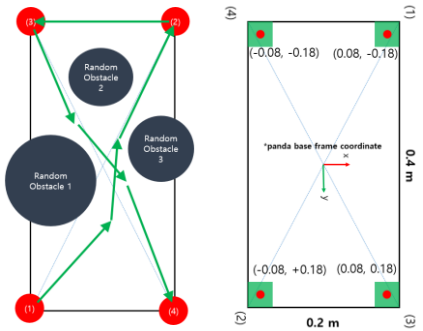


▲ [1] An origami-inspired, self-locking robotic arm ▲ that can be folded flat. *Science Robotics*, 2018

Robot Manipulator Obstacle Avoidance Control

- Motivation
  - Control of a robot manipulator with the existence of obstacles in the workspace while accomplishing desired tasks.
- Contribution
  - Developed a safety control algorithm of a robot manipulator which imposes artificial potential fields around obstacle.
  - Robust control while maintaining the initial configuration of the end effector to avoid singularity through null space control method.

Obstacle Position Coordinate Transform



Obstacle Position

Planning & Control

C++

Artificial Potential Field

Null Space Control

Torque Input

Torque Input

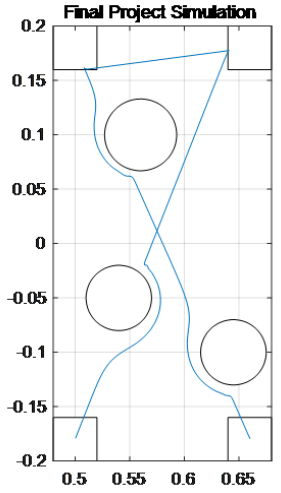
Simulation

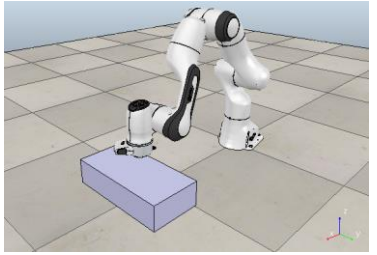
MATLAB

End effector Position

V-rep

Robot Manipulator

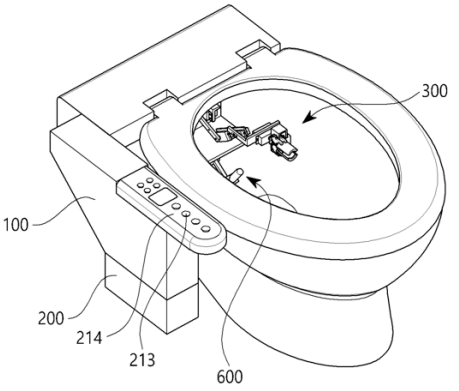


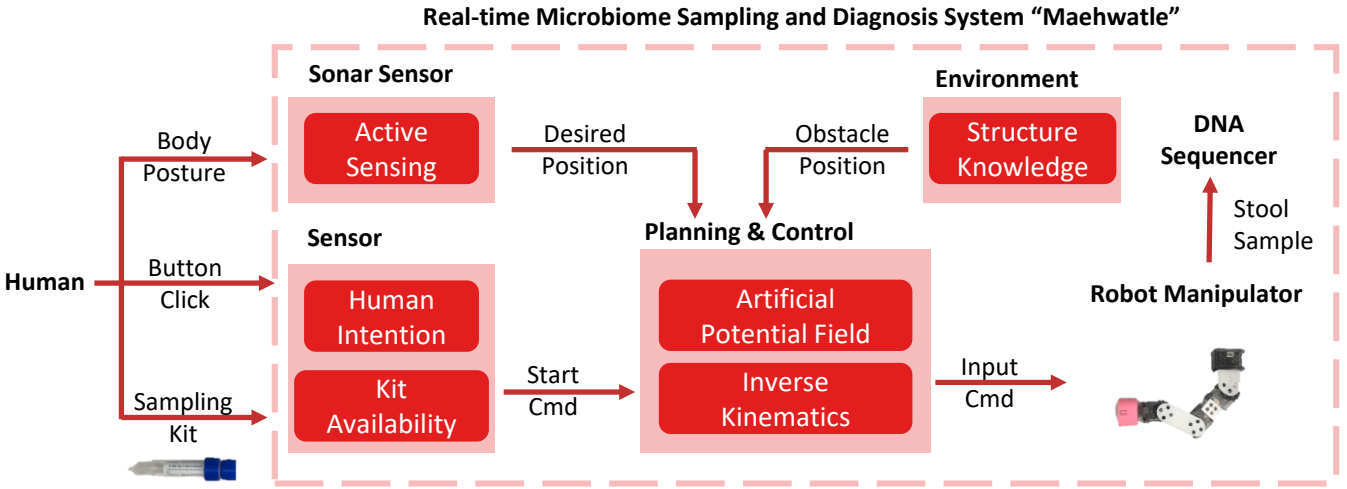


Simulation Result

Real-time Microbiome Diagnosis System Development

- Motivation
  - High demands of microbiome dataset for on-going research studying correlation between microbiome and various diseases (e.g. diabetes, obesity, Alzheimer's).
  - Necessity of relieving the discomfort of the existing fecal sampling process and improving reliability of stool sample through the automated sampling process.
- Contribution
  - Developed one-click sampling mechanism achieving ease of fecal sampling process and sampling platform for building microbiome dataset.





▲ Autonomous Microbiome Sampling and Diagnostic System "Maehwatle" ▲