



Tokyo Tech

Space Robotics Researches

Nakanishi Laboratory
Tokyo Institute of Technology

Orbital Servicing Robot

Construction



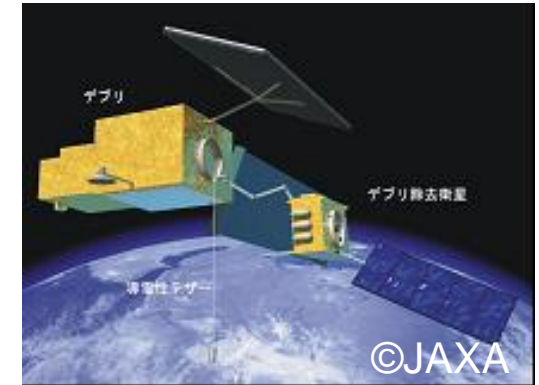
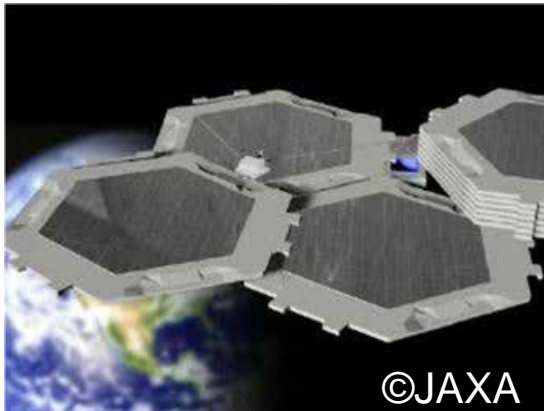
Inspection,
Repair, Refuel



Debris Removal



Dangerous and Expensive



Robotization of each service are expected for safe and economy

Technology for Orbital Service

Space Debris Removal

Approach

Non-cooperative rendezvous
Relative position sensing w/o target markers

Inspection

Estimation of tumbling motion

Construction, Maintenance, Astronaut Support

Our Research Themes

Capture / Grasp

Free-flying manipulation
Grasp without dedicated fixture and markers

Service

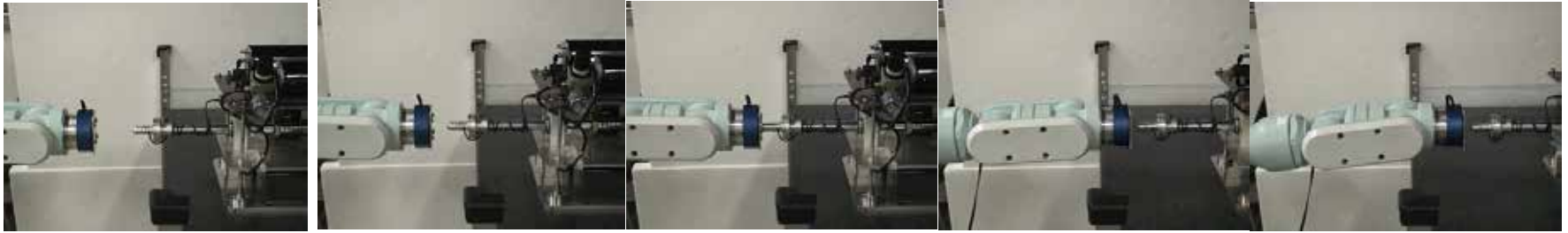
Device fixation, precise manipulation,
Cooperation with astronaut

Locomotion

Large area locomotion
Obstacle avoidance

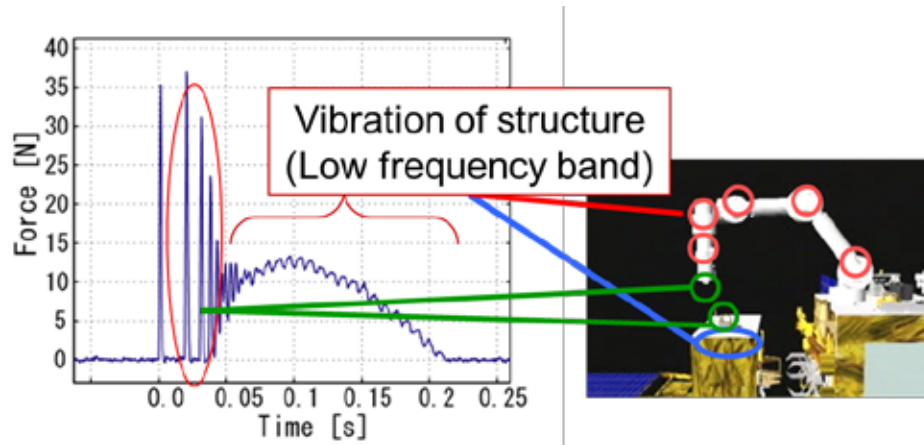
Contact Dynamics for Orbital Servicing

Force control for capturing free-flying object

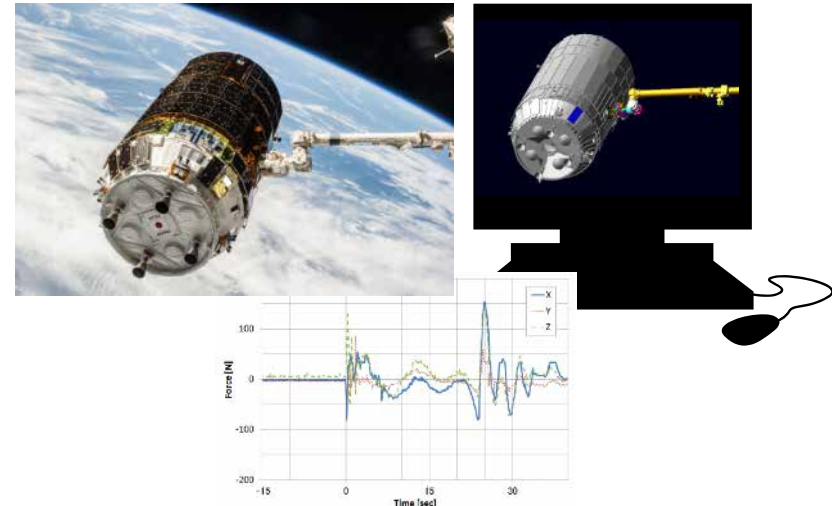


Maintain the contact after first impact

Contact force analysis for spacecraft capture



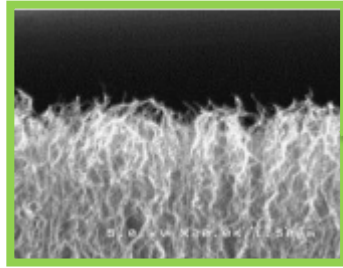
Dynamics analysis of a ISS-transporter capture operation



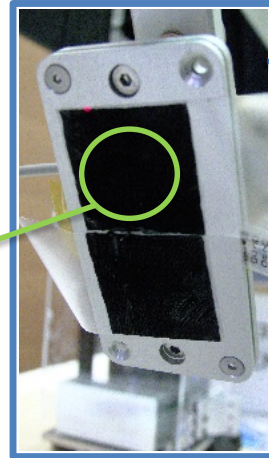
Estimation of contact force at capture

Space Debris Capture Devices

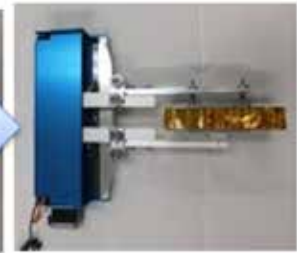
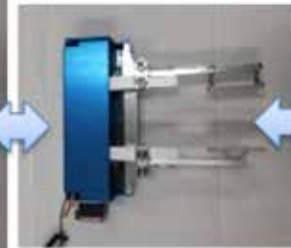
Gecko adhesive gripper for solar-array-paddle capture



Gecko Tape
©Nitto Denko Corp.

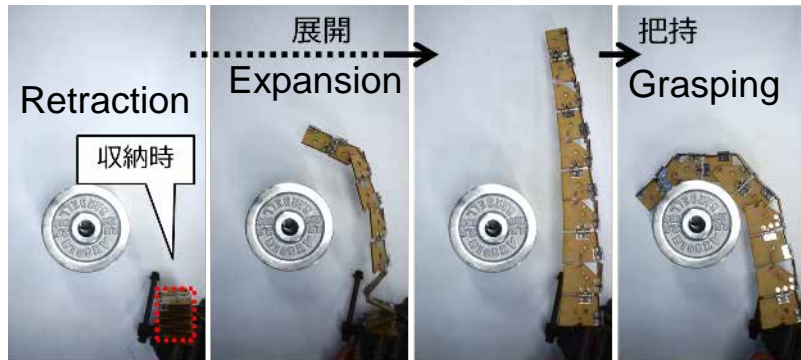
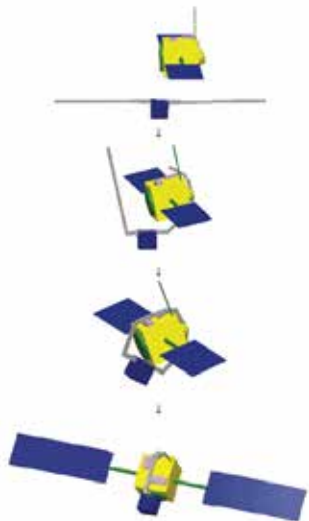


Arc clamp motion



Parallel clamp motion

Space debris wrapping gripper



Retractable multi joint gripper



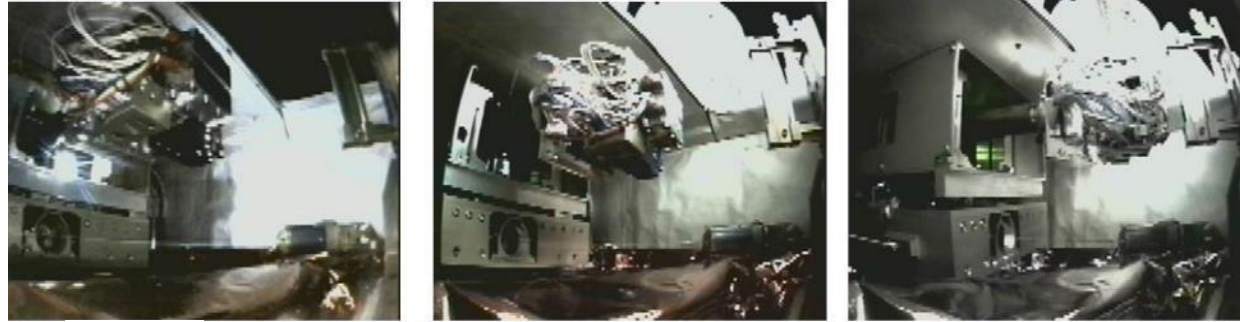
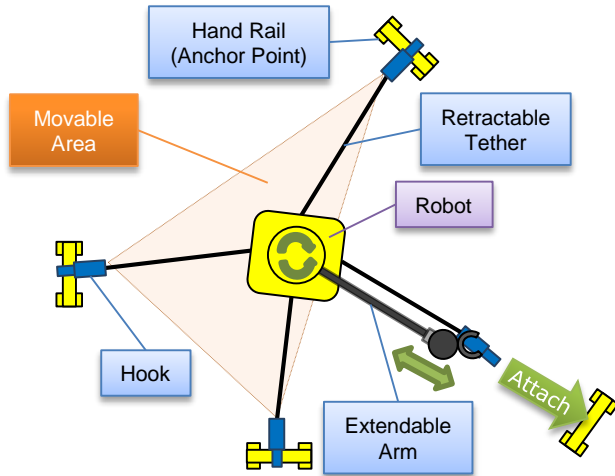
Convex spring gripper



New Locomotion System in Space

Tether based locomotion

By supporting a robot with tethers, the robot can move within a space as defined by the anchor points of the tethers.

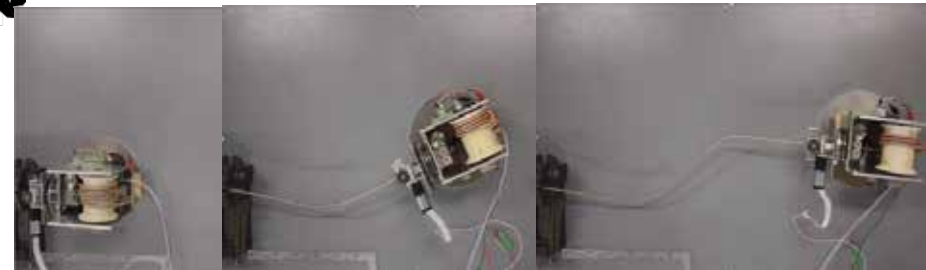
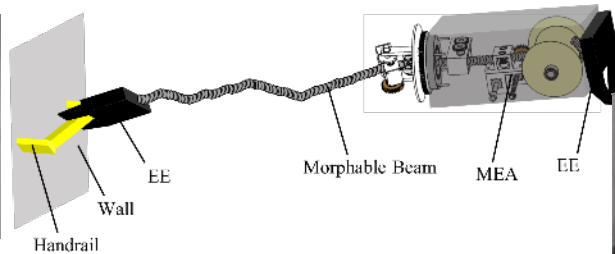


Orbital Demonstration at ISS (REX-J mission, 2012)

Morphable beam based locomotion



Morphable Beam



By extending and bending a morphable beam, the robot can move in space