

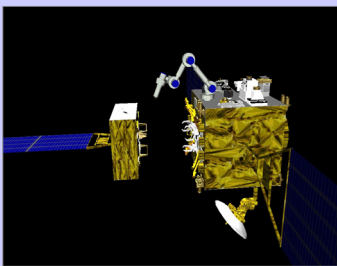
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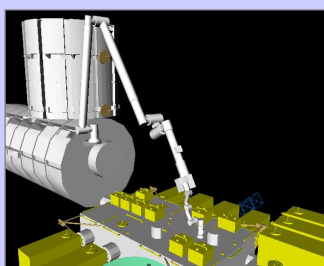
The Space Robotics Laboratory in Tohoku University, Japan, is dedicated to the research on dynamics and control of free-flying space robots and development of lunar/planetary exploration rovers. The lab has contributed to the JAXA's "ETS-VII" and "Hayabusa" missions. A micro-satellite and other science missions are under the development. Technologies for remote planetary exploration are also applied to the robots for search and rescue operations.

Orbital Free-Flying Robots

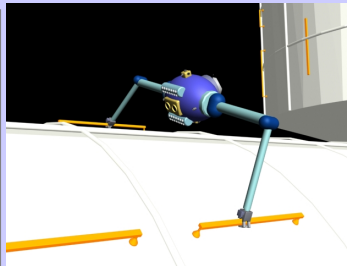
Dynamics and control of free-flying space robots are studied for manipulator operation in orbit. In 1999, we have successfully conducted the flight experiments of Japanese ETS-VII space robot. Technologies are being developed for future satellite servicing missions.



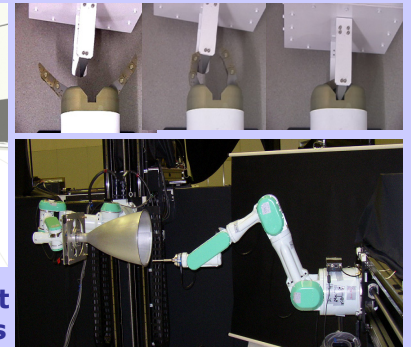
**ETS-VII,
a world-first free-
flying space robot**



**Japan Experiment Module
(JEM) on the Space Station
with a manipulator arm**



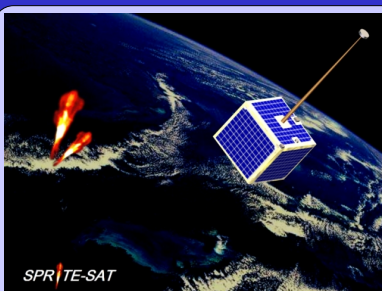
**A surface mobile robot
for maintenance tasks
of the Space Station**



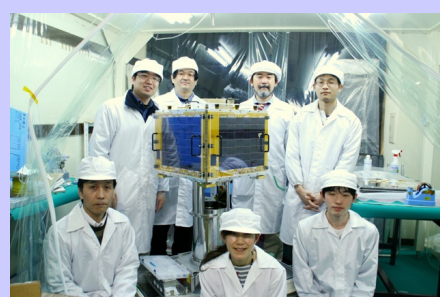
Study for satellite servicing

Micro-Satellite Development

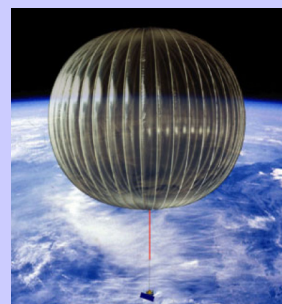
A 50kg-class micro-satellite "SPRITE-Sat" is now under the development for the scientific observation of hyper-altitude lightning discharge called "Sprite". The Sprites are recently discovered phenomena, which have the relationship with ground-lightning but their mechanisms are not yet understood. The SPRITE-Sat will provide significant clues to them. Technologies for other space flight missions are also developed and to be demonstrated.



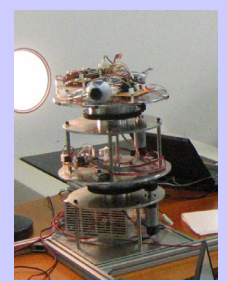
**Sprite observation from
the low Earth orbit**



Development of SPRITE-Sat



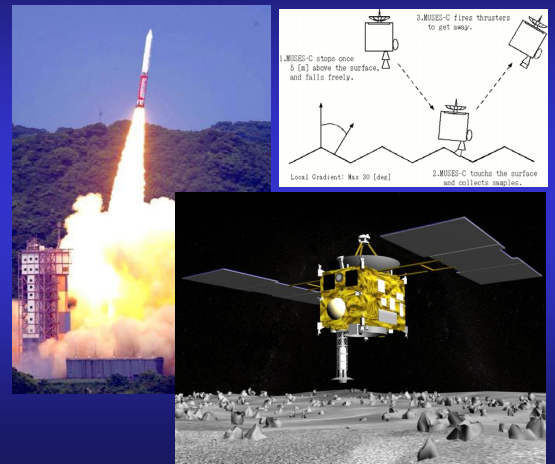
Hyper-altitude balloon



**Camera pointing
control system**

Asteroid Sample-Return Mission "Hayabusa"

In 2005, "Hayabusa", a Japan's asteroid sample-return probe successfully conducted scientific observation and touch-down maneuver on the target asteroid, named "Itokawa". The lab has contributed to this project for the design and evaluation of the sample acquisition mechanism and its motion dynamics. We are continuing on the study of novel robot designs for detailed surface exploration to be used in the future asteroid missions.



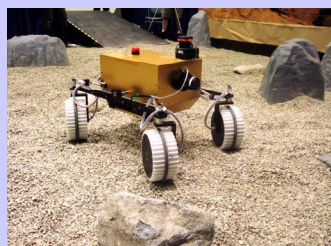
Planetary Exploration Rovers / Rescue Robots

Mobile robots (rovers) are expected to play a key role in future lunar/planetary exploration missions. Rough terrain mobility and traction control in the loose soil environment are a central focus of our research. Based on solid understanding of the soil/wheel mechanics, path planning and navigation control algorithms have been developed. Such technologies as mapping and localization in the unstructured environment, rough terrain mobility, and teleoperation with time delay, can be applied to the robots for search and rescue operations in response to terrestrial disasters, which are also of our research focus.

Lunar/Planetary Exploration Rovers



Rover test bed "Dune"

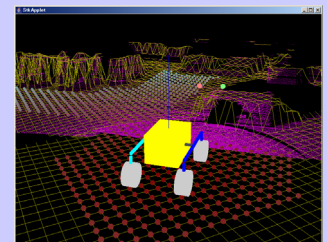


Rover test bed
"El-Dorado II"

Rescue Robots



Rescue robot test bed
"Reddy"



A 3-dimension map of environment obtained by a laser range sensor