Manipulation Concepts for Human-Robot Cooperative Lunar Exploration

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Introduction

- Identify in-house DLR-RM robot systems for space exploration

- Identify robotic concepts operated in terrestrial environment to be used for lunar and other planetary applications
Presentation Outline

- Manipulator – A Short Introduction
- Anthropomorphic manipulation
- DLR Light Weight Robot-III
- DLR Humanoid Justin
- Humanoid: Astronaut Substitution
- Humanoid: Complex tasks with astronaut cooperation
- Future works and Conclusion
Manipulator – A Short Introduction

A manipulating arm or manipulator is essentially a robotic arm that is capable of moving in a defined workspace and capable of accomplishing tasks such as:

- Object collection (i.e. collect rock, soil samples)
- Object handling
- Instrument positioning
Anthropomorphic Manipulation

- Attribution of human characteristics or behaviour to non-human things such as animals, natural phenomena and inanimate objects
- In space robotics: Robots that mimic or replace humans
DLR Light Weight Robot-III

- Anthropomorphic arm capable of high degree of dexterous manipulation
- Load capacity: 14 kg
- Load-to-weight ratio: ~1:1
- Highly modular
- Possible to integrate different end-effectors at arm’s end
- Light-weight for space applications
- Low-power consumption (150 W)
DLR Humanoid Justin

- 2-handed dexterous Manipulator
- Architecture of Justin
  - Two LWR-III robotic arms
  - Two DLR Hand-II
  - Torso
  - 3D Modeller Head
- 43 Degrees of Freedom system
Humanoid as Astronaut Substitution

- Work handled by humanoids instead of human astronauts
- Humanoids operated without much safety risks
- Application for object collection and lunar outpost construction by integrating on a mobile platform
Humanoid as Astronaut Substitute

Example: Perform EVA activities for collecting lunar or planetary rocks and soil
Humanoid for complex tasks with astronaut cooperation

- Humanoids work with humans for complex tasks including space outpost and other construction activities
- Astronauts in space find it relatively easier to control human-like robots
Justin
A humanoid upper body system for two-handed manipulation experiments.
Future works & Conclusion

- DLR Light Weight Robot-III and the DLR Humanoid would be an opportunity to address the need for future scenarios involving complex tasks that demand high level of dexterity

- Now, building a “humanoid-in-motion” mobile platform for integration and testing. Would be displayed at Automatica 2008

- Also, working on a hand-arm system very closely resembling human arm’s kinematics and dynamics
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