

SpaceClimber

Legged Exploration of Unstructured Terrain

System Description

SpaceClimber is a semi-autonomous free-climbing robot, developed as a research platform for investigating aspects of the multidisciplinary area of exploring unstructured terrain. Its six-legged locomotion concept allows highest mobility to traverse steep inclines as well as rocky and sandy surfaces, which is mandatory for exploring lunar craters of high scientific interest. The goal of this research area is the autonomous adaptation of the flexible locomotor system and the walking pattern to the changing environmental conditions with the help of the robot's high sensor and actuator disposition.

Technical Details

- **Size:** 0.9 m x 1.0 m x 0.3 m (standard pose)
- **Mass:** 25 kg (max. payload of 15 kg)
- **Speed:** 0.5 m/s (1/2 body length per second)
- **Runtime:** ca. 50 min
- **Drive systems:** 6 x 4-DOF legs, 1-DOF torso, 28 Nm nominal torque per leg joint (48 V RoboDrive motor with 100:1 HarmonicDriver gear)
- **Joint sensors:** Position (absolute 0.18 °, relative 0.06 °), speed, temperature, supply voltage, current
- In-house developed joint electronics, consisting out of three stacked printed circuit boards (power supply, FPGA, communication and sensors)
- **Leg sensors:** 3-DOF acceleration and four pressure sensors integrated in sole of foot, optical distance meter for spring in shank, 6-DOF force-torque sensor at leg mounting
- Swiveling head driven by Dynamixel DX117 servo and equipped with Hokuyo ULG-04LX laser scanner und VRmC-3+Pro CMOS camera (754 x 482 pixels) with 4.2 mm Pentax H416 lens
- Xsens MTi Inertia Measurement Unit to sense orientation and acceleration
- Power electronics, WLAN communication and battery supply (4 A @ 48 V, Lithium Polymer) integrated in main body
- Processing power: Suzaku S Board (FPGA with synthesized MicroBlaze core) for locomotion control and joint communication via LVDS bus, Kontron pITX SP Board in front torso to process high-level sensor data and for overall system control



Application: Space Robotics
Exploration of unstructured terrain

Projects: **LIMES**
Learning Intelligent Motions for kinematically
Complex Legged Robots for Exploration in
Space
(05/2012 - 04/2016)

SpaceClimber
(07/2007 - 11/2010)



Contact:
DFKI GmbH & University of Bremen
Robotics Innovation Center

Director: Prof. Dr. Frank Kirchner
Phone: +49 421 – 178 45 4100
E-mail: robotik@dfki.de
Website: www.dfki.de/robotics