3 'Locomotion & Mobility'

3.1 'SherpaTT – First Experiences with the Hardware' (LM-T-01)

Florian Cordes[1]

(1) Robotics Innovation Center, DFKI GmbH, Robert-Hooke-Straße 1, 28359 Bremen, Germany

Contact: `florian.cordes@dfki.de`

Abstract

SherpaTT is part of a team of heterogeneous robots developed in the project TransTerrA. The slides of the talk provided here give a first glimpse at the integrated hardware of the robot. During August 2015 the robot's locomotion system was electromechanically integrated, this presentation subsumes the first two weeks of experiences working with the actual hardware of the system.

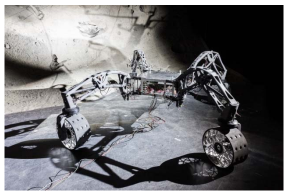
The motion control system (MCS) was already set up and tested in simulation prior to the hardware integration. Setting up the software for the robot's hardware worked flawlessly. Hence qualitative verification of kinematics calculations, forward control of basic functions such as body attitude control was possible to conduct in a short time frame.

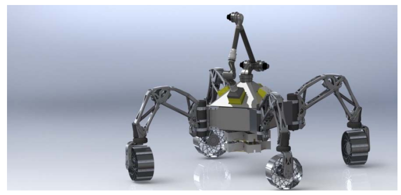
Future work in terms of the very next steps is provided at the end of the presentation. This includes the very next step of setting the active ground adaption to work on the hardware system.

SherpaTT

First Experiences with the Hardware

Florian Cordes
2015-09-17





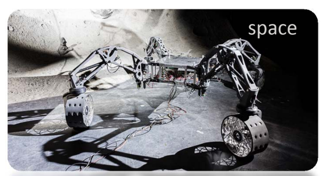
SherpaTT is part of the multi-robot team developed in the project:

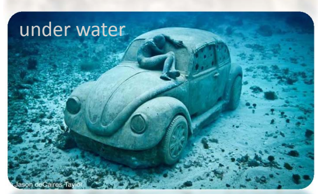
TransTerrA

DFKI Robotics Innovation Center Bremen
Robert-Hooke Straße 5
28359 Bremen, Germany

Plans for SherpaTT

- *SherpaTT* is the enhancement of Sherpa originating from the project RIMRES
  - TT for Sherpa in project TransTerrA
- SherpaTT will be used for
  - Space Exploration Scenario
  - SAR Scenario (Terrestrial Application Transfer)
  - Underwater Scenario (here: aka *SherpaUW*, 2nd Terrestrial Application Transfer)
- Development goals
  - Improve ground adaption capabilities
  - Reduce number of DoF
  - Enhance body posture control capabilities
  - Make it water proof





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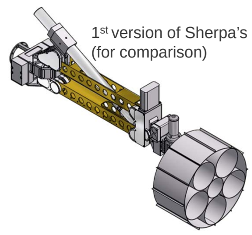
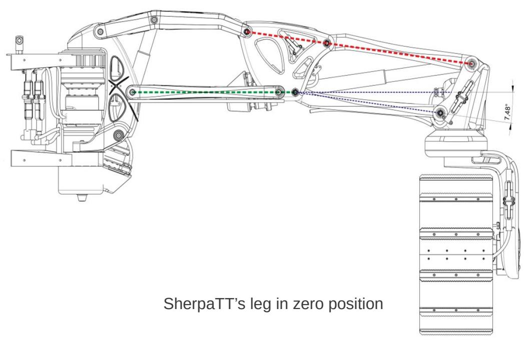
The SherpaTT Active Suspension System

- Four Legs / Suspension Units with 5 active DoF each
  - 3 DoF for positioning the leg end point (LEP) around the body
  - 1 DoF for orienting the wheel
  - 1 DoF for driving the wheel



1st version of Sherpa's legs (for comparison)

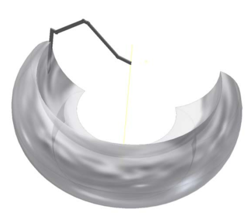


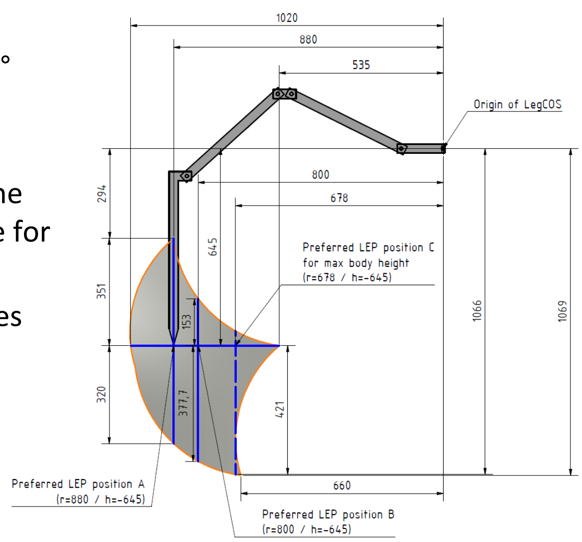
SherpaTT's leg in zero position

SherpaTT's integrated leg main structure

Workspace of Suspension Units

- First joint (Pan) has movement range of -90° <-> + 135°
- Second (InnerLeg) and third (OuterLeg) combine to an area of workspace for each Pan configuration
- Preferred standard poses maximize vertical movement capabilities





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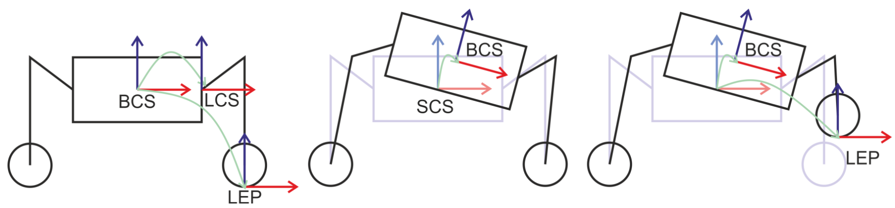
Coordinate Systems for Locomotion Control

- Body Coordinate System (BCS)
  - Attached to center of body, moves with body
  - Internal calculations (i.e. inverse kinematics) are described in BCS
- Shadow Coordinate System (SCS)
  - Virtual coordinate system
  - BCS movements are described in SCS
- Leg Coordinate System (LCS)
  - Cylindrical coordinates (angle, radius, height)



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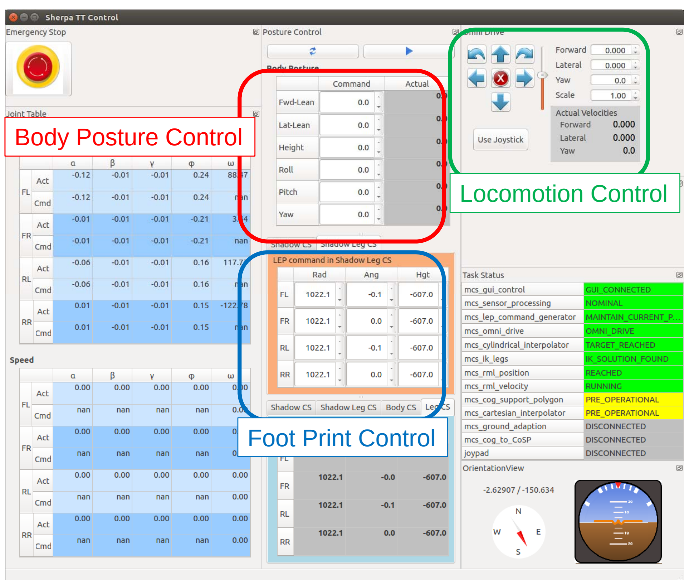
The MCS Control GUI



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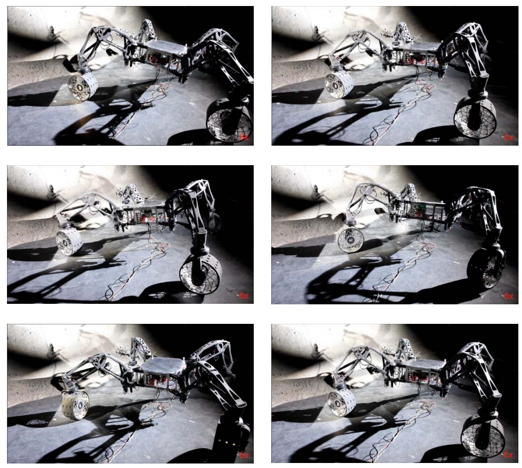
Body Control

- Body's attitude can be controlled in 6DoF
  - Roll / Pitch
  - Yaw
  - Body shift (forward and lateral)
  - Body height
- Foot print is not altered
- Allows to adjust body relative to terrain
  - Sensor alignment
  - BaseCamp pick-up
  - Manipulator leveling

Video: Body attitude control (screenshots for print version)



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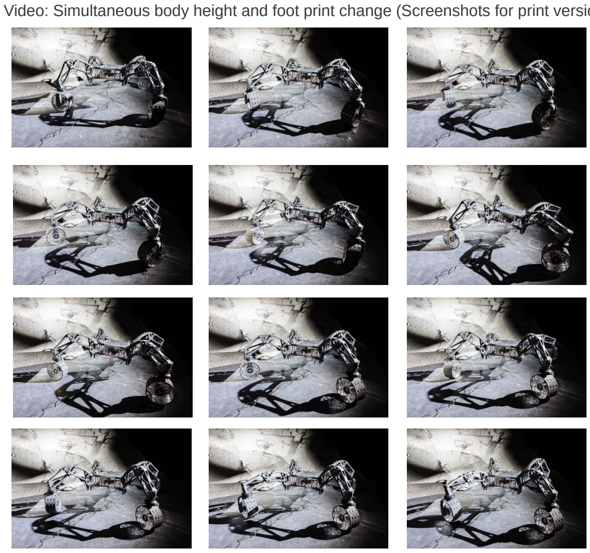
LEP and Body Control

- Possible to change foot print and body posture simultaneously
- Foot print changes do not alter body pose
- WheelDrive and WheelSteering follow LEP velocity vector

Video: Simultaneous body height and foot print change (Screenshots for print version)



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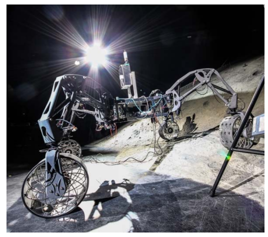
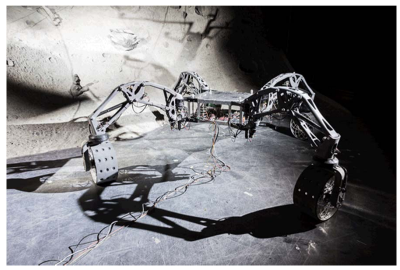
Next Steps

- Use FTS for active ground adaption
  - Ground Adaption Process (GAP) will include ground plane estimates by incorporating IMU data and internal configuration state
- Roll/Pitch adaption process (RPA)
  - Combine with GAP
- Parametrizable obstacle climbing behavior as preparation for autonomous climbing
- Quantify the system's capabilities
- Get the robot water proof





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