

## Of Spiders and Crawlers

– Bio-inspired Space Exploration  
Robotics at the DFKI Robotics  
Innovation Center

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Abb. Panorama-Bild © NASA Endurance Crater (Opportunity)



Abb. Shackelton Crater © ESA (SMART-1)

- **Craters and canyons were off-limits so-far**
- **However: they are of special scientific interest**
  - Access to outcrops of sediment layers
  - Potentially traces of water / ice
  - Potentially micro-habitats in fissures and caves
    - ▶ Climate is different than at surface
    - ▶ „potential refuge for biological organisms”

- **Objective**

- Development of a biological inspired, energy-efficient, adaptable, six-legged climbing robot for extraterrestrial exploration
- SpaceClimber has to be able to
  - ▶ Move freely and safely in a crater
  - ▶ Manage slopes of up to 80%
  - ▶ Navigate semi-autonomous
  - ▶ Carry a scientific payload
- Use components that can be space qualified

- **Förderung**

- DLR
- ESA



Gefördert durch:



Bundesministerium  
für Wirtschaft  
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aufgrund eines Beschlusses  
des Deutschen Bundestages

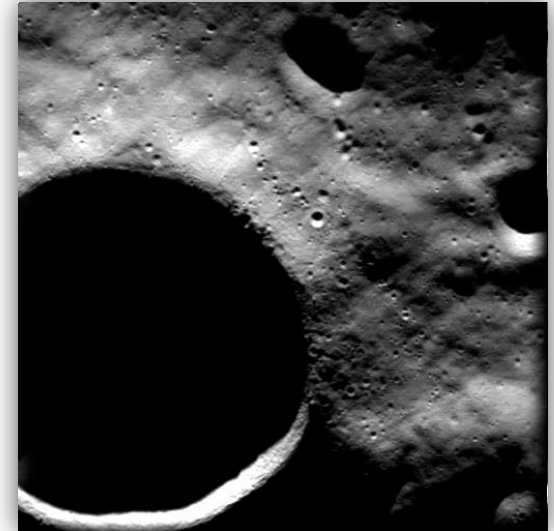


- **Mission scenario**

- Sample return and/or in-situ analysis in a lunar crater
  - ▶ In-situ prove of presence of water/ice in one of the permanently dark in the lunar polar region

- **Mission-/environment related requirements**

- Handle 80% slope
- Be able to operate on loose ground (Regolith)
- Overcome obstacles of up to 40cm height
- Semi-autonomous navigation
- Range > 1Km
- Ability to carry reasonable payload
- Overall weight ~20 Kg
- Small storage volume
- Robust and dust-proof hull



Shackleton Crater, lunar south-pole  
Bildmaterial der ESA (SMART-1)

## Specifications (2/2)

Power supply	44,4V @ 4000mAh (LiPo)
Power consumption	Beine ausgeschaltete: 21W Beine eingeschaltet und unbelastet: 62W Stehend (in 0°): 85W Laufen (Durchschnitt in 0°): 105W
Adaptation of pose	Min. / max. body height: 170mm / 640mm Min. / max. longitudinal shift -300mm / 300mm Min. / max. lateral shift : -50mm / 50mm
Max. step length	Foreward/backward: 500mm Left/right 100mm Rotation 25°
Max, velocity	Foreward/backward: 220mm/sec left/right : 75mm/sec Rotaton : 10°/sec
Max. payload	20kg (Nutzlast in Abhängigkeit von Steigung noch zu ermitteln)



- **Objective**

- Development of a modular, re-configurable robot team for planetary exploration

- **RIMRES is a cooperative project of**

- DFKI Robotics Innovation Center Bremen
- ZARM – Center for Applied Space Research  
Micro Gravity

- **Other partners**

- DLR-RY
- Astrium GmbH
- OHB System AG

- **Funded by**

- DLR



Gefördert durch:



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Deutsches  
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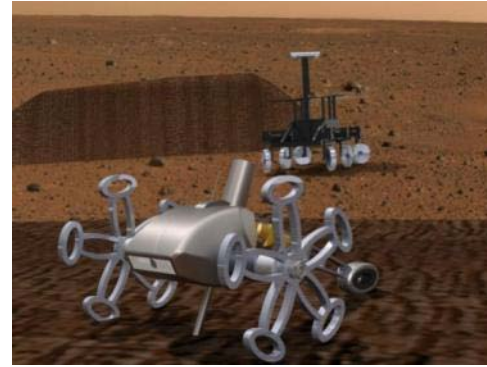
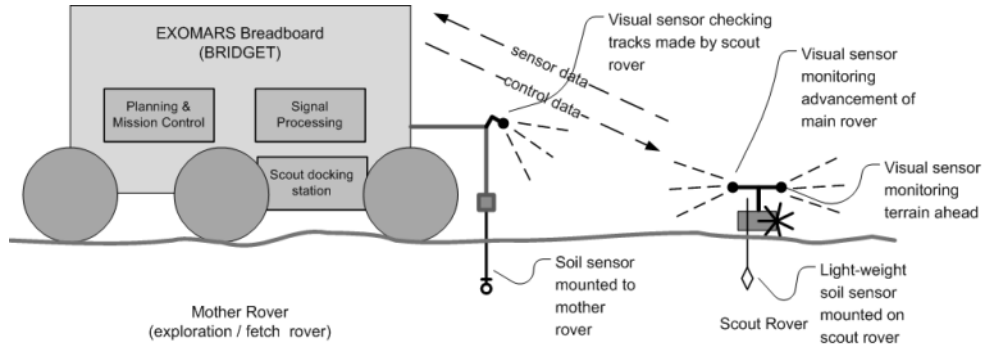


- **Objective**
  - Development of robotic devices to enable efficient in-situ acquisition of soil and terrain properties on planetary surfaces.
- **FASTER is a cooperative project of**
  - DFKI Robotics Innovation Center Bremen
  - University of Surrey (Surrey Space Center)
  - Astrium UK
  - Space Application Services NV
  - Liquifer Systems Group GmbH
  - Astri Poslka Sp. z o.o.
- **Funded by**
  - FP7-SPACE

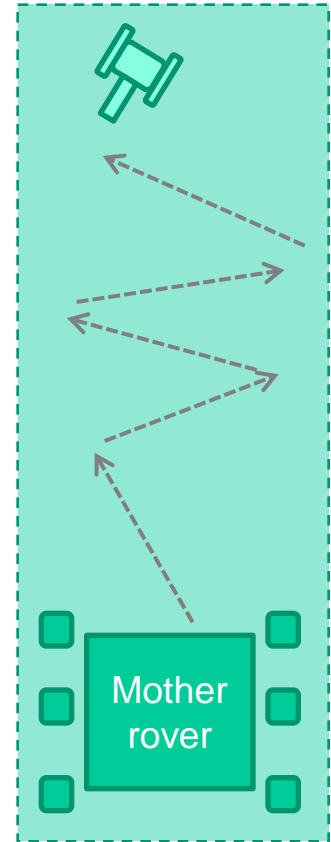




# FASTER



- FASTER scout rover inspired by CESAR (Crater Exploration And Sample Return)
- Winner of ESA Lunar Robotic Challenge 2009



- **Artificial lunar crater (100m<sup>2</sup>)**
  - Slopes from 25 to 45°
  - Surface structure with small craters
  - Rocks (variable positioning)
  - Stage lights for parallel lighting
  - High-Speed Motion Tracking System
- **Ramp with variable slopes (6m x 3m)**
  - Slopes from 0-45° (horizontal and vertical)
  - Basalt sand as Regolith equivalent
- **Allows reproduceable experiments in a controlled environment**



# DFKI RIC Weltraumexplorationshalle



## Thank you for your attention!

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