A LANDING PLATFORM WITH ROBOTIC SELF - LEVELING CAPABILITY

Concept and Background

Objectives

- Investigation of potential improvements of flight proven landing leg concepts by robotic elements [1]
- Enable a soft and precise landing, simplify the rover egress or provide a launch base for the a re-ascent stage
- Focus on early breadboarding [2] and full scale system demonstration in a representative environment

Concept

- Engine cut-off at physical contact using a failsafe electro-mechanical ground contact sensor attached to the footpad joints
- Landing shock attenuation using light weight landing legs with incorporated crushable Aluminum honeycomb shock absorbers
- Lowering, lifting and leveling of the platform using a robotic leg deployment arm with two active rotary joints
- Adaptive path planning based on on-board sensor data

Reference mission

- Reference scenario based on ESA Mars Precision Lander (MPL) [3]
- Delivery of a 85kg "Sample Fetch Rover" to the surface of Mars

Programmatic

- German national Triple-A (support code 50 RA 1030) and Triple-A follow-on (support code 50 RA 1321) studies
- Co – funded research activity (50% Airbus DS R&D / 50% DLR)

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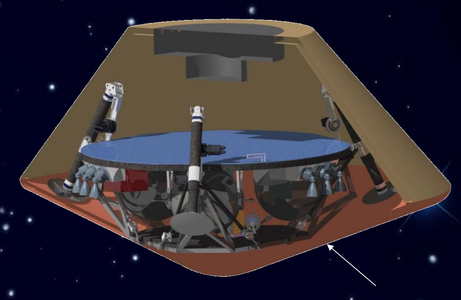
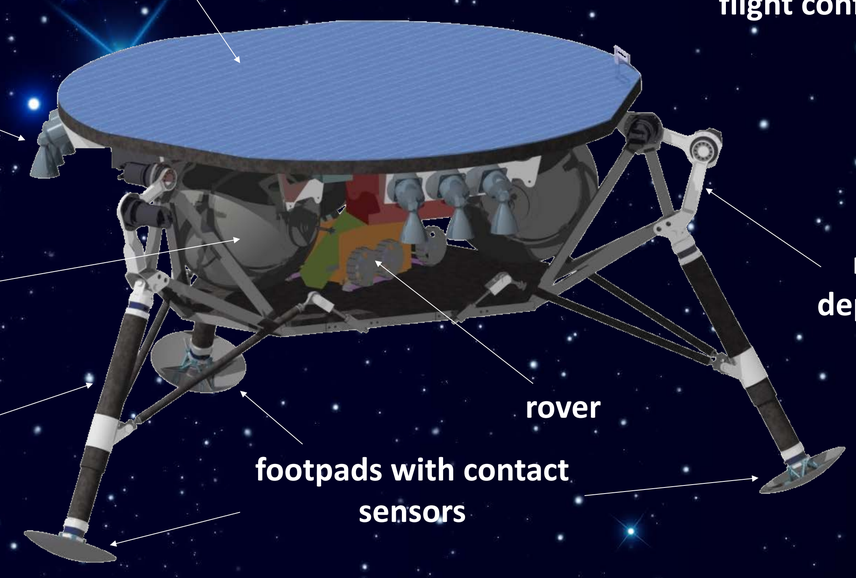


MPL capsule with Triple-A Lander in flight configuration



System Demonstration

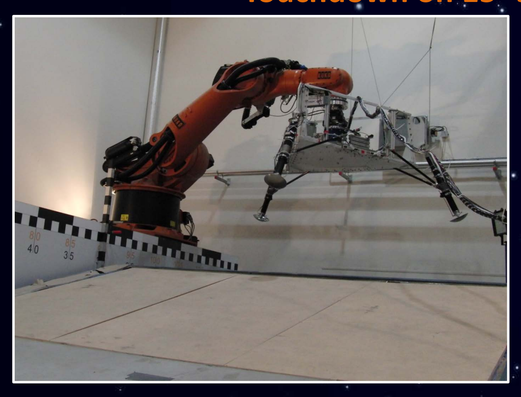
Touchdown system tests (1g)

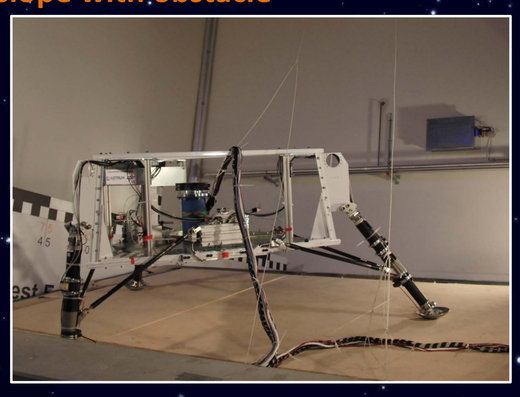
- 400kg breadboard mass
- Landing and Mobility Test Facility (LAMA) in drop test mode [4]
- Touchdown after short free fall under Earth gravity

Robotic system tests (3/8g)

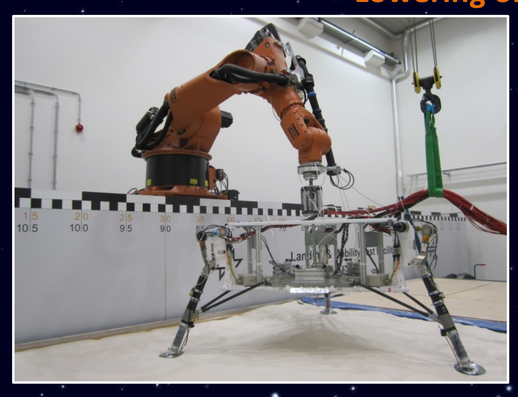
- 400kg breadboard mass
- Test object suspended at its center of gravity
- 250kg actively off-loaded by LAMA robot to emulate Mars gravity

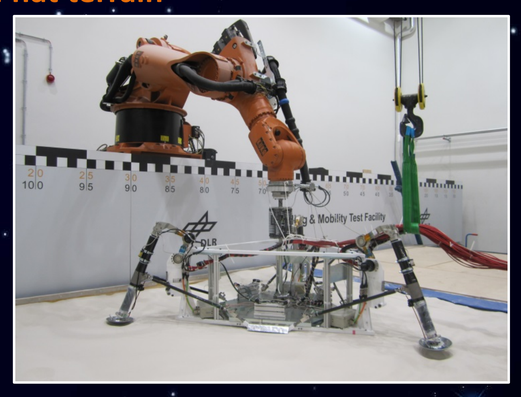
Touchdown on 15° slope with obstacle



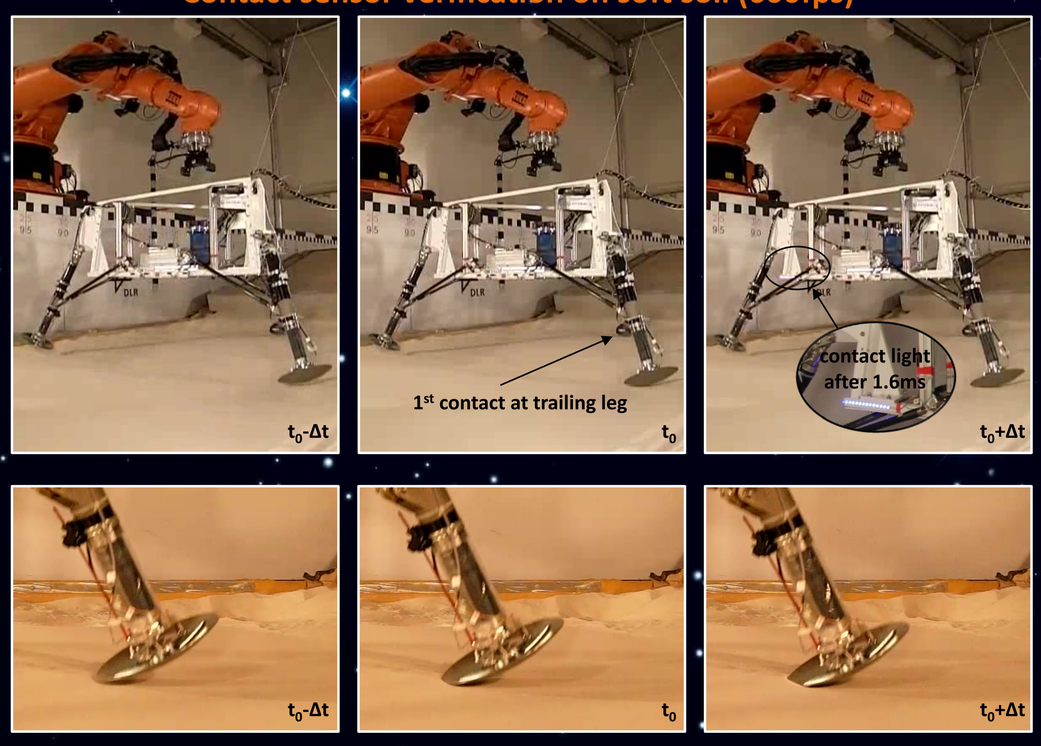


Lowering on flat terrain





Contact sensor verification on soft soil (600fps)



Leveling on 15° slope

Lowering on 15° slope with deformed legs

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References:
[1] Buchwald, R. et al; *A concept for the autonomous landing shock attenuation, self-leveling and lowering of a robotic landing platform*; 10th IPPW, 2013, San Jose, USA
[2] Perkinson, M. et al; *Mission Architecture and System Design of a Mars Precision Lander*, 9th IPPW, 2012, Toulouse, France
[3] Buchwald, R. et al; *Stepwise development testing and technology demonstration of a landing system with landing legs*; Proc. of the 60th DLRK, 2011, Bremen, Germany
[4] Witte, L. et al; *A Vehicle Dynamics Test Facility for Planetary Surface Mobility*, ECSSMMT, 2009, Toulouse, France