Professorship of Lunar and Planetary Exploration Technologies
TUM School of Engineering and Design
Technical University of Munich

Master Thesis (potentially Term Paper/Research Internship)

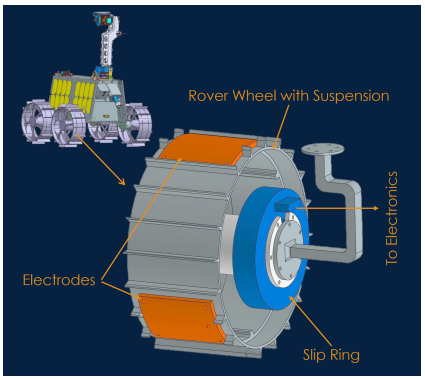
Optimization of slip ring brushes in a lunar rover instrument

theoretical/experimental thesis
Start date: immediately possible

Do you want to see your thesis work fly to the Moon? Do a thesis at the LPE!

Topic:

The Rover Permitivity Sensor (RPS) is an instrument, built by TUM, to be integrated into the wheel of the Rashid-3 rover from MBRSC (UAE) and is expected fly to the Moon in 2028. The sensor consists of two electrodes which are mounted to one of the rover's wheels and connected via a slip ring to the sensor's electronics inside the rover. The accommodation of the electrodes on the rover wheel allows RPS to map the regolith's water content in the lunar subsurface along the rover's track.



This thesis concerns the slip ring of the instrument, which needs to provide a good electrical connection between the sensor despite the harsh environment (temperature fluctuations, abrasive dust, etc.). The brushes of the slip ring need to be optimized for mechanical and electrical contact, vibration environment and abrasion properties. This thesis should look at a single brush/track pairing and improve the geometry of the brush as well as integrating lessons learned from the prototype.

Tasks:

- Literature review on brush design, material pairing parameters and mechanical contact
- Calculations of brush mechanical properties
- Design trade-off between spring preload/deflection, contact geometry, Hertzian pressure, expected wear rates.
- Create a basic FEM model of the brush/track pairing.
- Propose three variation of brush designs to be ordered as a test batch.
- (depending on thesis type) Evaluation of brush geometric and mechanical properties and correlation of the simulation results

Requirements:

- interest in lunar exploration and space mechanisms
- basic programming skills, preferably in Matlab or Python
- (ideally) knowledge of mechanical FEM, preferably COMSOL (alternatively NX Nastran, Hyperworks)
- (bonus) any experience with vibration or mechanical material contact properties

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