T11.01-9869-S - Rover Slip Estimation and Traction Control for Optimal Mobility in Lunar Environments

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NON-PROPRIETARY DATA

IDENTIFICATION AND SIGNIFICANCE OF INNOVATION

ProtoInnovations, LLC and the Massachusetts Institute of Technology propose to continue the maturation and validation of combined slip estimation and traction control software algorithms, called the Mobility Optimizer, for improved robotic or manned rover wheeled locomotion on The Moon. The Mobility Optimizer provides a dramatic improvement to current slip estimation and traction control strategies implemented on planetary rovers. These new software algorithms could significantly improve access to new areas on the Moon and ensure that rovers have reduced risk of entrapment. The Mobility Optimizer slip estimation software utilizes features from proprioceptive sensors as an input to a machine learning algorithm that classifies slip as low, medium, or high. The Mobility Optimizer traction control software then uses this slip estimate to modify the velocity of the wheels to improve traction and correct for rover kinematic incompatibility. The Mobility Optimizer can be implemented using existing sensors on rovers and does not require significant computational processing power or memory.

TECHNICAL OBJECTIVES AND WORK PLAN

Technical Objectives:

1. Advance proprioceptive slip estimation performance on lunar-like terrain
2. Advance proprioceptive state estimation and interpretation capabilities on lunar-like terrain
3. Advance traction control strategy performance with near-term lunar rover architectures on lunar-like terrain
4. Integrate the mobility optimizer software system and subsystems with space-relevant hardware and/or simulations
5. Test and validate the mobility optimizer and subsystems in lunar-relevant environments with space-relevant hardware and/or simulations

Work Plan:

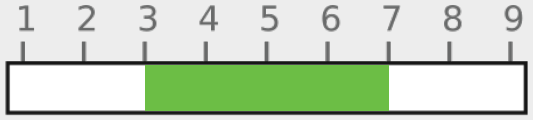
Advance and mature slip estimation, state estimation for safe mobility, and traction control algorithms. Integrate these technologies into a cyberphysical Mobility Optimize module. Test and validate the Mobility Optimizer on lunar rover prototypes and in high-fidelity state-of-art simulations. Demonstrate relevance and infusion value to NASA's Volatiles Investigating Polar Exploration Rover (VIPER).

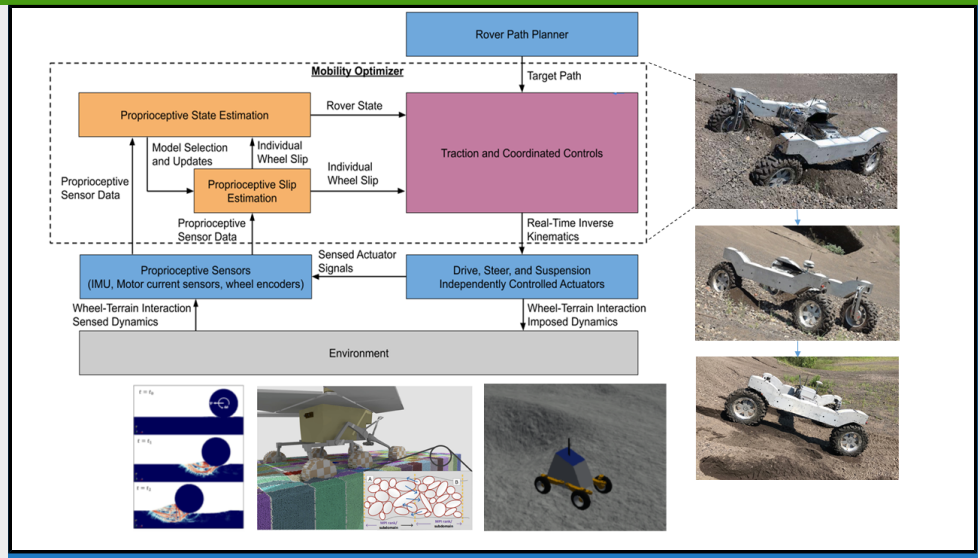
Final Deliverables:

1. Mobility Optimizer software including code for slip estimation, state estimation, and controls
2. Simulated lunar rover models and simulation code
3. Final project reports

TRL

Estimated





NASA APPLICATIONS

The Mobility Optimizer could have an immediate impact on the mobility systems of planned robotic or manned rovers such as the Volatiles Investigating Polar Exploration Rover (VIPER), small rovers that are a part of the Commercial Lunar Payload Services (CLPS) program, or even the new Lunar Roving Vehicle (LRV).

NON-NASA APPLICATIONS

Our primary target markets for the Mobility Optimizer and subsystem technologies (slip estimation, state estimation, and traction controls) are in transportation, construction, agriculture, and mining. These industries have a need for safe and efficient mobility and specifically all-terrain and work-site mobility

FIRM CONTACTS

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