NASA SBIR/STTR Technologies

Numerical Simulation of Rocket Exhaust Interaction with Lunar Soil

STTR Phase II, CFDRC/Univ. of Florida

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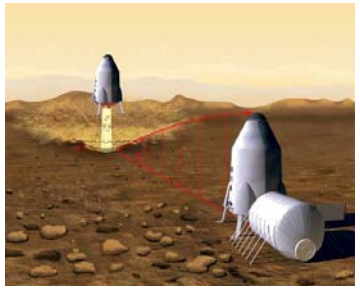
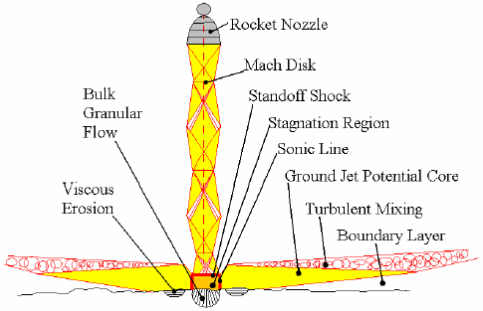
Proposal No: T6.02-9950

Identification and Significance of Innovation

- High risk areas for lunar exploration include lunar soil erosion, sandblasting and dust clouds generated by lunar lander rockets
- Sandblast damage to lander itself, multiple landing spacecraft, surrounding hardware and habitats
- Simulation tool needed to predict environment, quantify effects and develop countermeasures
- No tool exists; first-principle based model development proposed





Technical Objectives

Capture complex multi-physics:

- Mixed continuum/rarefied plume impingement in lunar vacuum
- Gas-soil interaction soil erosion mechanisms (flow through porous granular soil, particle liberation)

Leverage CFDRC and U. of Florida tools and expertise:

- Unified Flow Solver (UFS) for continuum/rarefied plume flow
- Sophisticated granular solid-gas interaction modeling tools
- Debris particle transport and interaction software development

Phase II Work Plan

- Phase I demonstrated proposed simulation tool components
- Extend gas-soil interaction modeling to lunar soil specific physics
- Formulate soil debris release models based on gas-soil modeling
- Implement debris particle tracking module in UFS flow solver
- Integrated UFS solver, erosion model, and particle tracking tool
- Establish post-processing framework for summarizing and visualizing simulation results
- Technology application demonstrations and Beta testing with NASA and industry partners

NASA and Non-NASA Applications

- Robotic and manned Moon landing
- Robotic and manned Mars landing
- Dust generation environment during ISRU operations (rovers, excavation, mining, etc.)
- Brown-out during desert helicopter and aircraft take-off

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NON-PROPRIETARY DATA