

MECHANICAL ENGINEERING COLLOQUIUM



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TOWARDS WIDER ACCESSIBILITY FOR LUNAR SURFACE AND SUBSURFACE EXPLORATION

ABSTRACT

The coming decade is expected to see a dramatic expansion of lunar exploration, driven by NASA's Artemis program, China's Chang'e program, commercial lunar initiatives, and India's expanding lunar roadmap, including Chandrayaan-4 and LUPEX. Yet many scientifically compelling and operationally relevant environments remain difficult and expensive to investigate directly. At the same time, sustained lunar exploration and future human operations will require substantially more ground truth from diverse surface locations on timelines that can inform and de-risk larger missions. This talk presents an ongoing research program aimed at enabling wider accessibility for lunar surface and subsurface exploration through an integrated mission architecture that combines low-mass transportation, impact-tolerant landing, and terrain-access mobility systems. The proposed architecture seeks to enable deployment of small-scale payloads to challenging lunar environments, including permanently shadowed regions and lava tube pits. It is built around three research projects: a low-thrust, low-energy transfer strategy for secondary-payload delivery; an impact-tolerant lander that reduces reliance on precision terminal-descent sensing; and a tethered dual-rover system for exploration of steep and shadowed terrain. Together, these elements form end-to-end architecture for reconnaissance and targeted in-situ science. The talk presents progress to date on two of the projects: a propulsion trade study establishing the feasibility of low-mass impact-tolerant landers, and a systems-engineering trade study and hardware prototype for a tethered rover system designed to access steep and shadowed terrain.

ABOUT THE SPEAKER

Dr. Rachana Agrawal is an Assistant Professor in the Aerospace Engineering Department at IIT Kanpur. She is a researcher in space mission engineering with specialization in astrodynamics and systems engineering. In particular, her work involves designing and analyzing end-to-end mission concepts, systems engineering, and sub-system development and prototyping for planetary missions. Previously, she was a Postdoctoral Associate at MIT and obtained her PhD from Purdue University.

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