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FLI-ME: A NOVEL APPROACH TO LUNAR EXPLORATION USING FLYING IMAGERS

Abstract

The Flying Imagers for Moon Exploration (FLI-ME) mission is currently competing for a slot in the International Missions bay of the Chang'E-8 lunar lander scheduled to launch in 2028. FLI-ME provides real-time high-resolution imaging and subsurface excavation capabilities, enabling a comprehensive characterization of the landing site. FLI-ME data products also enhance subsequent rover exploration by providing valuable measurements of regolith characteristics and surface features for route planning and science targets.

The mission consists of three small flying cameras and a ground penetrator that are ejected from the lander by a spring-based mechanism. The four ejection events take place after lunar touchdown, in sequence over the first day of the mission.

While still attached to the lander, the three onboard cameras capture imagery of the final descent of the lander. High resolution, high frame rate, stereo imagery will provide an initial characterization of the landing site as well as an opportunity to investigate engine plume and regolith interaction. After landing, the three cameras will capture high resolution imagery of the surface around the lander, providing crucial context for subsequent analysis.

Next in the mission phase, the first ejection operation consists of launching a passive penetrator downwards to impact the lunar surface at a safe distance of several meters away from the lander. The three cameras record the impact, the ejecta and the resulting crater to characterize the properties of the regolith and subsurface in the immediate vicinity of the lander.

The next ejection operations consist of launching each imager one by one. A spring-loaded mechanism provides ejection velocities of 13 m/s which, combined with an ejection angle of 70 degrees, sends each imager on a parabolic trajectory up to 50 meters high that impacts the lunar surface approximately 70 meters away from the lander. During the 15 seconds of flight time, the imagers stabilize their orientation with reaction wheels, take pictures of the lunar surface and transmit them in realtime to the base station on the lander. Upon impact, the imagers act as a seismic source for the lander's seismometer. The three resulting craters, estimated to be approximately 30 cm in diameter, could also be interesting targets for the rover to visit and take fresh measurements of the subsurface.

This multi-faceted approach, combining overhead imaging, seismic analysis, and rover exploration of the impact sites provides a comprehensive understanding of the surface and subsurface of the lunar landing site.