

Real time assessment of water content in icy regolith by analyzing drilling parameters

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ABSTRACT

The first target of mining activities on the surface of the moon is to find and extract water from the icy regolith on the moon. A test drilling unit was designed and fabricated under a NASA Early Stage Innovation (ESI) grant. A high-frequency data acquisition system was used to record drilling responses at 1000 Hz. Parameters like weight on bit (WOB), torque, RPM, rate of penetration (ROP), mechanical specific energy (MSE), field penetration index (FPI), and the uniaxial compressive strength (UCS) were recorded for 40 boreholes in the analog formations. This work utilizes the large dataset comprising of more than 1 billion data points recorded while drilling into various lunar analogous formations and cryogenic lunar formations to optimize power consumption and bit wear during drilling operations. The tests were also repeated in the samples of icy regolith at various water content at -190 deg Celsius to verify the ability of the algorithms to analyze the data from cryogenic environment and to estimate the water content. The paper will discuss the objectives and methodologies used in the project and reviews the testing program and the machine learning (ML) algorithms ability to identify various formations along the exploration boreholes