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SPACE SYSTEMS SYMPOSIUM (D1)
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AUTONOMOUS SCIENTIST FOR FUTURE SAMPLE RETURN MISSIONS

Abstract

Proper mapping of a planet's surrounding can offer in depth understanding about the geology of the surface, environmental conditions of the setting, and help gain better insights into the history of the solar system. The high cost of planetary rover missions limits risk-taking and as a result restricts scientific exploration. This constraint is further compounded by limited autonomy that requires time-consuming intervention of Earth-based operators to ensure safe operation in previously unexplored areas. The result is a frequently idle rover that misses potential scientifically valuable areas due to a lack of a priori knowledge about its current local surroundings. This paper offers a reliable, cost effective, and safe solution to perform sample return missions with minimum human intervention. As a result, the crew of the future missions can focus their time on other fields of the mission while the robot scouts the surrounding and selectively samples materials for further studying.

The proposed autonomous rock classification system utilizes vision algorithms to detect, classify, and train its system over time. Using Haralick parameters, rock's texture ranging from roughness, tonality, patterns, etc. are extracted. Then, using Bayesian theorem, the system applies statistical probabilities for detecting the sample based on its former exposures. However just like genetics, the system is capable of learning from its former mistakes to enhance and better classify samples. Moreover, the unique system is ideal for planetary exploration missions to hazardous environments where it is too dangerous and costly to send humans.