Paper ID: 83752
oral
student

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – missions current and future (3A)

Author: Mr. Yael E. Castrejón-Ocampo
Instituto Politécnico Nacional, Mexico

Mr. Joshua Hernández-Ramírez
Instituto Politécnico Nacional, Mexico
Mr. Alberto Y. Aguilar-Bautista
Instituto Politécnico Nacional, Mexico
Mr. José Pablo Estrada-Sansores
Instituto Politécnico Nacional, Mexico
Ms. Joelin Tshuma-Ramírez
Instituto Politécnico Nacional, Mexico
Ms. Estefania Hernández-Falcón
Instituto Politécnico Nacional, Mexico

ENHANCING AGRICULTURAL FEASIBILITY ON MARS: MACHINE LEARNING-BASED CLASSIFICATION OF MARTIAN SOIL TYPES USING CRISM HYPERSPECTRAL MINERAL DATA

Abstract

The past years have witnessed a surge in Martian exploration, leading to a progressive refinement of Martian surface mineralogical classification, culminating in a comprehensive analysis of Martian surface soil mineralogy. One of the highest achieves in this sector is the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) which has unique capabilities such as spanning a wide spectral range (visible to near-infrared) with high spatial resolution, allowing for detailed mapping of mineral distributions across the Martian surface.

The growing interest in establishing human settlements on Mars explores sustainable food production methods and becomes crucial; being the incentive of the aim of this paper which is focused on analyzing the data of the minerals present on the Martian Surface, looking to identify patterns and areas which exhibits soil properties similar to Earth's fertile regions, specifically for the growing of beans, wheat, and corn. These analyses are reinforced by deep learning modeling techniques for soil type classification, implementing different combinations of input variables, executing and evaluating by the Markov Random Field (MRF) model, improving Machine Learning against Computational Neural Networks (CNN) such as multi-layer random forest (MRF) models. These techniques have been previously tested and validated for classifying soil types in Northeast China (NEC) based on soil separability, forming the framework for the investigation and establishing the primary objective as identifying and mapping potential regions on the Martian surface that exhibit characteristics conducive to supporting the growth of crops driven by the hyperspectral data from the CRISM instrument aboard the Mars Reconnaissance Orbiter (MRO), while considering the effects of the dominant atmospheric gases on Mars.