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EXPLORATION OF MARS THROUGH AN AUTONOMOUS AND MACHINE LEARNING ENABLED CONSTELLATION OF DRONES

Abstract

Other than the Moon, Mars has held a special position in human fascination. Although it is not the closest planet to Earth, it closely resembles the Earth and excites our imagination, to explore its planetary surface to increase our understanding of its environment and mineralogy. Exploration of Mars has been the major driving force and destination, of space exploration for past few decades. Reaching to Mars has been a challenge in itself, let alone the development of a system to explore its surface. Although Curiosity and Opportunity have been on Mars for more than a combined 6000 sols, not much of the surface has been mapped. Many orbiters have also been placed into Mars's orbit, but the prospect of mapping the Martian surface through rovers, provides more accurate data about the mineralogy of the soil, however, robotic exploration is a slower process when compared to aerial surveillance. This paper presents a sustainable approach to map the surface of Mars through a constellation of Machine Learning enabled and Autonomous, Constellation of Drones, flying in a synchronized manner over the Martian soil. The mission architecture proposed through the paper has been designed to maximize the scientific data from the Martian surface. Various trade studies will be included at the architectural and system levels to demonstrate the compliance of the science instruments for a complete optimization. A detailed description of the scientific approach to establishing communication among the drones will be included. Detailed surface experiments and communication plans for the constellation of drones will also be showcased. Various system-level simulation results will be included to demonstrate the stability of machine learning architecture among the drones. Comprehensive tables and graphs will be given to illustrate the compliance of the functionality of the constellation of drone, in the harsh environment of Mars. Tables will also be given to depict the amount of time that will pass at each mode of travel and more importantly, some idea on the cost in terms of energy, as well as money, will be discussed within today's context. Even though the possibility of such a mission is probably nonexistent for this decade, it is essential to do these exercises so that mankind's understanding of Mars will be increased. In addition, this paper hopes to establish some general guidelines for such a planetary mission.