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Author: Mr. Matthias Frenzl
Space Forward Lab, Austria, Matthias.Frenzl@adjacentpossible.network

THE TUMBLEWEED R-SELECTED MARS ROVER SWARM TASKED WITH DEPLOYING MEASUREMENT STATIONS AT SCALE

Abstract

Traditional Mars Rover missions had trade-offs, requiring extensive resources and time for development. They had limited mobility and couldn't collect data from multiple locations simultaneously over extended periods. The low number of vehicles increased the risk of mission failure. The high cost per kilobyte of scientific data posed a barrier for researchers.

An alternative approach, using r-selection, can address these issues. r-selected rover swarms offer advantages like lower mass and cost per vehicle, increased utility, and reduced risks. The swarms can act as transporters and data collectors, deploying measurement stations or acting as stations themselves. This decreases costs and mission risks.

Using multi-objective design optimization, we demonstrate the efficiency of the r-selected Tumbleweed Rover swarm, achieving a significant reduction in data costs compared to traditional rovers. The swarm enables simultaneous multi-location data collection, addressing the limitations of standard missions.

Its distributed nature enhances redundancy and fault tolerance, reducing risks.