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MARS HABITAT RESOURCE MANAGEMENT USING MULTI-AGENT MODELS AND MACHINE LEARNING FORECASTS

Abstract

Using data from the Hawaii Space Exploration Analog and Simulation (HI-SEAS) a resource management system is presented here that utilizes multi-agent modelling with power and inventory consumption forecasts using machine learning. Human Mars explorations face a large number of challenges never encountered before. Not only are these extreme environments, these missions will face extreme isolation with little to no chance of resupply. Under these conditions, the efficient management of habitat resource consumption, inventories, and crew activity scheduling are a mission critical capability. Given the long duration and long term adaptability required these problems are non-linear which demand effective forecasting models. An intelligent Mars habitat system is presented here using an agent based AI model simulating the conditions of the HI-SEAS habitat. The model is focused on crew member AI agents and their projected power resource allocation and inventory usage during planetary surface exploration missions lasting 8-months to a year. This model incorporates forecasting of power use and crew mood with active resource allocation decision making. Crew AI agents must cooperate with the habitat agent to establish power requirements under dynamic conditions. Solar power production is forecast using data from the weather station and machine learning models. The crew schedule organized by NASA playbook software from an eight-month isolation mission at HI-SEAS is incorporated into the multi-agent system to partially manage critical power consumption from typical habitat tasks as well as autonomous crew self-scheduled tasks.. This research is applicable to Mars habitats and other explorations requiring power, inventory, and scheduling forecasts and management.