Paper ID: 98519
student

IAF SPACE POWER SYMPOSIUM (C3)
Interactive Presentations - IAF SPACE POWER SYMPOSIUM (IP)

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ENHANCING SOLAR PANEL EFFICIENCY ON MARS: AI-DRIVEN DUST ACCUMULATION MONITORING

Abstract

This research is based on how dust particles affect the photovoltaic systems (PV) of rovers and how sufficient data on dust particles on Mars can be obtained in the process. Currently, the lack of sufficient knowledge about Mars makes the research on there more challenging. One of the main reasons for this is that the PV system does not have a long enough lifespan and becomes non-functional earlier than expected. For example, the rover InSight Lander, which was sent to Mars in 2018, was out of function in 2022 after just four years due to energy loss. The reason for this was the accumulation of dust particles on the PV panels, gradually leading to their failure. The cameras on rovers cannot measure the depth, volume, or spread of dust. Therefore, by implementing an AI-powered sensor, we can detect even the smallest dust particles, place limitations on them, and monitor them through a Convolutional Neural Network (CNN)-based sensor. This system automatically tracks and rapidly transfers data to Earth, enabling PV panels to be cleaned efficiently. As a result, the lifespan of the rover extends far beyond expectations. The monitoring system conserves energy by storing it for necessary operations, meaning it functions as an energy reserve and minimizes its reliance on the rover's power. These systems balance each other out. Although research conducted in 2018-2019 suggested that solar panels could be cleaned using electrostatic techniques or electrodynamic shields, these methods were deemed unsuitable for Mars, as they could lead to energy losses. In conclusion, while the failure to prevent dust accumulation presents a challenge to our exploration of Mars, the development and implementation of CNN-based sensors enable their full potential to be utilized. This, in turn, brings us closer to advancing Mars exploration.