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A LUNAR SURFACE SCENARIO SIMULATION APPLYING ADAPTIVE OPERATING SYSTEMS

Abstract

There is much discussion about the further exploration of the moon and its implementation by autonomous robots and rovers. Prognostics and health management approaches are considered for autonomous systems to assure reliable operation. In this context, the reliability-adaptive systems approach deals with the prediction of the remaining useful life (RUL) to avoid maintenance conflicts. The proposed paper introduces a multi-system scenario on the lunar surface consisting of six rovers maintained by a single base.

The rovers drill into the lunar surface and bring soil samples back to the base. To estimate the RUL as precisely as possible, the wear of the drill is monitored. Soil density, radiation, and soil versus rover temperature are just a few random aspects which are considered in the calculation of the drill failure rate. The simulation calculates random soil densities over drilling depth, modelling the unpredictable conditions on the moon. The random soil density influences the failure rate.

The base can maintain only one rover at a time. To avoid maintenance conflicts and to maximise the total scenario soil output, some rovers derate their performances in order to extend their RUL so that all rovers reach the base preferably one after the other. When predicting the RUL, all previous failures, the current performances, and RUL prognoses of all rovers are taken into account. The paper discusses the operation algorithm including the rover procedures.

The proposed contribution compares the efficiency of systems operated either conventionally in a non-derating mode or in a reliability-adaptive mode. The scenario-wide workload performed by all rovers is the evaluation measure in this approach.

The following results have been obtained: Reliability-adaptive systems are operating more efficiently in the given lunar context than the conventional systems operate as the adaptive rovers continuously achieve higher up times in total. The longer the simulation time, the higher is the efficiency of reliability-adaptive operation. It has also been shown that reliability-adaptive systems have a significant influence on reducing delay times when returning to the drilling sites.