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Quality and safety, a challenge for traditional and new space (1)

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MULTI-OBJECTIVE OPTIMIZATION FOR HABITATS IN EXTREME ENVIRONMENTS

Abstract

The increasing complexity of future habitats design for extreme environments, such as Moon and Mars, gives rise to large ranges of possible configurations for which no baseline has yet been established. To determine an optimal architectural concept, the entire design space has to be explored. Moreover, the presence of evolving requirements' uncertainty due to the lack of experimental data requires flexible decision-making techniques to alleviate the risks inherent to the launch of new programs.

The Multi-Objective Optimization (MOO) approach provides designers with efficient tools for generating and exploring variable-oriented architectures that can be further optimized and compared. It provides an helpful decision-making tool for identifying trends and trade-offs, while prioritizing designs.

The application of the proposed methodology highlights key promising technological enablers, which can be leveraged to design high-performance and robust concepts. Our approach is based on Pareto Ranking and heuristic algorithm to ensure diversity in the optimization process. These algorithms are implemented in a software exploiting inbuilt resources of 3D modeling and real-time visualization, physical and mecanical modelization.

Keywords: Multi-Objective Optimization, Pareto ranking, heuristic algorithm