

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Space Exploration Overview (1)

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## MAKING MORE MARSCOPTERS: EVALUATING MARS ROTORCRAFT DEVELOPMENTS

**Abstract**

Mars helicopters, or "Marscopters," are unique in their ability to reach locations otherwise inaccessible to traditional land-based forms of mobility, as shown by Ingenuity's flight over the precarious sand dunes of the Jezero crater. However, Mars missions utilizing flying platforms represent a new paradigm where traditional space exploration technologies, architectures and design analysis approaches are ill-suited. To address this issue, there is a great and pressing need to develop tools, technologies, and architectures to enable this new type of mission. Likewise, funding stakeholders must evaluate these competing development efforts not only for their stated system-level performance and cost estimates but also according to their long-term potential for future performance improvement in the context of other ongoing technology development. This study aims to support these efforts and inform other information technology investment decisions by providing investigations on current development efforts and their improvement potential, both in terms of vehicle performance and enabling potential to science objectives, in terms of Figures of Merit (FoM) at the subsystem level. These FoM are further evaluated in the context of wider desires from space stakeholders for flexible, low-risk, low-cost and high-impact missions. Approaches to quantifying the long-term improvement potential of competing architectures and technologies are also investigated. This includes utilizing existing and unique Mars rotorcraft models to identify and quantify potential system-level benefits of investing in the improvement of subsystem performance while accounting for the feedback in such a complex system, which features multiple interactions between components. The result of this study also supports the exploration of alternative technology roadmapping and development questions.