Senior Design BS Project
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HIGH ENDURANCE ROTATING-WING MARS EXPLORATION SPACECRAFT

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SENIOR DESIGN EXPO

Abstract

This project describes the conceptual design of a High Endurance, Rotating-wing, Mars Exploration Spacecraft (HERMES). This carbon-dioxide breathing/nuclear hybrid engine design brings unique capabilities that will enable vital research from both the Martian surface and atmosphere that have been previously inaccessible.

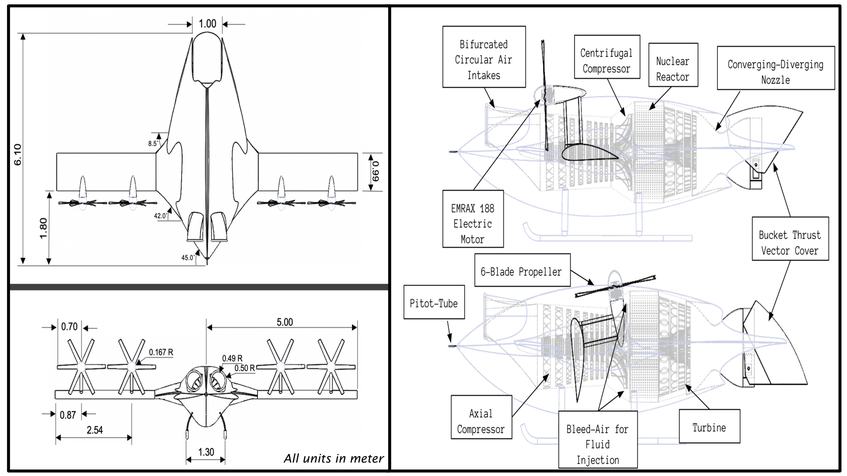
Introduction

Mars exploration missions been launched since 1971 and numerous campaigns are currently in service with the objective of gathering detailed information regarding the planet's atmosphere, deep interior, and history. The HERMES concept is developed to give unique capabilities for the collection of scientific data on Mars. With the endurance to circumnavigate Mars 225 times, this vehicle significantly increases the capacity for humans to collect and transport scientific data vast distances along the Martian surface. Additionally, as an airborne vehicle, HERMES enables the collection of unique atmospheric data at low altitudes. Key design drivers for the HERMES include long-range capabilities, operational flexibility, and vertical takeoff and landing (VTOL) capabilities.

Methods | Design | Analysis

Primary design features included this aircraft are as follows:

- The Advanced Co-Flow Jet (CFJ) airfoil was selected to enable adequate lift-generation in the low-density, low-Reynolds number atmosphere of Mars
- Bucket nozzle vectoring and rotating, propeller - CFJ wings enable this design to takeoff and land vertically, allowing access to complex terrain that current rover and satellites cannot reach
- HERMES has a range of 4.8 x 10^6 km and an endurance of 1 Martian year (1.88 Earth years)
- The stability of this aircraft is controlled by fluid injection valves, asymmetric propeller throttling, and ailerons. This unique control design reduces the weight and size of our aircraft
- Landing skids are used as a substitute for conventional landing gear to reduce overall weight, simplify the control systems, and maximize internal storage volume



Conclusion

This unique design will further improve our capability to research the vital information that only Mars can provide. HERMES can help humankind answer questions such as:

- Did life ever exist on Mars?
- How did climate change impact Mars and what comparisons can we see on Earth?
- How can we better prepare for the human colonization of Mars?

As a result, HERMES provides a framework for human exploration that is unprecedented, and it will change the way that humans collect and research data in the future.

Acknowledgments

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References

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