

# **Mission & Design Sensitivities for Human Mars Landers using Hypersonic Inflatable Aerodynamic Decelerators**

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*Abstract*— Landing humans on Mars is one of NASA’s long term goals. The Evolvable Mars Campaign (EMC) is focused on evaluating architectural trade options to define the capabilities and elements needed for a sustainable human presence on the surface of Mars. The EMC study teams have considered a variety of in-space propulsion options and surface mission options. As we seek to better understand how these choices affect the performance of the lander, this work informs and influences requirements for transportation systems to deliver the landers to Mars and enable these missions. This paper presents the effects of mission and vehicle design options on lander mass and performance. Beginning with Earth launch, options include fairing size assumptions, co-manifesting other elements with the lander, and Earth-Moon vicinity operations. Capturing into Mars orbit using either aerocapture or propulsive capture is assessed. For entry, descent, and landing both storable as well as oxygen and methane propellant combinations are considered, engine thrust level is assessed, and sensitivity to landed payload mass is presented. This paper focuses on lander designs using the Hypersonic Inflatable Aerodynamic Decelerators (HIAD), one of several entry system technologies currently considered for human missions.