**MECHANICAL AND AEROSPACE ENGINEERING DEPARTMENT**

*THESIS DEFENSE*

**CONCEPTUAL DESIGN OF A REUSABLE MARS AIRCRAFT**

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**ABSTRACT**

 This study has assumed that the launch vehicles and precision Mars entry descent and landing systems, required for eventual crewed missions to the surface, have been developed, motivating the rapid build-up of a fixed surface base to enable extended human stays. During the time interval between the first successful placement of a heavy (between 20 and 80 metric ton) payload and completion of the baseline human-rated Mars outpost, it will be possible to utilize this large payload delivery capability to accelerate robotic exploration of the surface from the fixed base location.

One element of such an expanded robotic exploration program will be the availability of a reusable multi-purpose aircraft utilizing locally-produced propellant on Mars. While a simple reconnaissance flight profile was certainly achievable, this study has focused on exploiting the precision delivery and recovery capabilities that can be enabled by this type of aircraft. As a consequence, delivery and recovery capabilities have been examined ranging from a non-recoverable rover deployment, with limited airborne sample collection and return capability, through autonomous landing and delivery of a recoverable rover at a remote location with subsequent recovery and return.

Aircraft mass is not a limiting constraint as payload delivery capability will exceed 20 metric tons. Aircraft size will be constrained by the dimensions of the cargo delivery container. The resulting aircraft wing span limitations affect overall range and flight payload delivery capabilities. Therefore this thesis has developed conceptual designs for a range of reusable Mars airplanes based on the available delivery method to Mars. Achievable aircraft sizes and range capabilities were estimated using a detailed component-by-component mass assessment based on a combination of physics based models and widely-used terrestrial aircraft design projections.

**ALL INTERESTED PERSONS ARE INVITED.**