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DESIGN AND OPTIMIZATION OF HYBRID DRONE FOR MARS EXPLORATION

Abstract

The focus of this work is to create an Unmanned Aerial Vehicle (UAV) that can carry a number of detachable multirotor drones. This concept entails creating a mechanism for attaching and detaching the multirotors, designing the fixed-wing UAV, dealing with system stabilization, and characterizing the performance of the system. This design can be useful for the exploration of Earth and other planets, seeing that research is currently being pursued in this area. Fixed wing drones are used for endurance flight and multi-rotors can be used to perform small tasks such as sample return, surveying, and data collection.

Detaching the multi-rotors from the fixed-wing drone is the primary focus. This UAV has a fixed-wing design with flying wing configuration powered by a ducted fan and has VTOL capabilities. There are multi-rotors, like quadcopter drones, that are oriented and mounted on the mother UAV and can attach or detach from the main UAV. These multirotors may also be used to assist the fixed-wing in hovering and vertical flight.

This drone can be applied for planetary exploration, both for Earth and Mars. Mars has a low-density atmosphere (0.087 psi) which makes flying difficult, but still possible. To fly in this atmosphere the UAV must be light and durable. Several options for the attachment mechanism are being explored ranging from magnetic, mechanical, claw, tethered, or using a high precision landing technique. The flight performance must be monitored for the multirotors, fixed-wing drone, and the system as a whole.

The combination of the two types of drones offers the chance to observe territories at a distance and perform tasks that may not be possible or safe for humans. Using drones for planetary exploration is beneficial in that it allows maneuvering around different paths that may contain obstacles on the ground. Research is currently being explored for the attachment mechanism. Results will include a design and prototype for the attachment mechanism and quantification of drone performance. This design entails addressing multiple engineering problems, such as separation flight, high precision landing, and drone swarming for drone recovery tasks.