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Decision Support Tool for Designing Niche Small Package Delivery Aerial Vehicles (DST-NSPDAV)

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Abstract: A growing market is the application of multi-rotor vehicles to niche delivery services such as just-in-time spare parts delivery, real-time asset repositioning, rapid food delivery, and remote medical supply delivery. These services are unique in their requirements, meaning there is no single aerial vehicle configuration that is optimal for every scenario. More importantly, these service providers do not have the expertise to design and operate small multi-rotor vehicles that are now feasible due to advances in technology. This is a complex design decision with non-linearities in the design-state-space. This paper presents a decision-support tool to assist small package delivery service providers on choosing the best multi-rotor vehicle for their payload application.

The decision-support tool for the design of multi-rotor small package delivery aerial vehicles (SPDAV) takes inputs such as payload range, minimum distance, maximum price and size, and recommends suitable pre-existing configurations. A configuration is defined as a frame size and weight, number of rotors and rotor torque, battery (size, voltage, amperage), propeller, and micro-controller. The algorithm used to generate the design-state-space consists of two separate models of multi-rotor aircraft: (1) a power consumption model and (2) a full dynamic flight model. The power consumption model evaluates the steady-state performance of the battery, motor, and propeller combinations at hover, 80%, and full throttle to determine systems that satisfy the users' requirements. A dynamic flight model is then applied to these pre-existing configurations to further account for airframe aerodynamics and specific flight profiles.

Keywords: Power-Model, Dynamic-Model, Multi-Rotor