The Use of Micro-fiber Composite in Simultaneous Gust Alleviation and Energy Harvesting for Small Fixed-Wing UAV

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This report presents the use of Micro-fiber Composite (MFC) in simultaneous gust alleviation and energy harvesting system for small fixed-wing Unmanned Aerial Vehicles (UAV). Vibration suppression in flexible structures is becoming an important design problem to develop energy-recycling systems powered using the harvested ambient energy. Reduced energy control laws are developed to address the trend towards autonomous ultra-light weight aerospace structures with limited energy supply. Experiments build upon recent advances in harvester, sensor and actuator technology that have resulted in thin, light weighted multi-layered composite wing spars. These beam-like multifunctional spars are designed to be capable of alleviating wind gust of small UAV using the harvested energy. Experimental results are presented for cantilever wing spars with micro-fiber composite transducers controlled by reduced energy controllers with focus on two vibration modes. A reduction of 16dB and 11dB is obtained for the first and the second mode using the harvested ambient energy. This work demonstrates the use of reduced energy control laws for solving gust alleviation problems in small UAV, provides the experimental verification details, and focuses on applications to light weight aerospace systems.