Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Experimental investigation of the unbalanced coaxial rotor configuration for unmanned aerial vehicles[1] EMILE OSHIMA, KATIA LUIS-DIAZ, MORTEZA GHARIB, California Institute of Technology — The coaxial rotor configuration on a helicopter eliminates the need for a torque-balancing tail rotor, but also induces large aerodynamic interference losses. For multirotor unmanned aerial vehicle (UAV) designs, however, such losses may be reduced by relaxing the torque-balancing restriction on each coaxial pair. The two rotors can have mismatched diameters, blade geometries, and rotation rates. This is a promising design approach for increasing the efficiency and maneuverability of UAVs in various applications such as package delivery, emergency response, and space exploration. A test stand for measuring the hover thrust of coaxial systems is built, with design emphasis on the ease of geometry alterations. Experimental results show that unbalanced configurations perform better than the traditional torque-balanced configuration. In particular, the thrust-to-power ratio is highest when the diameter and rotation rate of the upstream rotor are less than those of the downstream rotor. Various axial separation distances and mounting structures are also investigated. Flows for selected cases are then quantitatively visualized using particle image velocimetry.

[1]This work was supported by the Center for Autonomous Systems and Technologies (CAST).

Emile Oshima
California Institute of Technology

Date submitted: 31 Jul 2019 Electronic form version 1.4