Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Fan array wind tunnel: a multifunctional, complex environmental flow manipulator[1] CHRISTOPHER DOUGHERTY, MARCEL VEISMANN, MORTEZA GHARIB, Caltech — The recent emergence of small unmanned aerial vehicles (UAVs) has reshaped the aerospace testing environment. Traditional closed-loop wind tunnels are not particularly suited nor easily retrofit to take advantage of these coordinated, controls-based rotorcraft. As such, a highly configurable, novel wind tunnel aimed at addressing the unmet technical challenges associated with single or formation flight performance of autonomous drone systems is presented. The open-loop fan array wind tunnel features 1296 individually controllable DC fans arranged in a 2.88m x 2.88m array. The fan array can operate with and without a tunnel enclosure and is able to rotate between horizontal and vertical testing configurations. In addition to standard variable speed uniform flow, the fan array can generate both unsteady and shear flows. Through the aid of smaller side fan array units, vortex flows are also possible. Conceptual design, fabrication, and validation of the tunnel performance will be presented, including theoretical and computational predictions of flow speed and turbulence intensity. Validation of these parameters is accomplished through standard pitot-static and hot-wire techniques. Particle image velocimetry (PIV) of various complex flows will also be shown.

[1]This material is based upon work supported by the Center for Autonomous Systems and Technologies (CAST) at the Graduate Aerospace Laboratories of the California Institute of Technology (GALCIT).

Christopher Dougherty
Caltech

Date submitted: 31 Jul 2017 Electronic form version 1.4