Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Improving the Descent Performance of Small-Scale Rotorcraft through Added Geometries[1] DANIEL YOS, MORTEZA GHARIB, MARCEL VEISMANN, Caltech — The descent stage of all rotor vehicles—from helicopters to drones—results in a significant loss of thrust and increased fluctuations with respect to the system in hover condition. These losses are believed to derive from the reinjestion of the rotor flow that causes an accumulation of tip vortices at the rotor plane: often referred to as the vortex ring state (VRS). An approach of utilizing additional geometries within the proximity of the rotor plane was investigated by using enclosed shrouds and various props (with enhanced blade tip designs), in order to improve the stability and performance of rotorcraft in descent. These geometries were aimed to prevent the interaction between the blade tip vortices and the rotor disk. Results from single rotor thrust tests indicate that it is possible to reduce the thrust losses within the VRS by adding geometries in distinct locations relative to the rotor disk, while additional PIV analysis potentially outlines the underlying flow mechanism that causes these performance improvements.

[1]The presented material is based upon work supported by the Center for Autonomous Systems and Technologies (CAST) at the California Institute of Technology

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Date submitted: 01 Aug 2019 Electronic form version 1.4