Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

The influence of blade geometry parameters on the descent performance of small-scale rotors[1] MARCEL VEISMANN, DANIEL YOS[2], MORTEZA GHARIB, Caltech — In axial descent, rotorcraft generally encounter a flow phenomenon called vortex ring state (VRS), during which the rotor downwash is re-ingested, leading to severe losses in thrust and strong oscillatory air-loads on the rotor. In this study, we investigated the effect of specific geometric blade parameters on the descent behavior of small-scale rotors. The experimental approach included 3D printing custom rotor-blade designs and evaluating their performance in wind tunnel experiments. Metrics subject to perturbation were the blade's chord length, pitch, taper, and the number of blades. Furthermore, various tip geometries were given consideration. Results indicate that the descent performance is highly correlated to the geometry of the rotor and hover performance parameters. Thus, this study provides a predictive tool for rotorcraft behavior in descent, enabling us to estimate the average thrust losses without the necessity of having to perform actual tests. Complimentary PIV analysis provides further insight into the rotor-tip's vortex formation characteristics of the various blade designs, which are believed to be the driving factor for VRS behavior.

[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: 03 Aug 2020 Electronic form version 1.4