Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Transient flow around an airfoil at increasing angle of attack OLAF MARXEN, University of Surrey — Flow around the wings of an unmanned aerial vehicle may be subject to rapidly varying flow conditions. A particularly interesting case occurs when this change causes a sudden increase of angle of attack (AoA) for the airfoil. However, at present there is very limited knowledge of the underlying flow physics for airfoils subject to non-periodic transient conditions. Due to this lack of knowledge, accurate and general yet efficient calculation methods for the forces generated by an airfoil subject to transient flow conditions are presently lacking. In order to improve our knowledge of transient aerodynamics, the flow around a NACA0015 airfoil subject to a rapidly increasing AoA is investigated experimentally for constant wind tunnel speeds and hence Reynolds numbers (approximately Re=140,000 to 570,000). The lift during dynamic testing was found to be higher than that from static testing at the same AoA. For the lowest Reynolds number considered, a significant lift overshoot could be observed, reaching values beyond the global maximum lift achieved during static testing. Analysis of transient results indicates that the movement of the location of laminar-turbulent transition as well as local boundary-layer separation occurring on the suction side of the airfoil play a key role.

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Date submitted: 10 Aug 2020 Electronic form version 1.4