Abstract Submitted
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Dynamic stall in flapping flight TATJANA HUBEL, CAMERON TROPEA, TU Darmstadt, Germany — We report on experiments concerning unsteady effects in flapping flight, conducted in the low-speed wind tunnel of the TU Darmstadt using a mechanical flapping-wing model. Particle Image Velocimetry (PIV) was used for qualitative and quantitative analysis parallel and perpendicular to the flow field. A sensitivity analysis of the main flight parameters has been performed, with specific attention to the flight envelope of $26,500 < Re < 135,000$ and $0.029 < k < 0.29$ ($k = \pi f c/U_\infty$). The phase-averaged reconstructions of the flow field are then used to calculate the phase-resolved forces acting on the model and were compared with the results from an internal three component balance. The existence of the dynamic stall effect could be verified by the direct force measurement as well as the flow visualization. The observation of the leading-edge vortex for typical bird flight reduced frequencies shows that this flow cannot be approximated as being quasi- steady. This in effect proves that adaptive wings are necessary to fully control these unsteady flow features, such as dynamic stall.

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