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PIV Measurements of Engine-Jet/Vortex Interaction in the Near Wake of a Swept Wing

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Summary

Vortex wakes are a serious hazard in international civil air transport, especially in the vicinity of airports. Since years the characteristics of these vortex flows is examined in national and international research projects like WakeNet, Euro-Wake, FAR-Wake etc. There are different strategies to reduce the risk of vortex encounters, e.g. avoidance, minimization of vortex strength by design or reduction of the vortex lifetime. The latter focuses on ways to destabilize vortices through mutual induction or perturbations in the wake flow. Due to the extension of vortex wakes far downstream airplanes the research in this field is dominated by numerical investigation which use mathematical vortex models or experimental data to initialize the flow field in the computational domain. In both cases even small deviations from the vortex structure may result in remarkable consequences for the stability properties of the wound up vortex. Since engine jets significantly influence the wake they could have the potential to play an important role for the onset of instabilities. However, publications on engine jet/vortex interaction are rare. One reason might be the difficulty to determine the precise structure of vortices by experimental methods. Using the method of centered averaging of particle-image velocimetry data it is possible to determine the detailed structure of trailing vortices and the surrounding flow without the falsifying effects of ensemble averaging processes mentioned before. This allows replacing typical mechanisms of triggering instabilities in trailing wakes like White Noise or similar methods by an unsteady process that is based on measured fluid properties.