Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Large Eddy Simulations of controlled aircraft in formation relying on wake sensing.[1] IGNACE RANSQUIN, DENIS-GABRIEL CAPRACE, PHILIPPE CHATELAIN, Universite Catholique de Louvain, UCLouvain, JEFFREY ELDREDGE, UCLA — Aircraft formation flight leads to substantial improvements in energetic efficiency even for large separations. Maintaining an energy-saving formation requires the estimation of the preceding aircraft's wake position, and implies a sensing strategy. We propose to leverage the measurements of the six degrees-of-freedom dynamics of the follower aircraft. This study combines the simulation of the aircraft dynamics and the LES of the wakes by means of a Vortex Particle-Mesh method. In a 2-ship formation, the aerodynamics and vorticity sources are modeled using an immersed lifting line approach. The follower aircraft operates an autopilot in the form of a hierarchy of controllers that govern the ailerons, rudder, elevator and thrust in order to achieve wake sensing and tracking. The robustness of the autopilot is verified with the LES of a single aircraft in turbulent flow. Then the influence of a leader's wake on a follower's dynamics is studied through the analysis of the related aerodynamic forces and the resulting wake. Finally, based on an Ensemble Kalman Filter, the position of the leader's wake is estimated and used as the target of the autopilot to maintain the follower in the optimal position. The efficiency of the tracking procedure is analyzed and shows promising results.

[1]Funding from the European Research Council (ERC) under the European Unions Horizon 2020 research program; Computational resources from Consortium des Equipements de Calcul Intensif (CECI).

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Date submitted: 29 Jul 2019 Electronic form version 1.4