CALCULATION OF RADAR CROSS SECTION BASED ON SIMULATIONS OF AIRCRAFT WAKE VORTICES

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In a context of air traffic density expansion and increasing diversity of the operational aircraft fleet, real-time sensing of wake vortices at take-off and landing is a key solution for the implementation of new air traffic management systems. Indeed, by modulating the safe separation distances according to the weather conditions and airplane types, it becomes possible to optimise the transportation flow while maintaining the air safety thanks to reliable wake vortices detection systems. In the frame of the SESAR project P12.2.2, measurement campaigns performed by Thales's radars [1][2], supported by simulations modelled by UCL, [3] bring inputs for testing a Wake Vortex Advisory System.

A simulator has been developed for the calculation of the radar cross section by combining a 2D fluid mechanism model [4] and the electromagnetic modelling of the backscattering of the wake vortices. The fluid mechanism model computes the vortices effects on a stratified atmosphere in clear air condition. The evolution of the atmospheric parameters as pressure, temperature and humidity leads to the determination of the gradient of the dielectric permittivity which allows evaluating the power backscattered by wake vortices. This model is used for a parametric study aiming to optimise the radar parameters and for a better understanding of the physical mechanisms responsible for the variation of the power of the received signal.

The full paper will present results from different wake vortex scenarios involving the variation of Radar Cross Section parameter in different conditions atmospheric conditions and for several types of airplanes. These data will be applied to the generation of a look up table used for testing a Wake Vortex Advisory System. The simulated radar cross sections will be compared with X-band radar measurements performed by Thales. Furthermore, the paper will demonstrate the flexibility of the simulation procedure which is modular enough to be extended to more complex and realistic fluid mechanism models.

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[2] F. Barbaresco, P. Brovelli, P. Currier, O. Garrouste, M. Klein, P. Juge, Y. Ricci, J.Y. Schneider, "Radar Sensors for Wind & Wake-Vortex Monitoring on Airport : First results of SESAR P12.2.2 XP0 trials campaign at Paris CDG Airport", ERAD 2012 - The 7th European Conference on Radar in Meteorology and Hydrology, Toulouse, June 2012

[3] D. Vanhoenacker-Janvier, K. Djafri, F. Barbaresco. Model for the calculation of the radar cross section of wake vortices of take-off and landing airplanes. *ERAD2012 June 2012*

[4] I. De Visscher, L. Bricteux, G. Winckelmans, S. Caliaro, and T. Vilbajo. Large Eddy Simulations of Aircraft Wake Vortices in a Stably Stratified Atmosphere. *Sixth International Symposium on Turbulent and Shear Flow Phenomena, TSFP-6", Seoul National University*, 2009