SIMULATION OF X-BAND RADAR FOR THE ASSESMENT OF EDDY DISSIPATION RATE ON A CONVECTIVE BOUNDARY LAYER

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Real-time monitoring of wind hazards is becoming a key solution for Air Traffic Control as it allows increasing the safety level of aircraft landing and taking off phases while improving airports throughput. For this purpose, the UFO project [1] aims to design a new generation of sensors for the assessment of wind shear and clear air turbulences during these critical phases. Usually described as Eddy Dissipation Rate (EDR) [2], the rate at which the turbulence energy is dissipated can be detected by Radar and Lidar. In order to support EDR measurement campaigns, Radar and Lidar simulators are developed and allow evaluating the wind and turbulent EDR.

In the frame of a previous activity [3][4], a X-band Radar simulator was developed for a Wake Vortex Advisory System based on a 2D fluid mechanics model. The electromagnetic calculations performed were used to estimate the power backscattered by wake vortices. In the context of the UFO project, this simulator is modified for the detection of Eddies in a turbulent atmosphere. For this purpose, the Radar simulator is applied on tropospheric data generated by Large Eddy Simulation (LES) [5]. The LES performed represents the 3D space/time behaviour of a clear-air Convective Boundary Layer (CBL) and shows turbulences evolving at 1 km above the ground.

The LES atmospheric parameters such as temperature, pressure and humidity are used to evaluate the refractive index and its structure constant which characterises the turbulent intensity. This function is directly related to the Radar Cross Section (RCS). The time variation of the atmospheric parameters and wind speed enable the Doppler spectrum calculation and subsequently the EDR parameter evaluation.

Details on the electromagnetic modelling will be presented as well as results of simulation of RCS using LES CBL in order to assess the Radar sensitivity to clear air troposphere turbulences.

[1] http://www.ufo-wind-sensors.eu

[2] Hocking, W. K., On the extraction of atmospheric turbulence parameters from radar backscatter Doppler spectra, 1, Theory, J. Atmos. Terr. Phys., 45, 89-102, 1983.

[3] 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

[4] Pereira C., Canal D., Schneider J.Y., Beauquet G., Barbaresco F. Calculation of Radar Cross Section Based on Simulations of Aircraft Wake Vortices. *Wakenet Workshop May 2013*

[5] Cheinet & Cumin, 2011, Local structure parameters of temperature and humidity in the entrainment-drying convective boundary layer: a LES analysis, J. Appl. Meteor., 50, 471-481.