10.12 DUAL-POLARIZATION FOR CIVIL AIRCRAFT RADAR: EXPERIMENTS WITH A PROTOTYPAL SYSTEM IN THE NETHERLANDS AND IN ITALY

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Both civil aviation and military transport aircrafts are usually equipped with a radar mounted in the nose. Its task is to scan ahead of the aircraft for detecting the presence of dangerous meteorological phenomena along the route. In this way they support pilots to change the route to mitigate risks related to weather. For this reason, these devices are sometimes named weather avoidance radar. They operate typically at X-band with a coarse angular resolution to keep the physical size of antenna small enough to be compatible with mounting. Such systems can have Doppler capabilities, providing also forward looking windshear and turbulence detection within some limited ranges. Measurements of reflectivity are displayed according to few levels: their meteorological interpretation is left to pilot′s experience. Polarimetry has not been adopted in commercially available weather radars and its potential advantages for civil aviation aircraft are still mostly unexplored.

However, the success of ground-based dual-polarization weather radar has demonstrated several advantages that can be of interest also for avionic application. In particular, the reliable correction of X-band attenuation and a meaningful classification of the precipitation type (rain vs. hail vs. snow).

The European Commission initiative CleanSky launched several projects aimed at improving flight route planning in the presence of unforeseen events, such as the presence of rapidly evolving thunderstorms along the route. Objectives are to increase the safety and comfort of flight and to keep emissions as low as possible. In this perspective potential improvements to aircraft weather radar related to the use of dual polarization technology were investigated along such projects. In particular, specific radar signal simulators to support design phase, architecture of the data processing system, including a Support Vector Machine based hydrometeor classification system, and trajectory optimization tools to be implemented in an Electronic Flight Bag. The X-WALD project was funded with the main objective of planning and performing ad-hoc experimental airborne polarimetric radar measurements. The availability of real data is of great importance to test the quality of the simulator as well as the capability of the processing algorithms. Two measurement campaigns were conducted in 2015 and 2016 in the Netherlands and in Central Italy, respectively, using a low-power X-band radar mounted on two different aircrafts. Moreover, these measurement campaigns were the first of this kind performed in Europe. Measurements from these campaigns and their comparison with radar data collected by ground-based systems are presented and discussed.