The CleoSim Radar Simulator

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Civil and military transport aircrafts are usually equipped with avionic weather radars (AWR), that implement various functionalities for the detection of dangerous weather phenomena. In principle, the highest detection performances can be obtained by the Doppler-polarimetric radars; in fact, polarimetric radars can provide more refined information on the type of precipitation once the model of specific hydrometeor (rain, snow or hail) is known. So far, polarimetry has been used in meteorological ground-based radars, but not in avionic commercial radars (apart from some experimental systems).

During the CLEOPATRA project a new airborne Doppler-polarimetric radar simulator was developed (CleoSim), that combines the description of the meteorological scenario at mesoscale level (typical of the environment simulators) with the capability of generating accurate time series of raw signals received by the sensor (typical of the microphysical simulators). The simulator generates a virtual meteorological environment, simulates the transmission of the electromagnetic pulses, and solves the monostatic radar equation to produce a stream of synthetic I&Q samples.

The main application of CleoSim is the generation of synthetic signals to perform extensive tests of the signal processing and trajectory optimization algorithms developed in the framework of another related project (KLEAN). Obviously, algorithm performance analysis results are strictly dependent on the reliability of the polarimetric radar simulator, that therefore needs to be thoroughly validated.

In this contribution we present the results of the validation phase of CleoSim; the simulator was validated by comparing synthetic data against both "textbook" scenarios and measured data; those last were gathered concurrently by two ground-based Doppler-polarimetric radars (operating at C and X band) owned and operated by ARPAP (Agenzia Regionale per la Protezione dell'Ambiente del Piemonte) during an ad-hoc experimental campaign, conducted in the course of the Cleopatra project.