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Author: Mrs. Chiara Brighenti
S.A.T.E., Italy, chiara.brighenti@sate-italy.com

Mr. Riccardo Cagnato
S.A.T.E. S.r.l, Italy, riccardo.cagnato@sate-italy.com
Mr. Giacomo Farinati
S.A.T.E. S.r.l, Italy, giacomo.farinati@sate-italy.com
Dr. ATTILIO BRIGHENTI
Italy, attilio.brighenti@sate-italy.com
Dr. Vincenzo Schena
Thales Alenia Space Italia, Italy, Vincenzo.Schena@thalesaleniaspace.com
Mr. Alessandro Carletti
Thales Alenia Space Italia, Italy, Alessandro.Carletti@thalesaleniaspace.com
Prof. Marcello Pelillo
Italy, pelillo@unive.it
Dr. Sebastiano Vascon
Italy, sebastiano.vascon@unive.it
Mr. Alessandro Torcinovich
Italy, ale.torcinovich@unive.it
Mr. Antonio Cinà
Italy, antonioemanuele.cina@unive.it
Mr. Erio Gandini
European Space Agency (ESA-ESTEC), The Netherlands, Erio.Gandini@esa.int

AIDA – ANTENNAS DIAGNOSTICS ENHANCEMENT BY COMBINED USE OF AI AND EXPERTS' KNOWLEDGE

Abstract

The increasing demand arisen in the last decades for high-quality performances of Radio-Frequency (RF) systems to be exploited in space applications, brought up the need for accurate measurements. Nowadays, several methods can be used to measure antennas far field properties, including Near-Field Test Ranges (NFTR) carried out in anechoic chambers. From the measured properties, gain or phase patterns are reconstructed and compared with theoretical patterns. The theoretical antenna patterns are produced by electromagnetic (EM) computational methods and are used in combination with the results of the measurement process in order to obtain the best test prediction of the configuration realized in the NFTR. The comparison between reference theoretical patterns and in-field measurements could highlight discrepancies which may be caused by misalignments between the antenna under test (AUT) and the measurement system or by the presence of an anomaly introduced by the manufacturing process. These discrepancies require an accurate post-test analysis to understand the anomaly typology and the associated root cause. The activity of smoothing the theoretical model to the best representation of the measured case is time and cost demanding, because it is based on the iteration up to convergence of

the model-to-measure comparison process, and deeply depends on the expertise of antenna engineers. However, anomaly data are normally not recorded, nor is the experts' knowledge on how to quickly converge to the right diagnostic result. The huge amount of antenna test data and the experts' knowledge could be exploited to develop models that can detect the presence and the type of an anomaly based on the analysis of the antenna radiation patterns, thereby supporting young engineers addressing similar tasks or expert engineers speeding up the diagnostic process. AIDA is the result of a project carried out for the European Space Agency by S.A.T.E., Thales Alenia Space Italy and Ca' Foscari University of Venice, aiming at the development of a methodology and a software prototype intended to improve the iterative process of telecommunication antenna performance measurement, by supporting the anomaly detection due to different error sources, implementing an AI-based solution. This has been developed using state-of-the-art AI techniques, in particular implementing a fully supervised approach, exploiting a set of labelled observations (i.e. patterns of antennas with known anomaly class and anomaly entity) generated by simulations and real data. This contribution will describe the main results obtained with reflector and phased array antennas use cases.