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Measurement of the Radar Cross-Section of Targets in Reverberation Chamber by Cross-Correlation of the Diffuse Electromagnetic Field

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R.Weaver [1] has evidenced, theoretically and experimentally, **that cross-correlation of signals captured at two receivers located at positions A and B in a cavity that confines a diffuse field tends to the impulse response at point B as if the signal was transmitted from point A and vice versa**. Thus, without need of bringing energy at points A and B, it becomes theoretically possible to determine the impulse response between these two points whose nature depends on their relative distance and on the properties of the propagation medium. This technique was applied for the first time in electromagnetism through an experiment showing that the impulse response between two antennas located in a anechoic chamber is recovered only from the thermal noise produced in the chamber [2].

This Ph.D thesis (3 years duration) aims at evaluating the feasibility of this cross-correlation technique to characterize the scattering properties of targets located in a reverberation chamber. A reveberating medium consists of a diffuse environment within which only one or very few radiating sources create an isotropic and homogeneous electromagnetic field. This is a required condition so that the cross-correlation operator converges to the desired signal. Different criteria, including goodness-of-fit tests, enable to evaluate the homogeneity and the isotropy of the field in a reverberation chamber [3]. A reverberation chamber could therefore constitue an ideal test set up to control a diffuse field in the frequency range usually considered for Radar Cross Section measurements. We aim at detemining the appropriate conditions to fullfill in order to extract the monostatic and bistatic equivalent surfaces within the spectrum of all incidence angles and scattering directions of a target. The main interest of this technique lies on the fast acquistion of signals without mechanical movements of the target or of the illuminating source The theoretical and experimental study wiil be carried out on canonical objects of different types (spheres, dihedral…). **Such a technique could completely renew the process of characterizing radar cross-section of targets of military or civilian nature.**

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[2] M. Davy , M. Fink, and J. de Rosny, Phys. Rev. Lett., 110, 203901 (2013)
[3] C. Lemoine, P. Besnier, M. Drissi, IEEE trans. electromagn. Compat. , vol. 4, november 2007, pp 745-755

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Conditions: Citizen of European Union/Switzerland aged under 27.