*URSI GASS 2021, Rome, Italy, 28 August - 4 September 2021*

# Radar Cross-Section Measurement in Reverberation Chamber to Assess the Performance of an Absorbing FSS Structure in the 3.5 $GHz$ Band

F. Merzaki (1), M. Sergolle (1), P. Besnier (1), M. Himdi (1), X. Castel (1)
(1) Univ Rennes, INSA Rennes, CNRS, IETR - UMR 6164, F-35000 Rennes, France

In a recent communication, a technique was introduced to perform the radar cross-section (RCS) of objects within reverberation chambers (RCs) [1]. Following this contribution, this ability was confirmed with an alternative signal processing technique in [2] and further analyzed in [3] and even more recently in [5].

Measurements in an RC are intrinsically broadband. It therefore enables to catch RCS properties at different frequency ranges without having to pay attention to the performance of absorbing materials used in an anechoic chamber. Furthermore, the far-field condition may be met adjusting the respective positions of the single antenna (monostatic RCS) and of the target within the RC.

The technique presented in [1] may be briefly described as follows. We insert a target in an RC at a far-field distance and in the direction of the maximum directivity of a high-gain antenna (typically a horn antenna). Any direct echo from the target in the direction of the illuminating radar antenna is analysed through the observation of the complex scattering parameter over a pre-determined frequency span. This scattering parameter is composed of two major contributions : *i)* the real and imaginary part of the complex transfer function of the considered ideal RC with random fluctuations described by centred Gaussian distributions; *ii)* the direct echo from the target for which the complex S parameters oscillates according to the antenna-target distance. These two contributions may have very different signatures according to their rate of fluctuations with frequency. In other words, they have different spectra in the dual space of the frequency variable. This provides possible strategies to retrieve the direct echo alone (regression, time gating, Fourier transform, ...). We make use of the first one.

A low-profile (4 mm thick) absorber based on a screen-printed film over a composite substrate was fabricated for decoupling purposes in the 3.5 $GHz$ band for $5G$ applications [4]. The dielectric substrate consists in a Innegra$^{TM}$ fabrics (woven polypropylene fibers, namely a 340 $g/m^2$ taffeta) infused with polyester resin. Then, we performed our RCS measurement to assess the performance of this absorber according to frequency.To do so, the absorber is placed in front of a metallic plate to check its ability to reduce its RCS. Results are shown to be consistent with the numerical simulations of the fabricated composite FSS absorber.

## References

[1] P.Besnier, J. Sol, S. Meric,”Estimating radar cross-section of canonical targets in reverberation chamber,” *International Symposium on Electromagnetic Compatibility, EMC EUROPE*, Angers, France, Sep. 2017, pp 1–5

[2] A. Soltane, G. Andrieu, A. Reineix,”Estimating radar cross-section of canonical targets in reverberation chamber,” *International Symposium on Electromagnetic Compatibility, EMC EUROPE*, Amsterdam, The Netherlands, Sep. 2018, pp 1–5

[3] A. Reis, F. Sarrazin, E. Richalot, P. Pouliguen,”Mode-stirring impact in radar cross section evaluation in reverberation chamber,” *International Symposium on Electromagnetic Compatibility, EMC EUROPE*, Amsterdam, The Netherlands, Sep. 2018, pp 1–5

[4] F. Merzaki et al., ”A compact absorbing FSS structure for antenna decoupling in the 5G 3.5 GHz band”, International Symposium on Electromagnetic Compatibility, EMC EUROPE, Roma, Italy, 2020

[5] A. Reis, F. Sarrazin, E. Richalot, S. Meric, J. Sol, P. Pouliguen", Radar Cross-Section Measurements in a Mode-Stirred Reverberation Chamber", to appear in IEEE transactions on Antennas an Propagation, 2021