Université Gustave Eiffel

Laboratoire ESYCOM

Internship: Contactless Characterization of Miniature Antenna Characterization Within Reverberation Chamber

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ESYCOM Laboratory / ED MSTIC

Starting Date and Duration
This offer is for a 4-month internship that could start anytime between February and April 2021. It may be extended to a 3-year PhD.

Context
Antenna miniaturization as well as their integration in complex environments (antennas on vehicles, antennas buried in the ground, intra-body antenna) modify antenna radiation characteristics and strongly degrade their efficiency. The estimation of such efficiency, critical parameter to limit power consumption, is barely possible using conventional measurement methods in the case of miniature antennas. Indeed, conventional measurement approaches necessitate to connect the antenna under test to an analyzer and the presence of the cables in the antenna reactive near-field zone disturbs the radiation and impedance properties. This perturbation can be considered as negligeable for large antennas but not for small ones. Besides, conventional antenna characterizations in anechoic chamber require the alignment between the antenna under test and the reference antenna; in the case of small antennas (or buried ones), this precise alignment becomes very difficult even impossible. Therefore, the use of reverberation chamber (RC) as a measurement environment is better suited in these cases as it avoids the alignment issue. In that context, innovative methods that are contactless [1] and applied within RCs [2] are under research at the ESYCOM lab in order to overcome current limitations of conventional anechoic chamber methods.

Internship Topic
Several antenna characterization methods within RC have been developed in the last few years, so that antenna efficiency measurements are now commonly performed in such environment. Recent works have also addressed radiation pattern measurement within RC [3] but invasive cables are still required, making it irrelevant for miniature antennas. Contactless estimation of antenna losses within RC has been studied in [4] but intrinsic antenna radiation parameters were not extracted.

This internship objective is to establish the proof of concept of a novel antenna radiation efficiency measurement method that is contactless (noninvasive). Based on techniques to retrieve the absorption and diffusion cross sections [5] of lossy objects in RC, that will be extended to the antenna specific case, this new approach will enable miniature antenna characterization for the first time. The 700 MHz frequency band, as part of the 5G spectrum, is targeted for this study.

Work plan
Based on previous theoretical developments conducted in our team to retrieve the absorption properties of antennas within RC and on first measurement results, the measurement protocol required to retrieve the antenna radiation efficiency will be set up. After a validation on canonical antennas, this method will be applied on miniature antennas to extract the parameters of interest from measurement results.

Applicant Profile
The targeted student profile is the following:

- Last year of Master degree, engineer school degree or equivalent;
- Strong background in electromagnetics and antennas (essential);
- Knowledges in signal processing (preferable);
- Interest for high frequency measurement;
- Autonomous and highly motivated;
- Willing to pursue with a PhD.

Contacts
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The application file should include CV, statement of purpose, recommendation letters and all academic transcripts and may be addressed by email to both contacts. **Application deadline: April 15th 2021.**

The ESYCOM laboratory is within the field of communication systems, sensors and microsystems for the city, the environment and the person. The topics of interest are more specifically:

- antennas and propagation in complex media, photonic-microwaves components;
- microsystems for environmental analysis and pollution control, for health and the interface with living organisms;
- micro-devices for ambient mechanical, thermal or electromagnetic energy harvesting

References
[1] A. Reis, F. Sarrazin, E. Richalot and P. Pouliguen, *Mode-Stirring Impact in Radar Cross Section Evaluation in Reverberation Chamber*, 2018 International Symposium on Electromagnetic Compatibility (EMC EUROPE), pp 875-878, Aug. 2018.
[2] W. Krouka, F. Sarrazin and E. Richalot, "*Influence of the reverberation chamber on antenna characterization performances*," Int. Symp. and Workshops Electromagn. Compat. (EMC Europe), Amsterdam, 2018.
[3] A. Soltane, G. Andrieu, E. Perrin, C. Decroze, A. Reineix, *"Antenna Radiation Pattern Measurement in a Reverberating Enclosure Using the Time-Gating Technique,"* IEEE Antennas and Wireless Propagation Letters, vol. 19, no. 1, pp 183-187, 2020.
[4] A. Cozza, *"Power Loss in Reverberation Chambers by Antennas and Receivers,"* IEEE Trans. Electromagn. Compat., vol. 60, no. 6, pp. 2041-2044, Dec. 2018.
[5] G. Lerosey and J. de Rosny, "*Scattering Cross Section Measurement in Reverberation Chamber*," IEEE Trans. Electromagn. Compat., 2007.