4-month internship for M2

Characterisation of RFID chip impedance

Application to high density RFID systems

Context:

RFID (Radio Frequency IDentification) technology has played an important role in industrial logistics. With the growth of the Internet of Things (IoT), RFID technology is becoming ubiquitous and unavoidable. For food traceability, ready-to-wear labelling or logistics and supply chain management, many scenarios use UHF RFID (Ultra High Frequency RFID) for tracking and identification of products. These scenarios are complex for two reasons:

- The tag antenna is surrounded by other tags resulting in a high density of radiating elements.
- The immediate environment of the tag antenna is partially known or known with uncertainties.

In a context of high density of tags in a complex environment, the strong electromagnetic interactions between the radiating elements and the surrounding environment degrade the operation of RFID systems [1]–[4]. Consequently, certain tags are not detected and the read range and the read rate of other tags are reduced.

The previous PhD work and those in progress at the ESYCOM laboratory [5]–[6], attempts to carry out a statistical modelling of the operation of RFID tags in complex environments. This modelling could ultimately lead to the prediction of system performances and the optimisation of tag antennas from the design phase. One of the key parameters of this modelling is the accurate characterisation of the chip impedance integrated in RFID tags [7].

Objectives:

The internship will take place at the ESYCOM Laboratory and will consist of two scientific parts:

- The first part will be devoted to the characterisation of the impedance of RFID chips. This will involve developing a dedicated measurement bench, validating its operation, and carrying out measurement campaigns on commercialised RFID chips [7].
- The second part of the study will focus on the integration of chip impedance data from measurement campaigns into the statistical modelling of RFID tags. Statistical studies will then be carried out including these new input parameters.

Applicant profile:

This internship offer is intended for the candidates having a Master's degree in "3EA" or an equivalent degree in "Electrical engineering". The following conditions are required:

- Very high interest for experimentation
- Interest in applied mathematics and statistics
- Very high scientific rigour
- Autonomy in computer programming

Supervising group:

Benoit Poussot, Associate professor, ESYCOM/UGE,
Shermila Mostarshedi, Associate professor, ESYCOM/UGE

Application and contact:

The application file should include CV, statement of purpose, recommendation letters and all academic transcripts and may be addressed by email to Benoit Poussot (benoit.poussot@univ-eiffel.fr) and Shermila Mostarshedi (shermila.mostarshedi@univ-eiffel.fr).

References:

[1] C. Craeye and D. González-Ovejero, "A review on array mutual coupling analysis," *Radio Sci.*, vol. 46, no. 2, 2011.

[2] G. Marrocco, "RFID Grids: Part I—Electromagnetic Theory," *IEEE Trans. Antennas Propag.*, vol. 59, no. 3, pp. 1019–1026, 2011.

[3] S. Banerjee, R. Jesme, and R. Sainati, "Performance Analysis of Short Range UHF Propagation as Applicable to Passive RFID," in *2007 IEEE International Conference on RFID*, 2007.

[4] R. Fletcher, U. P. Marti, and R. Redemske, "Study of UHF RFID signal propagation through complex media," in *2005 IEEE Antennas and Propagation Society International Symposium*.

[5] I. Adjali, B. Poussot, S. Mostarshedi, & J. M. Laheurte, "Statistical study of the matching properties of high density randomly distributed dipoles," *IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications* (APWC), 2019.

[6] I. Adjali, A. Gueye, S. Mostarshedi, B. Poussot, F. Nadal and J.-M. Laheurte, "Matching Evaluation of Highly Coupled Dipoles Quantified by a Statistical Approach," *IEEE Trans. Antennas Propag.*, *68*(7), 5044-5051, 2020.

[7] Nikitin, P. V., Rao, K. S., Martinez, R., & Lam, S. F. (2009). Sensitivity and impedance measurements of UHF RFID chips. IEEE Transactions on Microwave Theory and Techniques, 57(5), 1297-1302.