PhD proposal 2021

Functionalized radome for enhanced scanning capacity of planar steerable antennas

Context/Motivation

Planar steerable antennas play an important role in many military and civil applications such as satellite communications, mobile terminals, radars, base stations for telecommunications, etc. These scanning antennas typically suffer from an increased scanning loss as the beam is steered off the broadside. In practice, the scanning range is therefore usually limited to ±60 degrees.

The degradation in antenna realized gain as the scan angle increases is mainly caused by two factors: a lower directivity resulting from a reduced effective radiating aperture and a strong active impedance mismatch on the radiating elements.

To improve the angular robustness of scanning arrays, two concepts have been explored in the literature. The first concept relates to wide-angle impedance matching (WAIM) techniques, which address the mismatch at the aperture–air interface and enhance impedance matching over a wide angle range. The second concept consists in using a quasi-optical system, which can deviate near-horizon incidence angles towards broadside, thus increasing the effective radiating aperture at high steered angles. Both concepts offer key advantages but, so far, no state-of-the-art solution offers a remarkable performance in scanning beyond 60° with a low form-factor.

Objectives of the PhD project

The overall objective of this PhD project will be to demonstrate an innovative concept to compensate the gain loss when antennas operate at high steered angles (>60°) so that link budgets, data rates, and spectral efficiency in SATCOM on the move applications are maintained.

The first task will consist in a thorough literature review on the various existing solutions.

The proposed research activity will benefit from a highly innovative development of theoretical and numerical modelling, design and optimization procedures for 3D-shaped structures with advanced functionalities. In particular, the development of dedicated numerical tools will be essential to achieve an efficient design and a low computation time. Additive manufacturing techniques will be considered to take advantage of all available degrees of freedom.

Finally, a demonstrator will be designed taking into account the fabrication process constraints, then manufactured and characterized with IETR/TRT facilities.

Key words: Electromagnetism, Metamaterials, Numerical methods, Additive manufacturing

Duration: 36 months, from October 2021

Deadline to apply: June 21, 2021

Host laboratory:

- Institut d'Electronique et des Technologies du numéRique (IETR), Rennes, France
- Thales Research & Technology (TRT), Palaiseau, France

Candidate profile: The candidate should hold a Master or equivalent degree in electrical engineering, physics. Strong knowledge in electromagnetism and electromagnetic (EM) simulation, good skills in using commercial EM software and MATLAB and/or Python programming are required for this position. French proficiency is not required but highly appreciated.

Application: Please send CV, motivation letter and the contact details of two references to:

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