

PhD position proposal

Analysis and design of compact antennas in cavities for multi-band applications

Host laboratories

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Context

Metamaterials are a promising research topic in various domains, and in particular in electromagnetism for circuit applications (filters, phase-shifters, etc.) or for radiation applications (antennas, diffraction, cloaking). They are engineered materials, constituted of periodic electrically-small elements and offering, in specific frequency bands, unusual properties, which are different from the ones of natural materials. Metamaterials offer many benefits, like antenna miniaturisation, bandwidth enhancement or reduction of mutual coupling in antenna arrays.

Integrating an antenna onto a specific platform (UAV or projectile) of small size requires its miniaturization and often its placement in a metallic cavity. The main consequence is the reduction of the antenna bandwidth, whereas the communication systems need more and more bandwidths.

Metamaterials are an extremely attractive solution for bandwidth enhancement of small antennas. Nevertheless, the structures designed up to now are relatively large or bulky and considered in an open environment, namely with no metallic walls placed on the antenna lateral sides, as in the case of cavity antennas.

Proposed works

The present project aims to investigate antennas in cavities with multiple resonances, in order to design wideband or multiband compact antennas to be integrated into various platforms; The typical applications are the two GNSS bands (GPS L1+L2 or Galileo E1+E5), or two telemetry bands (2.3 GHz + 5.2 GHz), and even simultaneously of one data link and of one GNSS reception.

We propose in a first step to investigate and define the types of metamaterials and / or structures, enabling multi resonances with reduced lateral dimensions. This study implies the characterization of the selected metamaterials.

Second, the analysis of the modes in cavities will be done, and prototypes will be designed and experimentally characterized.

The metamaterials in cavity will then be associated to radiating elements, and integrated into platforms existing at ISL, in order to be characterized under real conditions. These designs will be based on planar profiles as well as conformal profiles of small dimensions.

The possibilities offered will be further investigated depending on the achievements, and could be extended to other applications (antenna arrays among others).

This thesis will be performed both at the Institute of Electronics and Telecommunications of Rennes, in Bretagne (IETR, F-35) and at the French German Research Institute of Saint-Louis (ISL, F-68), close to the German and Swiss borders.

To apply: send a CV + recommendation letters + marks obtained over the last three years + motivation letter

Please note that the candidate has to be a national of the European Community (French Ministry of Defence constraint).

Key-words

Electromagnetism, metamaterial, compact antennas, cavity, telecommmunications.