The French-German Research Institute of Saint-Louis (ISL) situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network. The spectrum of our core activities comprises a variety of topics: aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is offering a PhD Position

Research field: Flight techniques for projectiles

Analysis and design of magneto-electric antennas and metasurfaces antennas in compact cavities, wideband and multi-bands for flying systems

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 or require a multi-band function (typically GNSS).

Magneto-electric antennas are an 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. Specifically, these electric walls have a strong influence on the resonance conditions, in particular when dimensions are compact.

Onboard instrumentation of various flying vehicles require to integrate the antennas in cavities, often of small dimensions. The performances of such small antennas were investigated in the frame of two previous PhDs (2011-2014 and 2016-2019), and solutions based on metasurfaces have been proposed to overcome their limits; the bandwidth enhancement and size reduction have been demonstrated for both linear and circular polarization.

Proposed works

This PhD aims at investigating antennas in small cavities with multiple resonances for wideband or multi-band operations, for the various bands of GNSS.

We propose in a first time to analyze magneto-electric antennas in cavities of small lateral dimensions. The objectives are to assess the feasibility and the performances within small dimensions (compact size).

In a second time, original structures combining magneto-electric sources and metasurfaces in cavity will be investigated, in order to overcome the limits achieved with the structures of the previous task. Polarization would be first considered as linear, and we will focus on circular polarization in a second time.

Prototypes of the designed antennas will be manufactured and measured. Then they could be integrated on specific platforms of ISL, in order to be characterized in real environments. These designs will be based on planar profiles, as well as conformal profiles of small dimensions.

The possibilities offered by the magneto-electric antennas in small cavities would be also further investigated in regards to the previous results and could be extended to other applications and frequency bands (antenna arrays, telemetry with flying systems).

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.

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