Design of Tunable SIW Filter-Antennas USing 3D additive manufacturing Technology

PhD position – Cotutelle France/Australia

Supervisions:

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The compactness of radio frequency front-ends (essential elements in any communicating object (connected sensor, autonomous radio base station,…) or detection systems(on-board radar,..)) remains a major research and innovation subject, addressing different application domains (space, health, defense, industry, telecommunications, etc.). Such expectation must be of course compatible with functional performances requirements in terms of electrical losses, selectivity, radiation & associated efficiency, etc.).

The electrical or operational reconfigurability is also a crucial issue for developing radio modules in order to access to interoperability and matching capabilities to a multitude of communication standards. Tunability requirements appear as a second major challenge, with numerous technological and design bottlenecks.

Substrate Integrated Waveguide techniques appeared at the beginning of the 2000s and constitute a mix between planar technologies together with waveguide modes. This novel concept has been applied to various electrical functions such as filters, couplers, power dividers, antennas…[1]-[3] and have rapidly gained interest for various applications such as the space industry. Indeed, these techniques exhibit enhanced electrical performances compared to planar components while insuring a planar, and thus affordable, realization process. Accesses to these devices are generally made through local multimodal transition structures which generate losses, mismatches and non-neglectable area occupation. Optimizing such interfaces appear as a fundamental issue to develop SIW technologies.

In this thesis, we aim to investigate the co-design of highly integrated devices made of the association of RF filters and radiating elements built upon the SIW technique, and including tenability capabilities. The idea is to take benefit of the waveguide mode to couple energy between the SIW filter to the antenna. This would lead to more compact structures than the conventional separately-designed filter and antenna that are both connected through lossly structures. Of course, this would necessitate to reconsider and optimize the matching scheme between these two components. The leading idea is to obtain a fully integrated structure insuring both frequency selection together with radiation through the air interface, through the exploitation of 3D additive manufacturing techniques. A particular effort will be done to provide the synthesis and design procedure of such fully integrated element combining filtering and radiating performances [4], [5].

The second investigation axis will focus on the tunability and reconfiguration of these integrated SIW filtrennas. The idea is here to develop tunable structures. Frequency tunability will be considered so that the structure would allow a central frequency tuning. Then, by considering the SIW radiating interface and particularly for beamforming or reflect arrays antennas with high directivities, the change in the operating frequency would lead to a change in the center of phase position, thus insuring steerable beamforming [6].

Context of the thesis / Location:

The thesis is done in the context of intensive collaboration between the laboratory LabSTICC – UMR CNRS 6285 (IMT Atlantique Engineering School & University of Brest) and the University of Adélaïde, with the contribution of the Brittany Regional Council. The PhD Student will be enrolled in the cotutelle agreement program between IMT Atlantique and University of Adelaide, and will be co-supervised by both Australian and French Professors. He/her will have the opportunity to spend half of the time in both institutions. The doctoral student is expected to have a federating role between the two teams (IMT-Atlantique/UBO and UoA) along with an increased inter-site mobility.

In detail, the hosting facilities for the thesis are:

- **IMT Atlantique Bretagne/Pays de la Loire** (Brest campus), a public institute of superior education (postgraduate) and research: www.imt-atlantique.fr / Laboratory LabSTICC/DIM team: https://www.labsticc.fr/en/index/
- **The University of Adelaide** is one of the top 1% universities worldwide and a member of the group of eight in Australia. https://ecms.adelaide.edu.au

Candidature:

Profile required: Holder of a postgraduate diploma, Master of research or engineer diploma in the domains of physic, Electromagnetisms, Antennas, high frequency components design.
Fluency in English is required, a spirit of collaboration and of initiative in the face of technological challenges.

Theoretical skills: Solid background in one or more of the following domains: Theoretical and computational electromagnetics, Microwave and mm-wave antennas & components, 3D additive manufacturing techniques
Technical skills: Experience in one more or more of the following technologies/tools: CAD Tools (HFSS™, CST™, etc..), Matlab™, Python™

Dates : From October 2020 – Duration 36 months
Financial support : IMT Atlantique + University of Adelaide.

How to apply:
The interested candidates are invited to email (to Christian Person and/or Christophe Fumeaux the following elements:

- CV detailing in full your academic background including all modules taken
- Motivation letter
- Academic notes transcript

and optionally, letters of recommendation.

Contacts

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