PhD offer

At IETR (Institut d'électronique et des technologies du numérique) UMR CNRS 6164, France

ARTIFICIAL INTELLIGENCE-DRIVEN DESIGN OF IRREGULARLY TILED PHASED ARRAY ANTENNAS

Project context

The rapid expansion of modern communication and sensing systems, such as satellite networks, beyond-5G infrastructures, and advanced sensing platforms, places stringent requirements on large phased array (PA) antennas [1]. Conventional PA architectures rely on numerous radio-frequency power amplifiers and phase shifters, resulting in high energy consumption, increased system complexity, and elevated production and maintenance costs. To address these challenges, recent research has explored unconventional PA architectures, particularly **modular tiled phased arrays**, where the antenna aperture is partitioned into elementary building blocks. By controlling each module through a single control point, the number of active components can be significantly reduced, improving energy efficiency, while reducing the production costs [2]-[4].

Within this context, a major challenge lies in designing irregular modular layouts that satisfy strict communication and sensing requirements while remaining computationally tractable for large apertures. This PhD research focuses on **Artificial Intelligence (AI)–based modeling and optimization techniques** to efficiently explore irregular PA antenna configurations and identify high-performance modular designs under application-specific constraints.

[1] J. S. Herd and M. D. Conway, "The evolution to modern phased array architectures," *Proc. IEEE*, vol. 104, no. 3, pp. 519–529, Mar. 2016.

[2] N. Anselmi, P. Rocca, M. Salucci, and A. Massa, "Irregular phased array tiling by means of analytic schemata-driven optimization," *IEEE Trans. Antennas Propag.*, vol. 65, no. 9, pp. 4495-4510, Sep. 2017.

[3] N. Anselmi, P. Rocca, S. Feuchtinger, B. Biscontini, A. M. Barrera, and A. Massa, "Optimal capacity-driven design of aperiodic clustered phased arrays for multi-user MIMO communication systems," *IEEE Trans. Antennas Propag.*, vol. 70, no. 7, pp. 5491-5505, Jul. 2022.

[4] N. Anselmi, P. Rocca, G. Toso, and A. Massa, "A divide-and-conquer tiling method for the design of large aperiodic phased arrays," *IEEE Open J. Antennas Propag.*, 2026.

Objectives of the PhD offer

The goal is the development of novel modular antenna concepts, AI-driven electromagnetic performance prediction models, and optimization frameworks for scalable PA layouts. The proposed methodologies will be validated through full-wave simulations and experimental prototyping, demonstrating their relevance for next-generation communication and sensing systems.

Work context

This thesis will be carried out at IETR – UMR CNRS 6164 (http://www.ietr.fr) and it will strongly involve two of IETR's technological platforms:

1) nR (NanoRennes) platform, https://www.ietr.fr/en/nr-nanorennes-platform with experience in microfabrication.
2) M²ARS (Manufacturing Measurement Analysis of Radiating Systems) platform https://www.ietr.fr/en/m2ars-manufacturing-measurement-analysis-radiating-systems-platform, with experience in advanced antenna metrology and prototyping.

The PhD student will first identify and develop AI-based techniques to address large-scale tiling problems. These techniques will then be applied to the design and optimization of large PAs, followed by the prototyping and experimental validation within IETR's world-class facilities.

Candidate

Required education level: Master or equivalent degree in electrical engineering or physics.
Duration: 36 months.
Required background: antenna theory, microwave engineering, antenna arrays. Proficiency in written and spoken English (knowledge of French is not required).

How to apply: To apply please send your motivation letter, CV, and recommendation letters (optional) by email to the contact persons (see below).

Contact persons:

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