Politecnico di Torino

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ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

PNRR - Computer Aided Design of smart electromagnetic surfaces for future wireless communications

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Context of the research activity	Future wireless communications beyond 5G will require advanced and reconfigurable processing capabilities at the physical layer. Smart metasurfaces can provide such features by assembling large arrays/matrices of identical unit cells, which in turn can be individually tuned and reconfigured through suitable control signals interacting with smart linear/nonlinear materials. Exploitation of these meta surfaces is expected to increase channel capacity and at the same time reduce latency in electromagnetic signal conditioning operations. PNRR M4C2, Investimento 1.3 - Avviso n. 341 del 15/03/2022 - PE0000001 RESearch and innovation on future Telecommunications systems and networks, to make Italy more smart (RESTART) - CUP E13C22001870001
Objectives	This PhD program intends to develop novel Computer-Aided Design and verification techniques to support development of smart reconfigurable and tunable electromagnetic metasurfaces. Various aspects including spatial filtering, beamforming, and protection from high-energy fields through nonlinear grids will be considered. The main approach that will be conducted to improve state-of-the-art CAD flows will be through Model Order Reduction (MOR) and behavioral/surrogate modeling. The candidate will develop new techniques for fast modeling and simulation of smart metasurfaces by exploiting the repetitive pattern of such devices together with various approaches for model compression, in order to reduce the possibly large runtime required for design centering and optimisation based on specific performance metrics. The main developments are expected to arise from a multidisciplinary interaction between the complementary fields of

	electromagnetics (due to the specific application) and circuit/system theory (for the advocated MOR approach).

Skills and competencies for the development of the activity	The candidate should have a strong mathematical background, with specific competencies in theoretical and numerical electromagnetics. Experience or at least some exposure to basic Model Order Reduction techniques are also appreciated. Proficiency in code development is a requirement (MATLAB environment highly desired, alternatively Python). Curiosity, creativity and willingness to learn new tools and methods are also highly recommended skills, as well as ability to work in a multidisciplinary research team.