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Microwave computational imaging: Simplifying RF architectures with cavities and metasurfaces

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In this talk, we present a review of new computational imaging systems developed in the microwave range. Significant simplifications of RF architectures are achieved in this context by leveraging dispersive cavities and radiating metasurfaces. These coding devices allow for the all-electronic multiplexing of the transmitted and received waves using frequency diversity without any mechanically moving parts or active circuitry, minimizing the data acquisition time and the redundancy of burdensome active chains in radar systems.

We first introduce the framework and the origins of microwave computational imaging and the associated proofs of concept proposed independently by our two institutions. Then, an overview of existing works in various domains is proposed for highlighting the strong potential of this technology for modern applications. In recent efforts, the scientific community has notably been focused on the development of high-resolution imaging systems applied to concealed threat detection. This talk will thus feature prototypes of UWB MIMO radars [1] and array imaging systems [2], and the associated computational challenges will be presented.

Particular attention will be paid to the resolution of inverse problems in computational imaging and the identification of key-parameters for designing these new devices and determining the capabilities and limitations when applied to imaging.

Finally, this presentation will introduce new paradigms of computational imaging such as the compatibility with phaseless measurements [3], the estimation of polarimetric information and the development of computational interferometric radiometers [4].

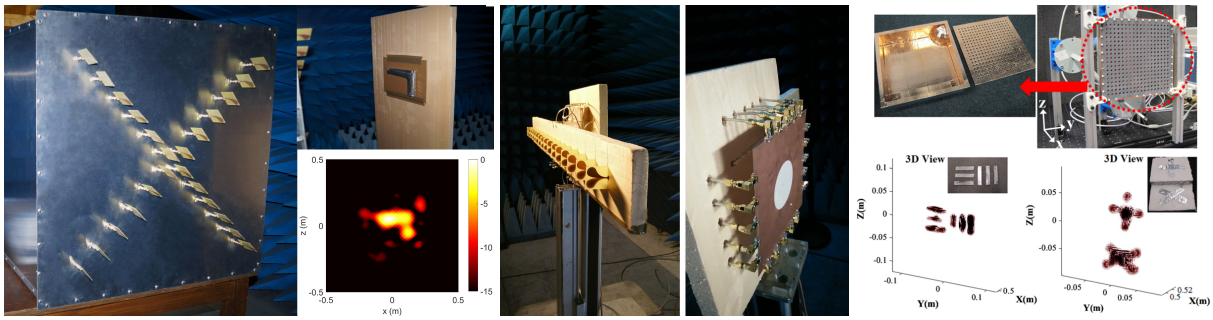

Figure 1. Implementation of microwave computational systems applied to MIMO imaging, beamforming, and near-field high-resolution imaging [1, 5, 6].

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