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Dynamically reconfigurable metasurfaces and leaky-wave antennas for millimeter-wave and THz applications

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Millimeter-wave (mm-wave) and THz technologies have emerged in recent years as a promising solution that will radically enhance the performance of a wide range of electromagnetic and electronic systems. These include multi-Gbps/Tbps telecommunication systems, powerful radar and imaging devices and highly sensitive sensors. Many of these systems require powerful high-gain antennas with the capability to dynamically reconfigure their performance, such as the direction of the main beam, their polarisation or their operating frequency.

This contribution will focus on the challenging topic of dynamically reconfigurable antennas for mm-wave and THz frequencies and will present a new tuning technology applied to multi-layer metasurface-based leaky-wave antennas. The advantages of the proposed technology in terms of low losses, high switching speeds and overall antenna performance will be demonstrated by reporting recent results both in simulations and measurements. The fabrication and implementation at higher mm-wave and THz frequencies using innovative micromachining processes will also be discussed.

The concept of a beam steered leaky wave antenna (LWA) will be initially presented and the design of the tunable High Impedance surface (HIS) that enables the beam steering performance will be discussed. The tuning of the HIS is based on the use of piezo-actuators that produce a displacement of up to 0.5mm between the periodic array and the ground lane of the HIS, thus yielding a reflection phase response of more than 200 degrees. The antenna radiation performance will be subsequently presented. Fig. 1 shows a representative result of the proposed beam steered antenna performance at 38GHz. The fabrication aspects of the antenna will be discussed in detail in the presentation. It must be noted that the proposed antenna design as well as the low-loss piezo-actuated tuning technique is directly scalable to higher mm-wave and THz frequencies.

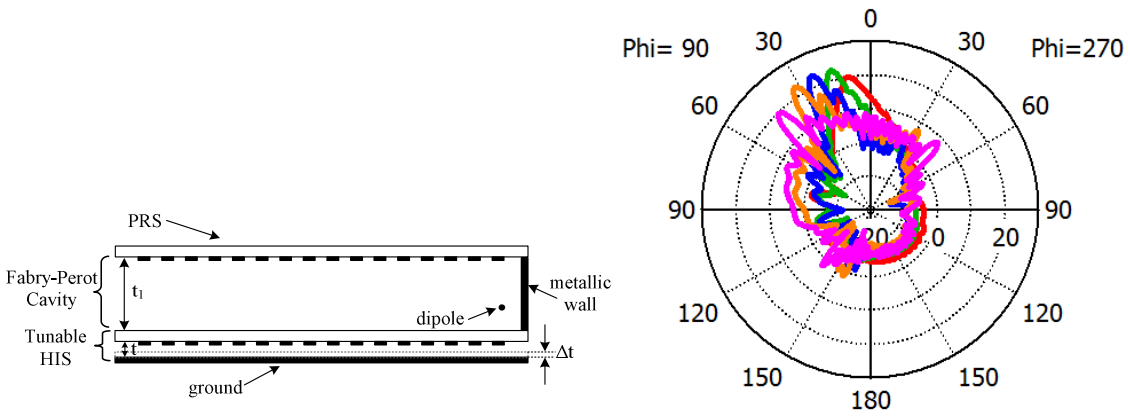

Figure 1. Proposed LWA with piezo-actuated HIS and radiation pattern performance