PhD offer

At the Institute of Electronics and Telecommunications of Rennes (IETR), France

PHOTOCONDUCTIVE ANTENNA ARRAYS FOR TERAHERTZ WIRELESS COMMUNICATIONS

Project context

A more efficient use of available spectrum does not suffice to ***reach the ultra-large bandwidths*** (BWs) ***required by wireless systems beyond 5G***, and the use of frequencies in the Terahertz (THz) gap is the key to enable ultra-large BW wireless. The ***frequency range between 275 and 350 GHz*** is particularly convenient, owing to the following advantages: a) it has not yet been allocated; b) it presents atmospheric attenuation windows, which enable mid-range links and small cell deployment; c) the short wavelengths favor the design of on-chip antennas, integration and packaging; and d) THz links are less susceptible than optical wireless to air turbulence and humidity, fog, smoke, and rain.

The 1st challenge in THz wireless communications consists in ***designing high-gain antennas efficiently coupled to continuous-wave THz sources at room temperature***, to compensate for the propagation loss. The 2nd hurdle lies in the ***lack of sources with adequate output power*** in the THz gap. The ***carrier in the transmitter will be generated using optical heterodyning*** by mixing two optical wavelengths on a photodiode, which presents an output electrical signal in the THz range, equal to the wavelength spacing of the two optical tones. This ***photonic approach is particularly convenient for communications due to its wide bandwidth, tunability and stability***. It also allows one to stablish a direct bridge between 1.55μm data flows in optical fibers and THz radio.

Objectives of the PhD offer

First, we will investigate the ***efficient radiation of the photocurrent generated in the photodetector, overcoming the impedance mismatch between antenna and photomixer***. Our goal will be to obtain conjugate matching for broad bandwidths. In photodetectors integrated with planar wideband antennas, we will use multilayer structures, with each layer designed to match the impedance of a frequency range in the band. As an alternative, we will study planar-circuit to rectangular waveguide (RW) transitions, which allow one to increase the radiated power using high electron mobility transistor amplifiers in RW blocks after the photomixer.

Second, ***appropriate radiation patterns must be tailored for the antennas in each THz wireless system***. For instance, directive pencil beams will suffice for point-to-point links, whereas small cells will demand broader angular cover-age. Hence, ***we will pursue photoconductive antenna arrays with agile radiation patterns***. By bringing one fiber to each photomixer in the array, it will be possible to steer the beam by controlling the phase of each element with true time delay, or to obtain multiple beams using beamforming in antenna arrays.

Last but not least, special attention must will be paid to ***finding the most appropriate materials and fabrication techniques*** for the photoconductive antenna arrays. The manufactured ***prototypes will be measured*** in the newly established space at IETR for testing this class of antennas.

Candidate

Required education level: Master or equivalent degree. *Duration*: 36 months
Required background: antenna theory, microwave engineering, numerical modeling, periodic structures.
Knowledge of French is not required, but will be appreciated.

Deadline to apply: ideally before end of March 2017

Start date: September / October 2017

Contact persons

To apply please send your motivation letter, CV, and recommendation letters to:

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