PhD offer

At the Institute of Electronics and Telecommunications of Rennes (UMR CNRS 6164) and Institut Foton (UMR CNRS 6082), France

PHOTOMIXING ANTENNA ARRAYS FOR TERAHERTZ WIRELESS COMMUNICATIONS

Project context

Wireless data traffic increases by a factor of 100 every 10 years and, in 10 years' time, we will have to provide data rates of even Tb/s. Given Shannon's limit, a more efficient use of available spectrum will not suffice to reach the predicted data rates. The use of ***carrier frequencies in the sub-Terahertz*** (sub-THz) regime (between 100 GHz and 1 THz) ***will be pivotal*** to achieve the total bandwidths (BWs) required for front- and back-hauling ***in beyond 5G systems***, ultra-high definition multimedia streaming and data centers. Moreover, sub-THz frequencies have not yet been allocated and they present atmospheric transmission windows with attenuation below 10 dB/km. To enable the use of this frequency band, we will need adequate front-ends with high gain and beam steering capabilities to receive/transmit efficiently in point-to-point and point-to-multipoint scenarios.

The first challenge in sub-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 second hurdle lies in the lack of ***sources with adequate output power*** in the sub-THz range. Finally, one must to provide ***beam steering capabilities*** to guarantee an excellent alignment of the required narrow beams.

Objectives of the PhD offer

The overall objective of this thesis will be to develop sub-THz front-ends by photonic generation with several disruptive proofs of concepts at international level:

- One of the first ***high-gain photomixing antenna array*** with broad bandwidth. We will investigate the integration of UTC-photodiodes with planar wideband antennas. Special attention will be paid to ***find the most appropriate materials and fabrication techniques*** for these arrays.
- The developed photomixing arrays will also provide ***beam steering capabilities***. By bringing one fiber to each photodetector, it is possible to control the phase of each element with true time delay and provide either beam steering or multiple beams. As a first demonstration, a prototype in the X band frequency will be assembled at the beginning of this project.
- Sizing and realization of ***dual frequency optical sources*** to achieve the targeted sub-THz carrier with ultra-low frequency noise and compatible with photomixer arrays.
- Last but not least, the manufactured ***prototypes will be measured*** at IETR/Institut Foton facilities, and real-time high data rates over medium or long distances in ***point-to-multipoint scenarios***.

Candidate

Required education level: Master or equivalent degree in electrical engineering or physics.
Duration: 36 months.
Required background: antenna theory, microwave engineering, microwave photonics, Terahertz radiation. Knowledge of French is not required, but will be appreciated.

Deadline to apply: as soon as possible.

Contact persons

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

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