



PhD Position 2018 (IETR, Rennes, France)

## MILLIMETER-WAVE TECHNOLOGIES FOR BIOMEDICAL ELECTROMAGNETICS: POTENTIAL OF AMPLITUDE-MODULATED MILLIMETER WAVES

- **Key words**

Electromagnetic exposimetry, 30–100 GHz range, electromagnetic / thermal co-modeling, thermal pulses, heat focusing.

- **Context**

Millimeter-wave (MMW) technologies are increasingly used for various applications. In particular, they have been used for high data rate communications [ $> 5$  Gb/s], and 60-GHz technologies are expected to be integrated in the near future in the next generation mobile systems. Besides, it was suggested that MMW can be used for biomedical applications, including remote monitoring of wounds and non-invasive detection of glucose level. Recently, our research group has demonstrated the possibility of selective focusing of heating in cutaneous and sub-cutaneous layers by means of MMW. This paves the way to new potential applications of MMW in the field of biomedical electromagnetics, including selective targeting of skin cancers.

- **Objectives**

The main purpose of this PhD research project is to explore the potential of MMW for innovative applications in the field of biomedical electromagnetics.

- **Work description**

The PhD student will work at the Institute of Electronics and Telecommunications of Rennes (IETR), UMR CNRS 6164, Rennes, France. The guidelines of the PhD project are threefold:

1. To explore the potential of the 30–100 GHz range for selective non-invasive high-resolution focusing of heat within human skin and sub-cutaneous layers based on recent advances in the field. This work will include numerical analysis of the electromagnetic field propagation and heat deposition in the body, design of radiating structures for the near-field focusing, and measurements using tissue-equivalent phantoms.
2. To develop a dosimetric methodology for accurate control of exposure and local heating applied to pulse-modulated MMW radiations. A unique experimental tool recently developed by the IETR and able to generate short thermal pulses with the peak amplitude of several tens of °C will be used.
3. Finally, previously developed methodologies and approaches will be used for selective targeting of cancer cells and tissues. This part of the study will be carried out in collaboration with experts from the French Institute for Research on Environmental and Occupational Health (IRSET) and Institute of Cell Biophysics (ICB).

- **Candidate**

*Education:* MS or equivalent. *Background:* electromagnetics, numerical modeling, antenna design, microwave / MMW measurements. Knowledge in biology / biophysics is welcome but not mandatory.

- **Contacts**

To apply please send your CV, motivation letter, and reference letters (optional) before April 15, 2018 to:

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