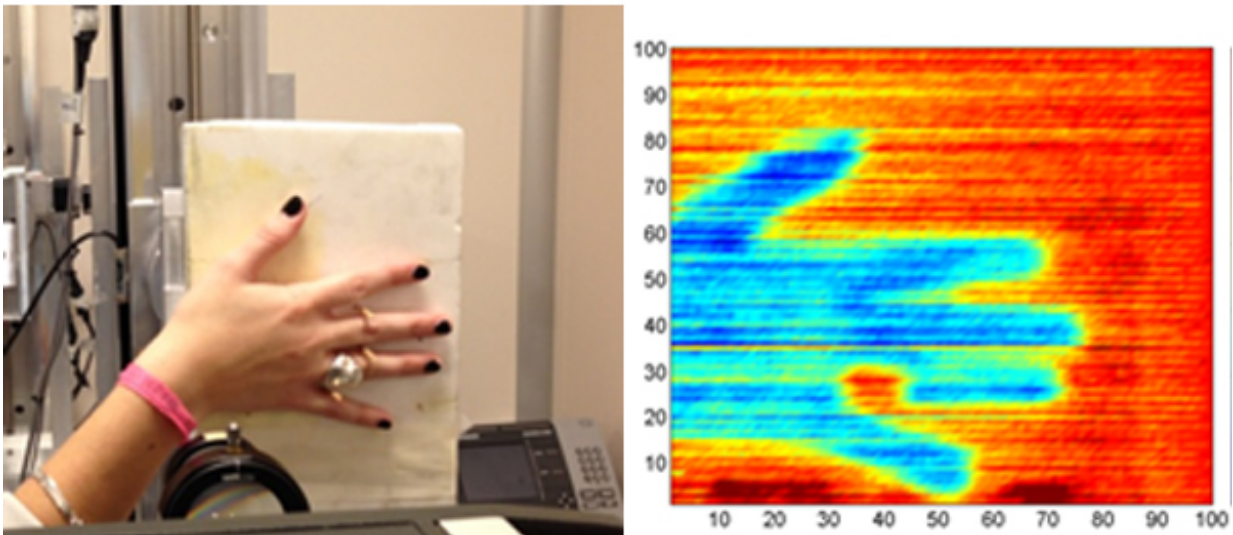


Innovative components for an imaging system in the terahertz range

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Object detection sample. Credit: UPNA-NUP

Terahertz frequencies offer the unique feature of displaying things that in other frequency ranges such as the visible, microwave or X-ray, would be impossible. So they are able to image a ceramic weapon or a parcel bomb hidden under clothing, or skin cancer in its early stages, and even the properties of certain foods. In her PhD thesis, read at the NUP/UPNA-Public University of Navarre, Itziar Maestrojuán-Biurrun has developed specific technology for imaging applications in this

frequency range.

"This thesis has opened up the possibility for the first time of using substrates of this type to implement components of the system, which leads to reduced losses and, therefore, an improvement in the functioning of the mixer," says Itziar Maestrojuan. Specifically, her research has incorporated various innovations: First, she has developed a terahertz imaging system using cyclic olefin copolymer (COC) substrates in the implementation of its components; second, it is the first time that a fourth harmonic mixer in the WR2.2 band, specifically at a frequency of 440 GHz, has been designed, manufactured, measured and published.

Her thesis, "Development of Terahertz Systems for Imaging Applications", was supervised by the Professor of Signal and Communications Theory Ramón Gonzalo-García. The work, produced and defended totally in English before a tribunal at the highest level comprising professionals from the United States (Virginia Diodes), Germany (ACST) and the Netherlands (European Space Agency), received a cum laude distinction with an International Doctor mention.

As the researcher explained, any object with a temperature above zero degrees Kelvin emits radiation that can be captured by receivers to obtain an image, thanks to the contrast between radiation emitted by various bodies. A camera that works within the terahertz range "could enhance airport security as it can pick out objects hidden in clothing or the skin; it could be used to assist in the take-off of helicopters in the middle of a sandstorm, or could play an important role in medicine ([skin cancer](#) detection, caries, passive tomography, etc.)."

Good image resolution

Once the viability of using the new substrates in the mixer design had been confirmed, a receptor array of 1X8 elements was developed. The

operational array comprising eight Schottky diode mixers for imaging application purposes was shown in Spain for the first time.

The thesis concludes with the images taken (for which a quasi-optical system lent by the company Alfa Imaging was also used). "The possibility of taking images with the components designed was also confirmed," said Itziar Maestrojuán. "The results showed good resolution of the objects and variation in the power level depending on their nature."

The user was able to distinguish between elements such as the human body, a metal plate or ceramic material, and detect and identify them by their shape. "The images taken in the open air at a distance of 4 metres from the system made it possible to fully distinguish a person and detect a metal plate placed on his/her chest, which offers an alternative for the current airport scanners."

Provided by Elhuyar Fundazioa

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