Plenary talk - Engineering holographic metasurfaces for biomedical ultrasound applications

Noé Jiménez *†

[1] Instituto de Instrumentación para Imagen Molecular, Consejo Superior de Investigaciones Científicas (CSIC), Universitat Politècnica de València, Camino de Vera s/n, 46022 València, Spain

Abstract: Optical holograms can modulate light wavefronts to generate visible images. In the same way, acoustic images can also be synthesized by holograms, shaping the areas where mechanical waves present a high amplitude, and areas where the media is at rest. In this work, we present the recent advances of acoustic holograms and structured media to engineer the acoustic wavefront to focus ultrasound beams for biomedical applications. We show how we can engineer ultrasonic wavefronts by using acoustic metasurfaces. This results in complex holographic lenses, or acoustic holograms, that can shape therapeutical acoustic images for the non-invasive treatment of neurological disorders, to produce cavitation patterns for localized drug delivery, and thermal patterns of arbitrary shape for targeted hyperthermia. In this way, acoustic holograms emerge as a disruptive and low-cost approach for biomedical ultrasound applications in neurology, including blood-brain barrier opening for localized drug-delivery or neuromodulation using low-cost systems. In addition, increasing the temperature using low-cost and MRI-compatible holographic transducers might be of great interest for many biomedical applications, such as ultrasound hyperthermia, physiotherapy, or high intensity focused ultrasound, where the control of specific thermal patterns is needed.

Curriculum vitae: Noé Jiménez, Ph.D. in Acoustics from the Universitat Politècnica de València, (Spain) in 2015. Noé Jiménez is currently "Ramón y Cajal" Fellow (tenured) at Spanish Research Council. In 2015 he joined the CNRS (UMR6613, France) for a post-doctoral position to research on acoustic metamaterials and in 2017 he joined the Institute of Instrumentation for Molecular Imaging as a "Juan de la Cierva" post-doctoral fellow to research on ultrasonic metamaterials for biomedical applications. He has been visiting researcher at Columbia University (NY, USA) and at the University of Salford (Manchester, UK). He was awarded by the Spanish Royal Society of Physics in 2019 for his scientific contribution to transcranial ultrasound propagation using acoustic holograms. He is the author of 5 patents in the field of biomedical applications of ultrasound, published 44 journal papers, edited 2 complete books, and 7 book chapters, and participated in more than 200 conferences. He teaches at the Applied Physics department of the Universitat Politècnica de València. His research interests concern from fundamental research in mechanical waves in complex and artificially structured media such as metamaterials, to its application for innovative biomedical ultrasound techniques.

*Speaker

†Corresponding author: nojigon@upv.es