University of Crete
Department of Physics

Physics Colloquium

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Ultra-thin endoscopic imaging with multimode fibers

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ABSTRACT

Fiber endoscopy plays an important role in clinical diagnosis and treatment processes in modern medicine. Thin fiber probes can relay information from confined places in the human body that are inaccessible by conventional bulky microscopes. Aiming for more compact fiber endoscope devices, various types of fibers have been investigated for their ability to integrate superior imaging modalities and microsurgery capabilities while maintaining an ultrathin size (less than 400um). Two approaches for imaging through ultrathin fibers are discussed in this talk; wavefront shaping using the transmission matrix approach and deep learning. The use of wavefront shaping has enabled the integration of femtosecond laser ablation and two-photon fluorescence imaging in the same multimode fiber, showing, for the first time, selective tissue modifications at a cellular level. Moreover, deep neural networks have shown an impressive potential to recover information from intensity-only images of the speckle patterns emerging from multimode fibers. Moreover, deep learning for multimode fiber imaging proved to be resilient to perturbations related to mechanical, thermal and even wavelength drifts. Both methods strongly prove the value of multimode fibers in imaging and information recovery.