

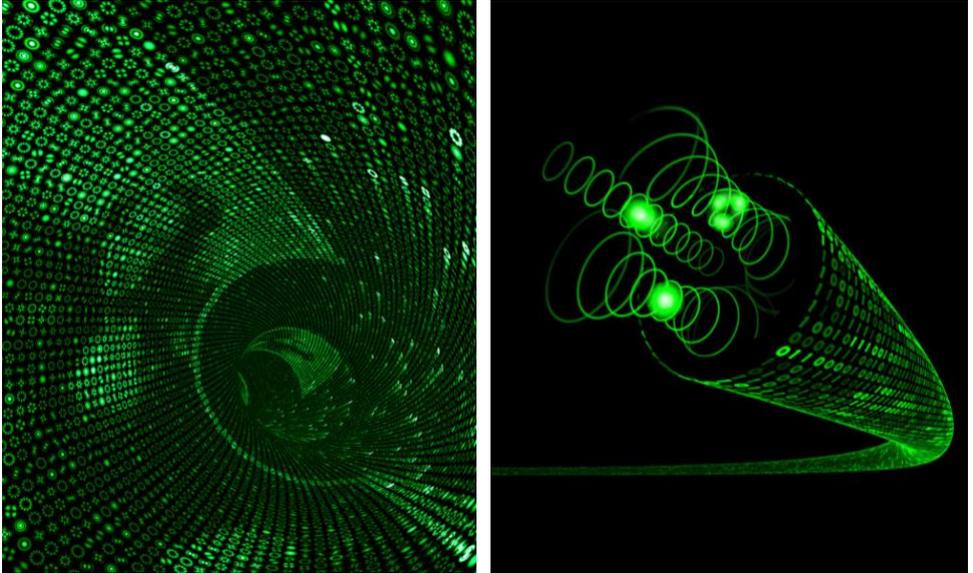
## HOLOGRAPHIC MICRO-ENDOSCOPY BASED ON MULTIMODE WAVEGUIDES

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The turbid nature of refractive index distribution within living tissues introduces severe aberrations to light propagation thereby severely compromising image reconstruction using currently available non-invasive techniques. Numerous approaches of endoscopy, based mainly on fibre bundles or GRIN-lenses, allow imaging within extended depths of turbid tissues, however their footprint causes profound mechanical damage to all overlying regions and their imaging performance is very limited.

Progress in the domain of complex photonics enabled a new generation of minimally invasive, high-resolution endoscopes by substitution of the Fourier-based image relays with a holographic control of light propagating through apparently randomizing multimode optical waveguides. This form of endo-microscopy became recently a very attractive way to provide minimally invasive insight into hard-to-access locations within living objects.

I will review our fundamental and technological progression in this domain and introduce several applications of this concept in bio-medically relevant environments.

I will present isotropic volumetric imaging modality based on advanced modes of light-sheet microscopy: by taking advantage of the cylindrical symmetry of the fibre, it is possible to facilitate the wavefront engineering methods for generation of both Bessel and

structured Bessel beam plane illumination. Further, I will demonstrate the first utilization of multimode fibres for imaging in living organism and present a new fibre-based geometry for deep tissue imaging in brain tissue of a living animal model.

Lastly, I will show the development and exploitation of highly specialised fibre probes for numerous advanced bio-photonics applications including high-resolution imaging and optical manipulation.

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I. Leite, S. Turtaev, X. Jiang, M. Šiler, A. Cuschieri, P. St. J. Russell & T. Čižmár Three-dimensional holographic optical manipulation through a high-numerical-aperture soft-glass multimode fibre, *Nature Photonics* 12, 33–39 (2018)