Imaging with Scattered Light: looking through the ‘fog’: Scattering of light in complex samples such as biological tissue renders most samples opaque to conventional optical imaging techniques, limiting the penetration depth of even the state of the art microscopy techniques to a fraction of a millimeter in tissue. However, although random scattering is a deterministic process, and it can be undone, controlled, and even exploited by carefully shaping the input wavefront, forming the basis for the emerging field of optical wavefront-shaping [1,2], and opening the path to imaging through visually opaque samples [3] and to the control of scattered ultrashort pulses [4]. Unfortunately, many of these pioneering demonstrations [1-4] required an invasive implantation of an optical probe at the target for determining the wavefront distortions.

I will present some of our recent efforts in addressing this challenge [5-10]. These include the use of the
photoacoustic effect to focus and control light non-invasively inside a scattering medium [5,6], and the use of optical nonlinearities to focus light noninvasively through scattering samples [7]. I will also show how one can surprisingly image through opaque samples and around corners using nothing but a smartphone camera [8], by exploiting the inherent correlations of scattered light, challenging the common view on diffuse scattered light as an information-less halo. If time permits I will present our efforts in exploiting these principles for novel endoscopic techniques [9-11].

References


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