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Guiding of HIFU beams towards optical contrast agents by time-reversal of photoacoustic waves

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This presentation will discuss the opportunity to use photoacoustics to guide high-intensity focused ultrasound (HIFU) in biological tissue. The photoacoustic effect consists in the emission of sound by an illuminated optically absorbing region, based on the thermoelastic expansion following the absorption of a light pulse. In the near-infrared range (700 nm to 900 nm), the absorption of light in biological tissue is relatively low, and multiply scattered photons can travel as deep as a few centimetres in tissue. Photoacoustic waves can therefore be generated deep in tissue, and have recently been used *in vivo* to perform passive acoustical imaging of optical absorbing features, such as blood vessels. We recently demonstrated on tissue-mimicking phantoms that photoacoustics could be coupled to time-reversal to automatically focus ultrasound towards an optical absorber [Bossy *et al.*, APL **89**(18), 2006]. We propose to further develop this approach to automatically guide HIFU therapy beams towards a targeted region labelled with an optically absorbing contrast agent. This presentation will discuss various aspects of such an approach, based on modelling and experimental results.