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METHOD AND APPARATUS FOR OPTICAL TIME REVERSAL BY ULTRASONIC ENCODING IN BIOLOGICAL TISSUE

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Background:

Optical imaging through a highly scattering medium, such as biological tissue, has been stymied by the loss of optical focusing inside such a medium. Current optical imaging techniques, such as optical coherence tomography, image up to approximately one optical transport mean free path, such as about 1 millimeter (mm), into biological tissues. Other well-known techniques, such as confocal microscopy and multi-photon microscopy, have an even more restricted penetration path. Other imaging techniques, such as diffuse optical tomography or thermal wave microscopy, have a low depth to resolution ratio.

Technology Description:

Researchers at Washington University have developed methods, systems, and apparatus called time-reversed ultrasonically encoded (TRUE) optical focusing to deliver light into any dynamically defined location inside a scattering medium. TRUE combines two key mechanisms – localized ultrasonic encoding of the diffused light and selective time reversal of the encoded light – to suppress the scattering effect and achieve dynamic focusing of light. The focal spot size can be flexibly scaled with the ultrasonic frequency, and the experimental system can be adapted for reflection or other configurations according to the application. This technology improves spatial resolution of a variety of imaging modalities, as well as efficiency and accuracy of many clinical applications that involve non-invasive light delivery and manipulation to specific sites within a human or animal body.