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The feasibility of local harmonic motion imaging for the guidance and control of focused ultrasound surgery

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A Local Harmonic Motion can be generated within the tissues by the periodic induction of radiation force using a Focused Ultrasound (FUS) transducer. Tissue motion can then be tracked by collecting RF signals during the excitation using a separate transducer. Finally, displacement estimates can be obtained by cross-correlating the collected RF signals. The characteristics of the induced LHM depend on the local elastic properties of the tissues making it an attractive tool for imaging and therapy control applications. LHM measurements have been obtained in vivo on rabbit muscle and it was observed that the amplitude of the motion was significantly reduced after coagulation. LHM was successfully used to spatially detect the presence of the coagulation lesions within the tissues as a drop in LHM amplitude. It was also possible to detect the location of an implanted VX2 tumor when a spatial scan was performed as the LHM amplitude was lower inside the tumor because of an increased stiffness. Measurements of LHM during tissue heating using FUS reflected the changes in stiffness and revealed the apparition of coagulation showing the potential of these measurements as an alternative control for the FUS exposure. [Work supported by NIH GrantR33 CA102884 and CRC.