ACOUSTICS2008/3340
Experimental validation of the amplitude-modulated harmonic motion imaging for tissues stiffness estimation

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It has been previously shown that amplitude-modulated harmonic motion imaging (AM-HMI) has the capability of induce and image tissue displacement during the application of an oscillatory radiation force. Here, we aim at validating theoretical HMI findings with experimental results on similar phantoms. A finite-element-method (FEM) was first used to model a dynamic response of phantoms with inclusions at different stiffnesses and sizes. The FEM and experimental results were compared and used to describe the behavior of the locally displaced tissue. The radiation force was generated by a 4.68MHz FUS transducer modulated at 50Hz with acoustic pressure levels varied between 1.2 and 4MPa. A 7.5MHz pulse-echo transducer was placed through the center of the FUS transducer and used to image the displaced tissue. A 1D-cross-correlation method on successive RF signals was used to estimate the axial-displacement. The FEM and experimental results displayed good agreement in displacement patterns, i.e., the highest localized displacement occurred at the focus and was symmetrically distributed. In addition, mechanical testing was performed to estimate the phantom-gels moduli. A linear relationship between HMI displacements and tissue Young's moduli was established within the range of 13-to-50kPa. Further studies will involve the implementation of 1D linear-array transducer for full-view imaging.