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Supersonic Shear Imaging: a multi-wave imaging example

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A new imaging method that relies on the simultaneous use of both a low frequency shear wave and a high frequency ultrasound is described. The shear waves have typically centimetric wavelengths and they propagated at low velocity in tissues. They are progressively distorted by the viscoelastic inhomogeneities of encountered tissues. When coupled to an ultrafast ultrasound scanner (5000 images per second), it allows for the follow up of the propagation of these waves with a millimetric resolution over a large zone of interest. From the spatio-temporal evolution of the shear displacement fields, inversion algorithms are used to recover the shear modulus and viscosity map with sub millimetric resolution. These techniques are no more diffraction limited because, the near field of the transient waves is directly observed. In this multi-vave technique, the shear wave gives the contrast while the ultrasonic wave gives the spatial resolution. Shear waves are generated leveraging the innovative use of the ultrasonic radiation force generated by an ultrasound probe. A supersonic shear source is remotely created in tissues. Such a moving source creates two plane shear waves propagating in a Mach cone. In vivo images obtained in breast, liver, muscles will be presented that show the great interest of this quantitative imaging technique.