We are studying methods of reconstructing the elasticity from MRI measurements of tissue vibration. There has been significant interest in estimating tissue elasticity from MRI phase contrast measurements of periodic and quasi-static displacement. MRI seems to hold more promise than ultrasound because of its ability to measure small tissue displacements simultaneously in all three directions resulting from a single mechanical stimulus while ultrasound is limited to recording tissue displacements in one preferred direction at at time.

We have calculated tissue displacements with the partial differential equations describing dynamic and static elastic deformation. Models of the breast were generated from MRI scan data. We have performed simulations for various modes of vibration. These simulations have led to three conclusions which impact how estimates of elasticity can be obtained from displacement fields:

1) If the driving displacement is large enough to obtain 3D MR phase contrast images in reasonable times, there is likely to be significant displacement in directions perpendicular to the direction of the driving force.

2) Multi-dimensional displacement (e.g. in directions other than in-line with the driving force) requires partial differential equation solution to adequately describe the displacement field.

3) Because partial differential equations are necessary to describe the motion, those equations must be used to estimate the elasticity.

If the displacement is all essentially in the direction of the driving force, simple local estimates of the elasticity would be possible.