Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Using MR Elastography to Image Force Chains in a Quasi-Static Granular Assembly L. SANFRATELLO, S.A. ALTOBELLI, NMR, R.P. BEHRINGER, Duke University, E. FUKUSHIMA, ABQMR — Questions about the internal structure of dense granular assemblies remain unanswered for lack of 3D experimental data. It is known from 2D observations and from the boundaries of 3D systems that non-uniform stresses are present on container boundaries as well as at the bottom of granular piles. These forces are seen in 2D to be distributed by force chains, where most of the stress is transmitted through a small number of chains with much of the assembly transmitting little or none of the force. However, force chains have yet to be fully visualized in 3D. We propose a variation of magnetic resonance elastography (MRE) to image 3D force chains within a densely packed granular assembly. MRE is an MRI technique whereby small periodic displacements within an elastic material can be measured. Multiple bipolar motion encoding gradients incorporated into a typical pulse sequence, and applied at the frequency of mechanical oscillations, are used to detect the displacements. We have verified our MRE technique using a gel (Perma-Gel). We now extend this method to image force chains within a 3D granular assembly of particles under stress, on top of which is superimposed a small-amplitude vibration. It is our hypothesis that significant coherent displacements will be found only along force chains while most particles will move randomly. Experimental results will be presented.

Lori Sanfratello
New Mexico Resonance

Date submitted: 14 Nov 2007 Electronic form version 1.4