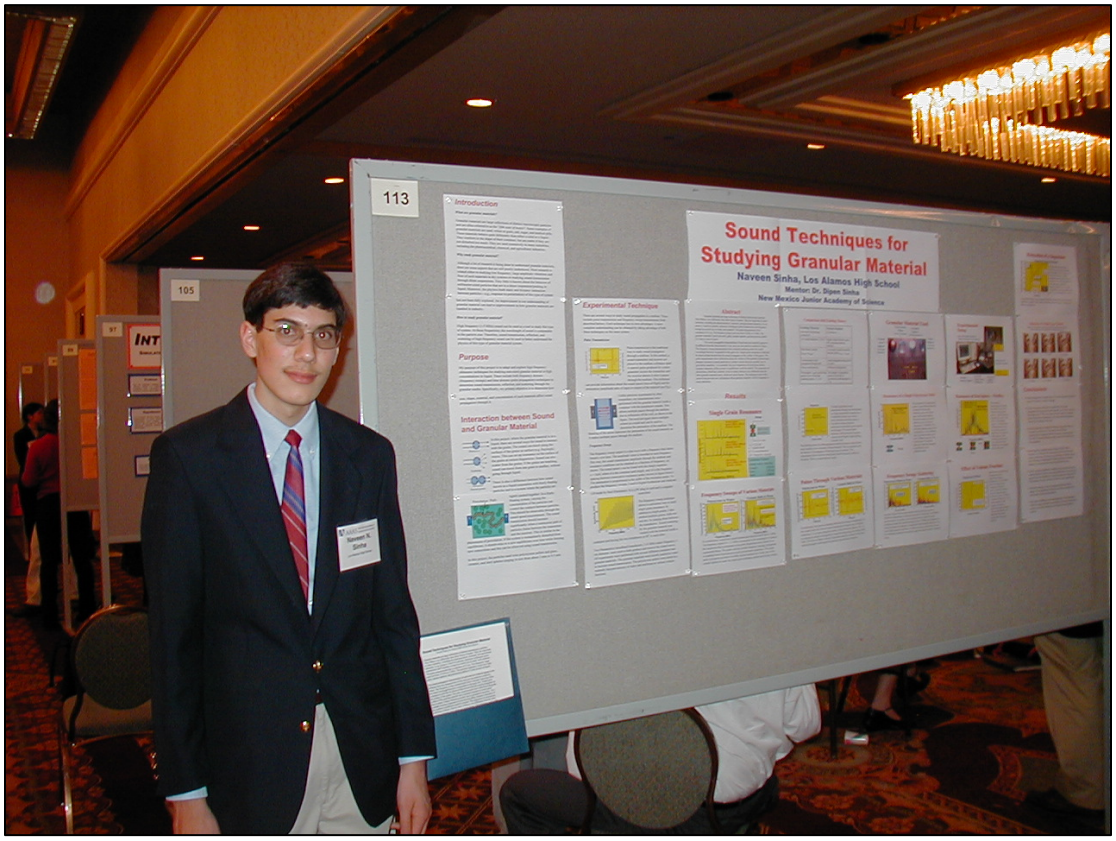
2000 State NMJAS Paper Competition Winner

Naveen Sinha

Novel Ultrasonic Techniques for Studying Granular Material

Los Alamos High School, Los Alamos, New Mexico



Abstract: Granular materials are large collections of distinct macroscopic particles. They behave very differently than other forms of matter. They are important to many industries, including the pharmaceutical, chemical, and agricultural industries. In this project, two primary ultrasonic techniques (pulse transmission and frequency sweep) were used in a novel way to study such material. The pulse measurements had a resolution of 0.2 µs. The frequency range used was from 10 kHz to 5 MHz. The granular materials used were steel, glass, ceramic spheres, and polystyrene pellets (2-5 mm in size) in liquid. The sound propagation characteristics of such mm-size material appear to be different from the characteristics of dry and µm-sized particles studied by others. The frequency sweep measurements show resonant scattering when the sound wavelength becomes comparable to the grain size. Single grain resonance could also be observed that showed that the sound propagates on the surface of the grains. The pulse measurements are consistent with sound traveling on the surface of the grains. The polystyrene pellet behaved differently than the other materials because its density was close to that of water and the particles were cylindrical. The techniques used in this project help to provide new information about granular material, which is important to many industries.