Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Effective medium model for a granular monolayer on an elastic substrate[1] ALEXEI MAZNEV, Department of Chemistry, Massachusetts Institute of Technology — Effective medium models have been shown to work well in describing experimental observations of the interaction of surface Rayleigh waves with contact vibrations of a monolayer of microspheres (see e.g. Boechler et al., Phys. Rev. Lett. 111, 036103 (2013)) . However, these models contain intrinsic conceptual problems: for example, the local displacement of the substrate at the contact point is equated to the effective medium average value of the surface displacement. I will present a rigorous derivation of the effective medium model for a random arrangement of mass-spring oscillators on an elastic half-space using elastodynamic surface Green's function formalism. We will see that the model equating the local surface displacement to the effective medium displacement is indeed valid if the spring constant of the oscillators is modified to include the stiffness of the contact calculated in the quasistatic approximation. In the case of contact vibrations of microspheres, this means using the spring constant calculated using the Hertzian contact model. Thus the results obtained in the prior work were correct despite the apparent inconsistencies in the model. The presented analysis will provide a solid foundation for effective medium models used to describe dynamics of microparticle arrays adhered to a solid substrate.

[1]This work was supported by the U. S. Army Research Office through the Institute for Soldier Nanotechnologies under grant W911NF-13-D-0001.

Alexei Maznev
Massachusetts Inst of Tech-MIT

Date submitted: 01 Nov 2016 Electronic form version 1.4