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Stress wave mitigation in granular media[1] CHIARA DARAIO, CALTECH, F. FERNANDO, University of Salerno, Italy, MASON PORTER, Oxford University, UK — We study stress wave mitigation in one- and two-dimensional granular media employing evolutionary algorithms to investigate the optimal design of composite protectors using granular chains composed of beads of various sizes, masses, and stiffnesses. We define a fitness function using the maximum force transmitted from the protector to a "wall" that represents the body to be protected and accordingly optimize the topology (arrangement), size, and material of the chain. We obtain optimally randomized granular protectors characterized by high-energy equipartition and the transformation of incident waves into interacting solitary pulses. We provide a quantitative characterization of dissipative effects using the propagation of highly nonlinear solitary waves as a diagnostic tool and develop optimization schemes that allow one to compute the relevant exponents and prefactors of the dissipative terms in the equations of motion. We thus propose a quantitatively-accurate extension of the Hertzian model encompassing realistic material dissipative effects. Experiments and computations with steel, brass, and polytetrafluoroethylene reveal a common dissipation exponent (for a discrete Laplacian of the velocities) with a material-dependent prefactor.

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