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Strongly Nonlinear Stress Waves in Dissipative Metamaterials

YICHAO XU, VITALI NESTERENKO, University of California, San Diego — We present the measurements, numerical simulations, and theoretical analysis of stress wave propagation in a one-dimensional strongly nonlinear dissipative metamaterial composed of steel disks and Nitrile O-rings. A stress wave of bell shape is generated by impactor with different masses. A strongly nonlinear double power-law is used to describe the nonlinear viscoelastic force interaction between the disks due to the compression of rubber O-rings. Numerical modeling including a nonlinear dissipative term is developed to predict the wave shape and propagation speed. The shape of generated stress wave can be dramatically changed by the viscous dissipation, which may prevent the pulse from splitting into trains of solitary waves. This strongly nonlinear dissipative metamaterial has a potential for attenuation of dynamic loading and allows an enhanced tunability of signal speed.

Vitali Nesterenko
University of California, San Diego

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