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ABSTRACT:

Effective suppression of impulsive elastic waves requires the reduction of the transmitted shock pulse and the elongation of shock duration. Recent experimental studies with engineered, lightweight elastomeric materials suggest that these requirements are met to large extent. The materials capitalize upon the mesoscale geometry that is known to collapse in unique ways according to the internal geometric design and magnitude of the impact force. Yet, the relations among material design, collapse trend, and resulting shock mitigation remain unknown. This research seeks to shed light on the connections using digital image correlation techniques that uncover exact origins of energy distribution through mapping of local strain fields. With a sequence of controlled shock experiments, we first identify how the impact force magnitude governs the classification of shock mitigation capability of the materials. Then, the relative variations of such trends as tailored by the internal material geometry are examined. All together, the results illuminate the range of working conditions and material designs for which shock attenuation capability of the materials remains exceptional.