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Wave attenuation in fragmented geomaterials with impact damping

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Energy dissipation occurring in fragmented geomaterials affects characteristics of a wave propagating through it. Viscous damping is a common model for analysis of such an effect in homogeneous materials. Fragmented geomaterials are more challenging to model because of a complex mechanism of vibration transfer from one fragment to another via impacts. However, instead of a homogenised approach with contact interaction between neighbouring fragments, a discrete approach can be used for numerical modelling of wave propagation in fragmented geomaterials.

In this study, a model of wave propagation in a chain of identical masses connected by elastic springs, representing undamped fragments, coupled with an additional condition on energy loss is considered. The condition is the following: when a ball passes through its neutral point, i.e. where the relative displacement is equal to zero, its velocity reduces by multiplying itself by a restitution coefficient less than the unity and equal over all pairs of masses.

Unusual nonlinear behaviour, e.g. the possibility of non-dissipative wave propagation, is observed in the system. The results of the impact dissipation model are compared with the ones obtained by a simpler continuous Kelvin-Voigt model with equivalent damping and the applicability of the latter is analysed.