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Animations of dynamic responses in structural dynamics and earthquake engineering using Mathematica

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Abstract

In this talk, three models, the viscous damping model, the new hysteretic damping model and the Coulomb damping model, are studied. For the viscous damping and the Coulomb damping, the free vibration problem is reviewed and demonstrated by animations. Regarding the new hysteretic damping model, the free vibration problem for the different range of parameter, (a)  (b)  (c)  is analytically derived and is also demonstrated by animations. In animations, the trajectories for three damping models in the phase plane consist of straight lines, quarter-ellipses and hyperbolic curves. For the case of , it is interesting that permanent deformation may occur. In addition, the dead zone for the Coulomb damping model in the phase plane is also addressed. The envelope for the amplitude decay yields exponential, geometric and linear curves for the viscous damping model, the new hysteretic damping model and the Coulomb damping model, respectively. It is found that the same period and the same ratio of amplitude decay for the relation between the viscous coefficient and the hysteretic parameter can be constructed. All animations are produced by using the symbolic software, Mathematica, since it is easy for students to understand the physical behavior of three damping models. In addition, Crandall’s discussions on the hysteretic damping is also addressed. Finally, the SH wave scattering by the canyon and hill using the null-field BIE is also reviewed.

**Keywords: animation,** viscous damping; new hysteretic damping; Coulomb damping; phase plane; ratio of amplitude decay, null-field BIE, structural dynamics and earthquake engineering

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