Numerical perspectives on the design of large-scale seismic metamaterials

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Abstract

We have all been used to see metamaterials control capacities in more or less idealized conditions: plane waves and limited polarizations, homogenous background models and resonators almost perfectly embedded in the host media. These ideal conditions are far from being met in seismic applications where, by definition, the wavefield results as the sum of multiple phases originated by the geological features of the site, the distance from the source and the fault kinematics. While the Bloch-Floquet theory and homogenization techniques still remain precious tools to understand the metamaterial dispersion properties, these must be complemented with large-scale numerical studies prior to field-testing.

In this presentation we will show some results from 2 and 3D numerical simulations that are being used to explore the physics of different metamaterial designs in the seismic context. We will discuss the complexities arising from the modeling of the long wavelength of the seismic input vs. the small scale of the resonators, the inclusion of geological features causing wave scattering, the presence of various phases and polarization in the wavefield. We will also try to bridge the gap between the modal analyses based view, typical of civil engineering, versus the propagative approach more common in seismology.