On the complexity of elastic waves trapped in convex features

While treated as a horizontal plane boundary in earthquake engineering and seismological models, the world is clearly not flat. Its irregular ground surface geometry affects strongly the amplitude, frequency and duration of earthquake shaking, and these effects are not only frequently ignored, but can be further complicated depending on the stratigraphy of the subsurface geology and the inelastic constitutive behavior of the underlying soils and rocks. In this talk, I will show a collection of examples that highlight the effects of topography on seismic ground shaking, and I will point out what these results suggest in the context of the current state-of-earthquake engineering practice. Examples will range from semi-analytical solutions of wave propagation in infinite wedges, to centrifuge experiments, to three-dimensional numerical simulations of topography effects using digital elevation map-generated models and layered inelastic geologic features. I will then present a system of dimensionless parameters that we have synthesized to study these complex wave propagation effects that beyond earthquake engineering, are relevant to a much wider range of fields, from non-destructive material testing to studies of continental plate margins. I will conclude by showing that what we typically refer to as topography effects in seismology and engineering are a lot less topography-dependent than their characteristic terminology suggests.

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