Non-periodic homogenization for elastic and acoustic wave propagation in complex heterogeneous media

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The modeling of seismic elastic/acoustic wave full waveform in a limited frequency band is now well established with a set of efficient numerical methods like the spectral element, the discontinuous Galerking or the finite difference methods. The constant increase of computing power with time has now allow the use of seismic elastic wave full waveforms in a limited frequency band to image the elastic properties of the earth. Nevertheless, heterogeneities of scale much smaller the minimum wavelength of the wavefield, are still a challenge for both forward and inverse problems. In this work, we tackle the problem of elastic property and topography varying much faster than the minimum wavelength. Using a non periodic homogenization theory and a matching asymptotic technique, we show how to compute effective elastic properties, how to compute local correctors and how remove the fast variation of the topography and replace it by a smooth Dirichlet to Nemann operator at the surface. After showing some 2D and 3D forward modeling numerical examples, we will discuss the implications of such a development for both forward and inverse problems.