EGU21-5887
https://doi.org/10.5194/egusphere-egu21-5887
EGU General Assembly 2021

Seismic moduli dispersion and attenuation obtained using Digital Rock Physics

Simón Lissa[1], Matthias Ruf[2], Holger Steeb[2,3], and Beatriz Quintal[1]
[1]University of Lausanne, Institute of Earth Science, Switzerland (simon.lissa@unil.ch)
[2]Institute of Applied Mechanics (CE), University of Stuttgart, Stuttgart, Germany
[3]SC SimTech, University of Stuttgart, Stuttgart, Germany

Seismic waves are affected by rock properties such as porosity, permeability, grain material and by their heterogeneities as well as by the fluid properties saturating the rocks. Consequently, seismic methods are a valuable tool for the indirect characterization of rocks. For example, at the microscale, the presence of compliant pores (cracks or grain contacts) in fluid-saturated rocks can cause strong seismic attenuation and velocity dispersion. In this case, the deformation caused by a passing wave induces a fluid pressure gradient between compressed compliant pores and much less compressed pores (stiff isometric pores or cracks having a different orientation than the most compressed ones) if they are hydraulically connected. The consequent fluid pressure diffusion (FPD) dissipates seismic energy due to viscous friction in the fluid.

Digital rock physics (DRP) aims to reproduce experimental measurements using numerical simulation in models derived from high resolution rock images. We developed a DRP workflow to calculate the frequency dependent seismic moduli dispersion and attenuation in fluid-saturated models derived from micro X-Ray Computed Tomography (µXRCT) images. Filtering, segmentation and meshing procedures are applied on sub-volumes of different rock images to create 3D numerical models. We apply our workflow to calculate seismic moduli attenuation due to FPD at the microscale (squirt flow). We consider a µXRCT image of a cracked (through thermal treatment) Carrara marble sample. A detailed visualization of the fluid pressure as well as of the energy dissipation rate in the 3D model helps to understand the squirt flow attenuation process at different frequencies.