Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **589** Type: **Poster Competition (Undergraduate Student) / Compétition affiches (Étudiant(e) du 1er cycle)**

(U*) POS-F43 – Finite Difference Simulation of Interacting Resonance and Pulse Waves in a Nonlinear Material

Wednesday 9 June 2021 13:49 (2 minutes)

The field of nonlinear acousto-elastic behaviour in materials such as rocks is an area of active research, applicable to phenomena such as earthquakes or material fatigue. This nonlinearity arises from the rock microstructure, notably through cracks, and appears in the form of a nonlinear relation between the stress and strain fields within the rock. We study how this nonlinearity manifests when the sample is in either a resonant or a non-resonant state. To do this, we numerically model a sample including a crack and broadcast a low frequency pump wave and a high frequency probe wave through the sample. We use a fourth order finite difference scheme to model the evolution of wave velocity, stress, and strain, then use a form of averaging to represent the cracked, heterogeneous model with an effective homogeneous model [1]. Calculating the nonlinear interactions between the two waves allows us to compare the resonant and non-resonant behaviour. We demonstrate differences in the effective wave velocity, and in the travel time delays between effective velocities with and without a pump source.
[1] Heru Rusmanugroho, Alison E. Malcolm, Meghdad Darijani, A numerical model for the nonlinear interaction of elastic waves with cracks. Wave Motion 92, 102444 (2020). DOI: 10.1016/j.wavemoti.2019.102444

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Session Classification: W-POS-F #41-56 Poster session (DCMMP) / Session d'affiches (DPMCM)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)