**46th Annual Review of Progress
in Quantitative Nondestructive Evaluation
QNDE2019
July 14-19, 2019, Portland, OR, USA**

QNDE2019-1234

FINITE ELEMENT MODELLING OF SHEAR WAVE PROPAGATIONS IN CRYSTALLINE MATERIALS

Bo Lan, Ming Huang, Peter Huthwaite, Michael J.S. Lowe

Department of Mechanical Engineering, Imperial College London
London, SW7 2AZ, UK

ABSTRACT

Shear waves in elastic solids have demonstrated higher sensitivities to both defects and material properties than their compressional counterparts. However, they have seen comparatively limited applications in the areas of material characterisation and beyond, mainly due to the higher complexities associated with their physical propagation mechanisms and relative difficulty in exciting and receiving them. In this talk, I will present a finite element model that is capable of capturing the most important physical aspects (wave speed, polarisation, grain scattering and attenuation) of shear wave propagation in crystalline materials, thus providing a valuable tool for better understanding, and potentially overcoming, the aforementioned complexities. The basic setup of the model will be introduced, and calibrated on a single crystal example against theoretical solutions, for simulating the wave speeds and polarisation. This is followed by polycrystalline models based on well-characterised physical samples, to illustrate the simulations of wave scattering and attenuation. Preliminary experimental results of these samples will also be included to demonstrate the efficacy of the model. Such computational capability, and the physical understanding it generates, has practical values in areas such as NDT, material characterisation, and geophysical investigations; it also epitomises the advancements enabled by the GPU-based finite element package Pogo [1], which is developed at the NDE group at Imperial College, as well as the group's broader efforts in studying and utilising shear waves.

Keywords: Ultrasonics, shear waves, finite element modelling

REFERENCES

[1] Huthwaite, Peter. Accelerated finite element elastodynamic simulations using the GPU. *Journal of Computational Physics*, 257, pp.687-707.