Soutenance d'une thèse de doctorat
De l'Université de Lyon
Opérée au sein de l'INSA Lyon

La soutenance a lieu publiquement

Candidat	M. DU Quanshangze
Fonction	Doctorant
Laboratoire INSA	LAMCOS
Ecole Doctorale	ED162 : MÉCANIQUE, ÉNERGÉTIQUE, GÉNIE CIVIL, ACOUSTIQUE
Titre de la thèse	« Numerical modeling of MR elastography experiment : excitation and tissue inhomogeneity »
Date et heure de soutenance	05/07/2022 à 10h00
Lieu de soutenance	Amphithéâtre Emilie du Châtelet, Bibliothèque Marie Curie (Villeurbanne)

Composition du Jury

Civilité	Nom	Prénom	Grade / Qualité	Rôle
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Résumé

In medical examination, palpation has been used for a long time. More advanced and quantitative methods were developed over the past decades, including the magnetic resonance elastography (MRE). It is an elasticity imaging modality using the MRI technique and allowing to measure mechanical properties of soft tissue. Based on the measurements, doctor can diagnose certain pathologies such as tumor and fibrosis. The finite element method (FEM) has been used in MRE to simulate mechanical wave propagation, which can further help in understanding effects of different parameters on MRE measurements, reconstructing stiffness, evaluating novel MRE inversion methods, etc. However, in front of inclusion with complex interface, modeling by FEM can be a burdensome task in terms of model partitioning and remeshing efforts.

In this work, we developed from scratch a dynamic and explicit FE solver, which is capable of modeling wave propagation within a linear, isotropic, locally homogeneous and viscoelastic medium subject to small amplitude excitation. Based on this solver, we further implemented the extended FEM (XFEM). This formulation of FEM originates from fracture mechanics and has been widely used for modeling discontinuities like crack and inclusion. By a XFEM model, we studied the wave conversion across a plane oblique interface between two viscoelastic materials, and compared it with a FEM model and an analytical model. Furthermore, a pseudo-practical application was investigated using the model containing a random-shape inhomogeneity. It was shown that XFEM is more convenient and efficient than FEM, while having the same, even better accuracy.

A metric for measuring the steady state of model/phantom in MRE studies was also proposed. Its threshold was analysed by both XFEM and FEM models. By this metric, the effect of different factors on the system steady state has been investigated, such as the boundary conditions, the inclusion size, the excitation polarization, etc.