Wave propagation in felt-like viscoelastic media

Summary

The aim of this project is to investigate the properties of strain wave propagation through natural and synthetic felts. The proposed study is mostly related to mathematical modelling and numerical experiments.

Research field:	Applied physics and mathematics
Supervisors:	Prof. Dr. Andrus Salupere Dr. Dmitri Kartofelev
Availability:	This position is available.
Offered by:	School of Science Department of Cybernetics
Application deadline:	Applications are accepted between June 01, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

Description

Felt is a truly unique material that is used for a wide variety of applications, such as vibration isolation, sound absorption, noise control and reduction, etc. Felt is a non-woven fabric that is produced by matting, condensing and pressing natural or synthetic fibres. Felts are highly dissipative and dispersive materials which properties are directly related to their internal structures and fibres that comprise them. Deformation wave propagation through such tight fibre mass is a complex multifaceted phenomenon. The shape of a diffused and rapidly dissipating initial wave is determined by several simultaneous effects: elastic or viscoelastic stretching of fibres; elastic collision of fibres; porosity; viscous friction effects induced by natural waxes and relative motion of fibres in the case of wool felts; etc. The study of porous viscoelastic materials is a new emerging field of study with many open questions ripe for exploration. Example research questions tackled during the projects are: Can previously discovered spectral bandgaps in porous materials be reproduced in felts made of different natural, synthetic or mixed fibres? How can the bandgap regions of felt-type media be widened or narrowed? How to apply this knowledge to the design of noise-cancelling materials?

It is expected that the results of this project will have a significant scientific impact and will be important to other research fields, e.g., civil engineering, musical acoustics, noise control and material science. The project is financed by a grant from the Estonian Research Council.

Responsibilities and tasks for the PhD student:

- Participation in development of models and performing numerical experiments.
- Publishing obtained results and presenting them at scientific conferences.
- Participation in lab activities (lab seminars, science popularisation, etc)
- Teaching undergraduate students.

The applicant should fulfil the following requirements:

- Must have MSc degree in applied mechanics, physics, applied mathematics, or in a related field
- Must have knowledge in numerical methods (integration of nonlinear PDEs)
- Must have previous experience in programming using a high-level object-oriented programming language
- Must have strong written and oral skills in English
- Must be a highly motivated and proactive individual with excellent communication skills

The following experience is beneficial:

- Knowledge in continuum mechanics
- Latex text preparation system
- Programming in Python and/or Matlab

- Familiarity with following Python modules/packages: numpy, scipy, sympy, matplotlib

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