Inverse problems for generalized fractional wave equations

Summary

In the PhD project, inverse problems for media whose motion is governed by generalized fractional wave equations will be handled. The problems consist in identification of inhomogeneities of the media by means of measurements of scattered waves.

Research field:	Earth sciences
Supervisor:	Jaan Janno
Availability:	This position is available.
Offered by:	School of Science
	Department of Cybernetics
Application deadline:	Applications are accepted between November 16, 2020 00:00 and December 16, 2020 23:59 (Europe/Zurich)

Description

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Scattered acoustic waves are used in seismic tomography and nondestructive testing (NDT) of solids and materials. Many materials and media have attenuating or other complex properties that disfigure wave profiles (e.g. soil, viscoelastic materials, disordered materials). Wave processes in such media are described by equations involving nonlocal terms in time and/or in space. Nonlocal terms may be usual fractional derivatives or their generalizations (e.g. distributed fractional derivatives, tempered fractional derivatives). Generalized fractional derivatives include more degrees of freedom, therefore they enable more exact modelling of wave dynamics. Problems to determine inhomogeneities of nonlocal media by means of boundary measurements of scattered waves are scarcely studied. Results are available in cases the equations contain non-local lower terms or usual fractional derivatives in principal terms. The aim of the PhD project is to study inverse problems to determine inhomogeneities of media whose motion is governed by wave equations involving generalized fractional derivatives in principal terms. The investigation will contain both theoretical study (existence, uniqueness and stability of solutions) and development of effective numerical solvers. However, depending on the background and/or preferences of the student, the main focus of the research can be either theory or numerics.

Responsibilities and tasks:

- investigation of inverse problems
- collaboration with other scientists of a research group
- publishing results of the research in scientific journals
- presenting the results in scientific conferences and seminars
- participation in other working activities of the group (e.g., organization of conferences)
- writing and defending PhD thesis within 4+1 years

Qualifications

Master's degree in mathematics, physics or a related field.

The applicant should fulfill the following requirements:

good knowledge about partial differential equations and numerical methods

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