Summer school EUR MINT 2025 ”Control, Inverse Problems and Spectral Theory”

Rapport sur les contributions

https://indico.math.cnrs.fr/e/CIPST25

ID de Contribution: **1** Type: **Non spécifié**

Spectral geometry: old questions and new answers

Spectral geometry is concerned with the interaction between the spectrum of linear differential operators and the geometry of underlying Riemannian manifolds. The goal of the lecture is to acquaint the student with classical problems as well as the most recent developments in the field. The emphasis is put on the Laplace operator in Euclidean domains, subject to Dirichlet, Neumann and Robin boundary conditions. Among the topics covered, there are embedded eigenvalues in unbounded domains, spectral isoperimetric inequalities, nodal-line and hot-spots conjectures, inverse problems of hearing the shape of a drum and geometrically induced eigenvalues and Hardy-type inequalities in curved tubes.

Orateur: KREJCIRIK, David

ID de Contribution: **2** Type: **Non spécifié**

A few techniques to achieve invisibility in acoustic waveguides

The aim of this lecture is to consider a concrete problem, namely the identification of situations of invisibility in waveguides, to present techniques and tools that may be useful in various fields of applied mathematics. To be more specific, we will be interested in the propagation of acoustic waves in guides which are unbounded in one direction. In general, the diffraction of an incident field in such a structure in presence of an obstacle generates a reflection and a transmission characterized by some scattering coefficients. Our goal will be to play with the geometry, the frequency and/or the index material to control these scattering coefficients. We will explain how to:
- develop a continuation method based on the use of shape derivatives to construct invisible defects;
- exploit complex resonances located closed to the real axis to hid obstacles;
- construct a non self-adjoint operator whose eigenvalues coincide with frequencies such that there are incident fields whose energy is completely transmitted.

Our approaches will mainly rely on techniques of asymptotic analysis as well as spectral theory for self-adjoint and non self-adjoint operators. Most of the results will be illustrated by numerical experiments.

Orateur: CHESNEL, Lucas (Inria)

ID de Contribution: **3** Type: **Non spécifié**

Time Iteration Methods for Controllability

This course explores several important strategies ubiquitous in control theory, presenting them as time iteration methods, where each time step progressively brings us closer to achieving the control objective. This course aims to provide an accessible introduction to these techniques.

For ordinary differential equations (ODEs), we will focus on the tangent vector method, which allows us to prove local exact controllability for a nonlinear ODE starting from approximately reachable directions.

For partial differential equations (PDEs), we will survey the classical Lebeau-Robbiano method and its more recent adaptations by Beauchard, Miller, and Pravda-Starov. This method combines spectral inequalities and dissipation estimates to prove the exact controllability of a linear PDE.

We will also describe the Liu-Takahashi-Tucsnak method, which establishes the local controllability of a nonlinear PDE by analyzing the control cost of its linearized version.

Finally, we will sketch how time iteration methods can be applied to stabilization problems.

Orateur: MARBACH, Frédéric (DMA, ENS Ulm, CNRS)

ID de Contribution: **4** Type: **Non spécifié**

Inverse problems in the wave equation: from stability to parameter reconstruction

Orateur: BAUDOUIN, Lucie (LAAS-CNRS)