



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

MATHEMATICS COLLOQUIUM

Reduced order model approach for imaging with waves

By

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Abstract

We consider the inverse problem for the wave equation. The objective is to estimate the variable coefficients of the wave equation using sources that emit probing signals and receivers that record the backscattered waves. Under such circumstances, conventional Full Waveform Inversion (FWI) can be carried out by nonlinear least-squares data fitting. It turns out that the FWI misfit function is high-dimensional and non-convex and it has many local minima. We introduce a novel approach to FWI based on a data-driven reduced order model (ROM) of an operator that controls the wave propagation. The ROM is called data-driven because it can be computed directly from the measurements, without any knowledge of the wave field inside the inaccessible medium. We show that the minimization of ROM misfit function performs much better than FWI in different configurations, including the scalar wave equation and general first order hyperbolic systems. The talk is based on joint work with L. Borcea (Columbia Univ.), A. Mamonov (Univ. Houston), J. Zimmerling (Uppsala Univ.).

Bio: *Prof. Josselin Garnier has been a professor of Applied Mathematics since 2001, first in Toulouse, then in Paris at Université Paris Diderot and Ecole Normale Supérieure, and finally at Ecole Polytechnique since 2016. He has been the head of the Department of Applied Mathematics at Ecole Polytechnique since 2023. His field of research lies at the interface of probability theory and analysis, and concerns the modeling and study of random phenomena, in particular wave propagation and imaging in complex media, the quantification of uncertainties in numerical simulation, and stochastic algorithms. He has authored three hundred papers in these areas and has written five research books and three textbooks. He was the recipient of the Blaise Pascal prize in 2007 and the Felix Klein prize in 2008. He was an invited speaker at the International Congress of Mathematicians in 2018. In 2023, he was elected a member of the French Academy of Sciences.*

Date : 05 December 2025 (Friday)

Time : 3:00p.m.-4:00p.m.

Venue : Lecture Theatre K

All are Welcome!