



深圳北理莫斯科大学

УНИВЕРСИТЕТ МГУ-ППИ В ШЭНЬЧЖЭНЕ

SHENZHEN MSU-BIT UNIVERSITY

# 应用数学讲座

Научный Семинар по Прикладной Математике  
Research Seminar on Applied Mathematics

## 应用数学报告 (90)

报告人 / Докладчик / Speaker: 刘前程 研究员(IGGCAS, Chinese Academy of Sciences)

题目 / Название / Title: Full-Waveform Tomography and Uncertainty Estimate across scales

时间 / Время / Time: 2023.11.20, 14:00-15:30

地点 / Место / Venue: 主楼336

摘要 / Аннотация / Abstract:

The pioneers of seismic tomographic imaging techniques (Aki et al., 1977) and experts in geophysical inversion problems (Tarantola, 2005) have long recognized the inherent non-uniqueness of inversion results. They emphasize that obtaining a model that satisfies the data alone is insufficient unless the corresponding uncertainties (i.e., model assessment) can be determined. However, even with the abundance of data and computational resources available today, model assessment in seismic tomographic imaging for large-scale practical problems is either neglected or given minimal attention. This presentation will from both theoretical and applied perspectives, introduce the feasibility of using quasi-Newton methods for seismic full-waveform tomographic imaging and model assessment. The integration of quasi-Newton methods with random singular value decomposition will be elucidated for extracting elements from extremely large matrices, where the diagonal elements of the extracted posterior covariance matrix characterize model uncertainties. Our approach strictly follows the standard workflow of seismic full-waveform tomographic imaging, enhancing it into a Bayesian inversion under the assumptions

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of linearization and Gaussian model priors. The proposed workflow exhibits excellent scalability, making it suitable for large-scale seismic tomographic imaging applications.

### 刘前程研究员简介：

刘前程，中科院地质与地球物理研究所特聘研究员。2010年本科毕业于中南大学，2016年博士毕业于中科院地质与地球物理研究所，2016-2021年先后在KAUST超算中心、普林斯顿大学地学系从事博士后研究，2022年入职现单位。主要研究方向为地震波数值模拟与高精度成像、全波形结构反演与模型评价及其跨尺度应用等。已在JCP, JGR, Inverse Problems、GJI等期刊上发表第一作者论文十余篇。