深地科学论坛（第八十八讲）

Inference of Mining-induced Rock Fracturing Using Electric Resistivity Tomography

基于电阻率层析成像的采动裂隙推断

报告人：澳大利亚昆士兰大学 Lutz Gross 教授

时　间： 2025 年 4 月 15 日 15：00

地　点： 深地国重 411 会议室

邀请人： 方金伟，蔡武

报告人简介：

Lutz Gross is an Associate Professor in the School of Mathematics and Physics at The University of Queensland, Australia. His research interests are large-scale geophysical data inversion, numerical methods and mathematical modelling. His current research focus is on the development of inversion schemes tailored to monitoring mine waste tailing with funding from industry. For over 20 years until 2023, he has been the project leader for the development of Python-based scientific software within the Australian National Collaboration Research Infrastructure Strategy for Earth Sciences. Lutz was awarded a PhD in Mathematics by the Karlsruhe Institute of Technology in 1997. Before joining The University of Queensland, he held positions at the Australian National University, Massey University in New Zealand and the Commonwealth Scientific and Industrial Research Organization in Australia.

报告摘要：

Electric Resistivity Tomography (ERT) is increasingly recognized as a popular geophysical surveying technique due to its cost-effectiveness and ease of deployment. This method has been identified as a potential tool for monitoring stress and the propagation of fractured zones in the subsurface that occur during mining operations. This application scenario diverges from conventional ERT applications in two significant ways. First, cavities such as galleries and mined volumes need to be represented in the domain geometry of the ERT inversion, given their spatial dimensions relative to the electrode spacing. To allow for maximal flexibility, we employ an unstructured mesh and use the finite element method for the inversion. Second, the focus of the ERT survey is on assessing the integrity of geological structures surrounding the mining operation rather than obtaining an exact image of the fracturing. To address this requirement for long-range sensitivity, albeit with a potential loss of resolution, we implement a regularization term that incorporates a second-order derivative.

In this talk, I will introduce an appropriate inversion scheme designed for first-order finite elements on

unstructured meshes. Additionally, a new sensitivity indicator will be presented. This indicator measures the drop in resolution across the region of interest, enabling an assessment of the trade-off between resolution and spatial coverage as a function of distance from the survey location, even in complex geometries and for any given survey design. I will also present and discuss results from a synthetic test case and a field survey conducted within a coal mine.