深地科学论坛（第七十讲）

Low-order Finite Element Methods for Geophysical Imaging using Bayesian inference.

报告人：Lutz Gross 教授

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邀请人： 《深地科学（英文）》编辑部

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. Since 2003, 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：

An objective for geophysical inversion is to find the realization of the target property with maximum probability subject to the observations. In the framework of Bayesian inference, this posterior probability is interpreted as the product of the probability for the observed data and the so-called prior probability for the target property. The resulting optimization problem to be solved can be formulated following conventional inversion by minimizing an objective function comprised of a data misfit and regularization term. However, evaluating the latter involves the inverse of the dense covariance matrix built from a spatial variogram or - in the case of a continuous representation of the property function - the solution of an integral equation with a variogram as the kernel. Although costs can be reduced for instance by low-rank compression, computation and storage costs for the covariance matrix limit the spatial resolution for the target property with very little potential for parallelization.
Alternatively, the regularization term can be expressed as the L2-norm of the shifted Laplace operator which provides an invaluable advantage in that the inversion problem can now be solved in the framework of partial differential equations (PDEs). In the talk, we investigate the use of first-order finite element methods (FEMs) to approximate the target property potentially using unstructured meshes. To overcome the problem of evaluation of the norm of the second-order differential operator using low-order FEM, First-Order-System-Least-Squares (FOSLS) are used. We present results from 3D gravity point data inversion using a fast Conjugate Gradient method with multi-grid preconditioning and MT data inversion using the BFGS scheme.

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