

**反问题及相关议题研讨会**

Seminar on inverse problems and related issues

**主办单位：**深圳北理莫斯科大学

计算数学与控制系

莫大-北理工-深北莫应用数学联合研究中心

2025年5月9-10日·深圳

**一、会议日程(Program Schedule)**

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| **第一天(Day 1): May 9, 2025** | |
| 14:00-17:30 | Registration |
| 17:30-19:30 | Dinner&discussion |

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| **第二天(Day 2): May 10, 2025** | |
| **Chair: Youzi He** | |
| 10:00-11:00 | 王玉亮  Near-field inverse obstacle scattering by flexural waves: method of transformed field expansion |
| 11:00-12:00 | 曹鑫林  The electromagnetic wave generated by a cluster of high-contrast nanoparticles, with application to inverse problems |
| **Afternoon Session** | |
| **Chair: Youzi He** | |
| 14:30-15:30 | 张文龙  Stochastic Convergence Analysis of Inverse Potential Problem |
| 15:30-16:30 | 吴畏  Surface Plasmon and Metamaterial |
| 16:30-17:30 | 自由讨论  Free discussion |

**二、与会专家名单(List of Participants)**

**（按姓名首字母顺序排序）**

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| 曹鑫林 Xinlin Cao | 香港理工大学The Hong Kong Polytechnic University |
| 陈阳 Yang Chen | 深圳北理莫斯科大学 Shenzhen MSU-BIT University |
| 何酉子 Youzi He | 深圳北理莫斯科大学 Shenzhen MSU-BIT University |
| 李玉萍 Yuping Li | 深圳北理莫斯科大学 Shenzhen MSU-BIT University |
| 骆泳铭 Yongming Luo | 深圳北理莫斯科大学 Shenzhen MSU-BIT University |
| 王玉亮 Yuliang Wang | 北京师范大学 Beijing Normal University |
| 吴畏 Wei Wu | 吉林大学 Jilin University |
| 徐阳 Yang Xu | 深圳北理莫斯科大学 Shenzhen MSU-BIT University |
| 袁乐乐 Lele Yuan | 聊城大学 Liaocheng University |
| 张文龙 Wenlong Zhang | 南方科技大学 Southern University of Science and Technology |
| 郑家愉 Jiayu Zheng | 深圳北理莫斯科大学 Shenzhen MSU-BIT University |

**三、报告摘要(Abstracts)**

**（按姓名首字母顺序排序）**

**The electromagnetic wave generated by a cluster of high-contrast nanoparticles, with application to inverse problems**

Xinlin Cao

The Hong Kong Polytechnic University

**Abstract:** We present the recent study on the electromagnetic scattering generated by a cluster of nanoparticles with highly contrasting parameters, embedded into a background made of a vacuum. In the resulting point-interaction approximations for the far fields, the nanoparticles can be distributed to occupy volume-like domains or low dimensional hypersurfaces where periodicity is not required. Then concerning the extreme case for the size of the nanoparticles being small enough, we investigate the corresponding effective medium. As an intriguing application to inverse problems, we describe a new method to reconstruct the permittivity distribution, of an object to image, from the remotely measured electromagnetic field using plasmonic nanoparticles as contrast agents.

**Near-field inverse obstacle scattering by flexural waves: method of transformed field expansion**

Yuliang Wang

**Abstract: I**n this talk, we investigate the inverse scattering problem of an obstacle embedded in a thin plate using near-field measurements of flexural waves. The forward scattering problem is reduced to a coupled system of boundary value problems for the propagating and evanescent waves. Assuming the obstacle is a small perturbation of a circle, we employ the method of transformed field expansions to express the solution as a power series, obtaining closed-form expressions for the zeroth and first-order terms. These expressions are then used to derive an approximate reconstruction formula for the inverse scattering problem. We explore different types of incident fields, some of which lead to simplified and more efficient reconstruction methods. Numerical experiments demonstrate the effectiveness and efficiency of the proposed approach.

**Surface Plasmon and Metamaterial**

Wei Wu

**Abstract:** Metamaterial is the name of a vast category of man-made material with properties that never occur on natural materials. It consists of assemblies of multiple repeatedly aligned unit structures made of metal or plastics. By adjusting properties of unit structures, we could expect a remarkable change of corresponding metamaterial in the absorption, enhancement or refraction to incident wave, of which we could take advantage to develop new materials possessing specific physical properties. In this talk, we would like to discuss the possibility of constructing metamaterial with surface plasmonic resonators. We will elaborate the mathematical principle behind them, and the actual phenomenon observed by physicists. We will also give an outlook of the potential to generalize the method applied here to other scenarios.

**Stochastic Convergence Analysis of Inverse Potential Problem**

Wenlong Zhang

**Abstract: I**n this work, we investigate the inverse problem of recovering a potential coefficient in an elliptic partial differential equation from the observations at deterministic sampling points in the domain subject to random noise. We employ a least squares formulation with an H1(Ω) penalty on the potential in order to obtain a numerical reconstruction, and the Galerkin finite element method for the spatial discretization. Under mild regularity assumptions on the problem data, we provide a stochastic L2(Ω) convergence analysis on the regularized solution and the finite element approximation in a high probability sense.