Inverse Scattering by Locally Rough Surfaces with Phaseless Near-Field Data

Bo Zhang

Institute of Applied Mathematics, AMSS, Chinese Academy of Sciences, Beijing 100190, China

Email: b.zhang@amt.ac.cn

In this talk we consider inverse scattering of plane waves by a locally perturbed infinite plane (which is called a locally rough surface) with the modulus of the total-field data (also called the phaseless near-field data) at a fixed frequency in two dimensions.

We consider the case where a Dirichlet boundary condition is imposed on the locally rough surface. This problem models inverse scattering of plane acoustic waves by a one-dimensional sound-soft, locally rough surface; it also models inverse scattering of plane electromagnetic waves by a locally perturbed, perfectly reflecting, infinite plane in the TE polarization case. We prove that the locally rough surface is uniquely determined by the phaseless near-field data generated by a countably infinite number of plane waves and measured on an open domain above the locally rough surface. Further, a direct imaging method is proposed to reconstruct the locally rough surface from the phaseless near-field data generated by plane waves and measured on the upper part of the circle with a sufficiently large radius. Theoretical analysis of the imaging algorithm is derived by making use of properties of the scattering solution and certain results from the theory of oscillatory integrals (especially the method of stationary phase). Moreover, as a by-product of the theoretical analysis, a similar direct imaging method with full far-field data is also proposed to reconstruct the locally rough surface. Finally, numerical experiments will be shown to demonstrate that the imaging algorithm with phaseless near-field data and full far-field data are fast, accurate and very robust with respect to noise in the data. This is a joint work with Xiaoxu Xu and Haiwen Zhang.

Reference:

X Xu, B Zhang & H Zhang, Uniqueness and Direct Imaging Method for Inverse Scattering by Locally Rough Surfaces with Phaseless Near-Field Data, *SIAM J. Imaging Sci.* 12 (1) (2019), 119-152.