

# *MATHEMATICAL SCIENCE*

## *Colloquium*

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**Thursday, March 27, 2014**

**Speaker: Peijun Li  
(Purdue University)**

**TIME: 4:00–5:00pm**

**LOCATION: Sage 5101**

### **“Breaking the Diffraction Limit via Inverse Scattering”**

Abstract: Scattering problems are concerned with how an inhomogeneous medium scatters an incident field. The direct scattering problem is to determine the scattered field from the incident field; the inverse scattering problem is to determine the nature of the inhomogeneity from the measured scattered field. These problems play a fundamental role in diverse scientific areas such as radar and sonar, geophysical exploration, medical imaging, near-field and nano-optics. According to the Rayleigh criterion, there is a resolution limit to the sharpness of details that can be observed by conventional far-field imaging, one half the wavelength, referred to as the diffraction limit. It presents challenging mathematical and computational questions to solve the underlying inverse scattering problems with increased resolution due to the nonlinearity, ill-posedness, and large scale computation.

In this talk, our recent progress on inverse surface scattering problems will be discussed. I will present new approaches to achieve subwavelength resolution for the inverse problems of the Helmholtz and Maxwell equations. Based on transformed field expansion, the methods convert the problems with complex scattering surfaces into successive sequences of two-point boundary value problems, where explicit reconstruction formulas are made possible. A spectral cut-off regularization is adopted to suppress the exponential growth of the noise in the evanescent wave components, which carry high spatial frequency of the surfaces and contribute to the super-resolution. The methods require only a single incident field and are realized by using the fast Fourier transform. The error estimates of the solutions for the model equations will be addressed. I will also highlight ongoing projects in rough surface imaging, random medium imaging, and near-field and nano-optics modeling.

**REFRESHMENTS**

**3:30–4:00PM**

**Amos Eaton 4th Floor Lounge**



**Rensselaer**

Host: Don Schwendeman