Problèmes Inverses Plasmoniques

Opérateur de Neumann-Poincaré

29 novembre : Maison Jean Kuntzmann; 30 novembre : Amphi 22, UFR IM2AG

Programme

Mercredi 29 Novembre

Amphi Maison Jean Kuntzmann

14h-15h

Fernando Guevara Vasquez (University of Utah)

Title: Imaging small scatterers from polarization data

15h-16h

Brian Fitzpatrick (ETH, Zurich)

Subwavelength acoustic resonators: From super-resolution to metamaterials

16h-16h30 **Pause Café/Thé**

16h30-17h30

Chun-Hsiang Tsou (UGA, Grenoble)

Title: On the electro-sensing of weakly electric fish

Jeudi 30 Novembre

Amphi 22, UFR IM2AG

10h-11h

Kui Ren (University of Texas, Austin)

Title: Optical Imaging Based on Nonlinear Physics

11h-12h

Fadil Santosa (University of Minnesota)

Time reversal and other phenomena in graphene plasmons

12h-14 **Pause déjeuner**

14h-15h

Lucas Chesnel (Ecole Polytechnique, Paris)

A curious instability phenomenon for a problem of rounded corner in presence of negative material

15h-16h

Pierre Millien (ESPCI, Paris)

Title: Volume integral approach for the computation of plasmonic resonance
beyond the quasistatic approximation in the scalar case.

16h-16h30 **Pause Café/Thé**

16h30-17h30

Sanghyeon Yu (ETH, Zurich)

Title: Field concentration in plasmonic and elastic composites

——
————————————————————————————————

Abstracts

Mercredi 29 Novembre

Fernando Guevara Vasquez (University of Utah)

Title: Imaging small scatterers from polarization data

Abstract: The scattered electric field from a small scatterer can be well described by a 3 by 3 matrix called the polarization tensor. We consider the problem of finding the positions and polarization tensors of several point scatterers in a homogeneous medium. The medium is probed by a single point source for which we assume only knowledge of its position and first and second order moments of its polarization vector. The data that is used for imaging is the polarization state or Stokes parameters of the electric field as measured on an array of receivers. Our approach to this problem consists in partially recovering the electric field at the array and using it as data for an electromagnetic version of Kirchhoff migration. We prove that for high frequencies, the images we obtain are identical to those obtained with full knowledge of the electric field at the array.

Brian Fitzpatrick (ETH, Zurich)

Title:
Subwavelength acoustic resonators: From super-resolution to metamaterials

Abstract:
The aim of this talk is to review recent results on the propagation of acoustic waves in bubbly media. Our main focus is on developing a mathematical and computational framework for the analysis of Minnaert bubbles. By characterizing and exploiting the Minnaert resonance frequencies of bubbles in a variety of situations, we construct a unified theory of super-focusing of acoustic waves, acoustic metamaterials, and controlling acoustic wave propagation at the subwavelength scale. Super-resolution and metamaterials are usually studied within the context of different approaches. Remarkably, as shown in this talk, they owe their origin to the same underlying physical mechanism, namely, wave interaction with a subwavelength

resonator.

Chun-Hsiang Tsou (UGA, Grenoble)

Titre: On the electro-sensing of weakly electric fish

Abstract :

In this talk we are interested in electro-sensing inverse problems. Our objective is to understand the electro-perception mechanism of weakly electric fish. These species of fish have the ability to recognize the environment around them in complete darkness by generating a weak electrical field at different frequencies, and perceiving the transdermal potential perturbation. Assuming that the target has a known conductivity profile, the electro-sensing inverse problem consists in recovering the shape and location of the target from measurements of the electric potential over the skin. We will present uniqueness and stability estimates to the considered inverse problem as well as numerical validations of our theoretical approach using synthetic data in dimension two.

Jeudi 30 Novembre

Kui Ren (University of Texas, Austin)

Title: Optical Imaging Based on Nonlinear Physics

Abstract: We will discuss some recent developments on mathematical, computational and modeling aspects of imaging nonlinear effect, for instance two-photon absorption and second harmonic generation, in optics. We will also present some numerical results on uncertainty quantification issues in such imaging problems.

Fadil Santosa (University of Minnesota)

Title: Time reversal and other phenomena in graphene plasmons

Abstract: It is known that a graphene sheet surrounded by dielectric

material can support plasmons. Motivated by recent time reversal experiments of Fink et al, we investigate how such phenomena can be reproduced in graphene plasmon. Electrostatic gating is a method by which the conductivity in the graphene can be modulated. We demonstrate that by introducing time dependent conductivity, it is possible to have time reversal, amplification, as well as standing waves. This preliminary report is joint work with Tony Low, Paul Martin, Misun Min, and Josh Wilson.

Lucas Chesnel (Ecole Polytechnique, Paris)

Title: A curious instability phenomenon for a problem of rounded corner in presence of negative material

Abstract: We consider a 2D transmission problem between a positive material and a negative material. In electromagnetism, this negative material can be a metal at optical frequencies or a negative metamaterial. We highlight an unusual instability phenomenon when the interface between the two materials presents a rounded corner. We show that for certain settings, the solution of the source term problem depends critically on the value of the rounding parameter. We also study the corresponding spectral problem. We provide an asymptotic expansion of the eigenvalues and prove error estimates. We prove that the eigenvalues adopt an oscillatory behaviour as the rounding parameter of the corner tends to zero.

Pierre Millien (ESPCI, Paris)

Title: Volume integral approach for the computation of plasmonic resonance

beyond the quasistatic approximation in the scalar case.

Abstract: We present a new way to compute the resonant frequencies of a metallic
nanoparticle using the volume integral equation. We show that an approximate value for the resonant parameter of a metallic particle can
be computed easily (without computing the full resolvant for K^*), and
we apply some perturbative theory to compute the correction of these
resonant values due to the finite ratio : size of the particule / wavelenght of the incoming light.

Sanghyeon Yu (ETH, Zurich)

Title : Field concentration in plasmonic and elastic composites

Abstract :When metallic (or plasmonic) particles are nearly touching, strong concentration of electromagnetic fields can occur in the narrow gap regions. Similarly, the stress concentration may happen in the elasticity case. The understanding of the strong interaction between the particles is quite challenging both analytically and numerically. This requires to analyse the singular behaviour of solutions to elliptic PDEs with degenerate coefficients. Also, the numerical computation of the field concentration is very hard because extremely fine mesh is required in the narrow gap region. Moreover, in the elasticity case, the governing PDE is an elliptic system whose solutions don’t satisfy many useful properties in the scalar case. In this talk, I will discuss how to characterize the field concentration in a quantitative way and to develop efficient numerical methods. This talk is based on joint works with Habib Ammari, Hyeonbae Kang and Mikyoung Lim.