JULIEN DEROSNY, ESPCI PARIS, ACOUSTICS

Localization of scatterers on elastic plates. Abstract: The aim of the different approaches is to detect acoustically a contact defect on plate. The first one is based on the detection by an array of transducers of the acoustic emission of the defect when the plate is randomly vibrating at low frequency with a high amplitude. The second one, consists of monitoring the apparition of a defect and localize it from ambient high frequency noise correlations. Finally, the last method is based on a non-linear interaction between a high and low frequency vibrations.

STEFAN CATHELINE, LABTAU INSERM LYON, ACOUSTICS / MEDICAL IMAGING

Wave experiments in soft tissues and membranes. Abstract: In this presentation, the first part is devoted to natural pulse wave that propagates along blood vessels. Using ultrasounds, optics and noise correlation algorithms developped in seismology, it is possible to revisit the physics of propagation described by Thomas Young in 1808. In the second part, a gravitational lensing experiment is conducted with membrane waves.

SEBASTIAN WOLF, TUM MUNICH, APPLIED MATH / NUMERICAL WAVE PROPAGATION

Time reversal of elastic waves. Abstract: We review two approaches of how to time-reverse elastic waves: the Time Reversal Mirror (TRM) and the Instantaneous Time Mirror (ITM). We demonstrate how both methods can be incorporated into the discontinuous Galerkin framework. The TRM is built upon a specialized boundary condition, whereas for the ITM we apply a sudden change in material parameters. We present numerical results for both methods to show the time-reversed seismic waves.

LUKAS KRENZ, TUM MUNICH, APPLIED MATH / NUMERICAL WAVE PROPAGATION

Coupled elastic-acoustic simulations. Abstract: Fundamental mechanisms of how earthquakes induce tsunamis are still unclear. Typically, a two-step model is used, where the earthquake and tsunami are modeled in separate simulations. In our approach, we model Earth (elastic medium) and ocean (acoustic medium) in a fully-coupled system. We show how we can add tsunami propagation to this model and apply it to the Palu, Sulawesi earthquake-tsunami event. Furthermore, we show, how elastic-acoustic coupling can be used to model sound generated by an earthquake in the Helsinki metropolitan region induced by an enhanced geothermal system.

ROMÉO COURBIS, SISPROBE FRANCE, SEISMOLOGY

Sisprobe and Helsinki region ambient noise surface wave tomography (ANSWT). Abstract: Sisprobe is a company specialized in imaging and monitoring using seismic ambient noise. After a presentation of a few examples from previous projects, we will focus on the Helsinki region ANSWT as part of the Seismic Risk project. Using datasets from three different experiments, Rayleigh and Love waves have been extracted from cross-correlation functions. Then a two steps inversion - travel time tomography and depth inversion - leads to a 3D shear wave velocity model.

TANJA TARVAINEN, UNIVERSITY OF EASTERN FINLAND, MEDICAL IMAGING

Imaging with light and sound. Abstract: Photoacoustic tomography is an emerging imaging modality combining optical contrast and ultrasound resolution. In the approach, photoacoustic effect caused by absorption of an externally introduced light pulse is utilised to form images of the target tissue. In this talk, I discuss modelling and image reconstruction of photoacoustic tomography.

LAURI OKSANEN, UNIVERSITY OF HELSINKI, APPLIED MATH

Computational methods for acoustic inverse problems. Abstract: The inverse problem to recover a spatially varying speed of sound in the acoustic wave equation can be solved by using the Boundary Control method. This is a non-iterative method that is guaranteed to give the exact solution, but it is unstable and thus challenging to implement. A computational implementation of the method is presented, based on joint work with Maarten de Hoop and Paul Kepley. Related to regularization of the Boundary Control method, stabilized finite element methods for control problems are discussed, based on joint work with Erik Burman, Ali Feizmohammadi and Arnaud Munch.

DAVID WEIR, UNIVERSITY OF HELSINKI, GRAVITATIONAL WAVE COSMOLOGY

Gravitational wave cosmology at the University of Helsinki. Abstract: Gravitational waves - so-called ripples in spacetime - represent an exciting new mechanism for studying astrophysics and cosmology. At the University of Helsinki we study possible sources of gravitational waves in the very early universe, a few picoseconds after the Big Bang. We are also involved in the space-based LISA gravitational wave mission that will allow us to look for these cosmological sources of gravitational waves, with frequencies in the millihertz range. In my talk I will give a brief introduction to gravitational waves, why they are important for cosmology, and why we are launching space missions to detect them.

ALEXANDER MEANEY, UNIVERSITY OF HELSINKI, APPLIED MATH

Image reconstruction in low-dose cone beam computed tomography. Abstract: Cone beam computed tomography (CBCT) is an increasingly popular imaging modality in which X-ray data of an object is collected using a cone-shaped beam, and a reconstruction algorithm is applied to create a 3D volumetric image. Conventional analytical reconstruction algorithms, while fast and well understood, suffer from noise and cone beam artifacts, and perform poorly with noisy or undersampled data, and there is a growing demand for new, more flexible techniques. In this work, we have developed iterative reconstruction algorithms using two different regularization techniques: the orthogonal wavelet transform and anisotropic total variation. The reconstruction is computed using the primal-dual fixed point (PDFP) algorithm, an effective and flexible optimization technique which allows including additional useful properties such as nonnegative X-ray attenuation.

HONGYANG ZHOU, UNIVERSITY OF HELSINKI, ELECTRODYNAMICS / SPACE PHYSICS

Ultra-low frequency plasma waves in Earth's magnetosphere. Abstract: Our Earth is surrounded by a dipolar magnetic field generated by its core. The interaction between Earth's magnetic field and plasma from the solar wind creates the magnetosphere that protects us from being directly exposed to solar radiations and high energy particles. Using the hybrid numerical model Vlasiator that treats ions with phase space distributions and electrons as fluids, we simulate the impact of changing solar wind densities to the near-Earth environment. A global view of the magnetosphere can help us better understand the propagation of various electromagnetic waves and aid in space weather forecasting.

HEIKKI J. NIEMINEN, AALTO UNIVERSITY, ULTRASOUND / BIOMEDICAL ENGINEERING

Medical needle functionalized by ultrasound. Abstract: Medical needles are part of the everyday healthcare, exemplified by 16 billion needles consumed annually. In this presentation, coupling of ultrasound to a medical needle is demonstrated, enabling high-rate flexural oscillations of the needle tip. The tip becomes an ultrasound source, which can be employed to generate non-linear acoustic phenomena such as acoustic radiation force, streaming, atomization and cavitation. The approach could extend the use of conventional medical needles beyond their current use to applications such as ultrasonically enhanced biopsy, drug/gene/nano-particle delivery and fractionation of small tumors.