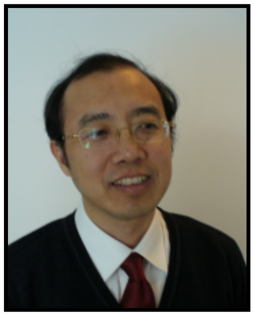

Special Guest Lectures

Fast Algorithms for High Frequency Waves and Applications in Kinetic Inverse Problems

Jianliang Qian, Michigan State University

Johnston Hall 338
March 29, 2011 - 02:00 pm

Abstract:
Computational wave propagation has emerged as a fundamental, vigorously growing technology for modeling, design, and development in areas ranging from radar, sonar, seismic imaging, medical imaging, submarine detection, stealth technology, remote sensing and electronics to microscopy and nanotechnology. The significant recent applications of the wave propagation technology have driven the need for more advanced mathematical models and numerical algorithms. However, by the physical nature of these models, it is difficult to develop rigorous numerical methods in the high frequency regime due to the highly oscillatory property of the fields. Therefore, a multitude of simulations are based on some approximate models. Among these, the simplest and most broadly used is the geometrical optics model that results as a lowest order (WKBJ) approximation of wave-like equations as the frequency becomes infinite. The focus of the recent efforts along the line is on developing fast algorithms for accurate high frequency wave propagation. I will give an overview of some newly developed fast algorithms for high frequency wave propagation, such as fast sweeping methods for eikonal equations, Gaussian beam methods for the Schrodinger equation based on fast wavepacket transforms, and multiscale Gaussian beam methods for wave equations based on fast multiscale wavepacket transforms. Fast sweeping methods are a family of efficient algorithms for solving nonlinear stationary Hamilton-Jacobi equations which include eikonal equations. Gaussian beam methods are a class of uniform geometrical-optics approximations for wave equations which include the Schrodinger equation, the Helmholtz equation as well as various classical wave equations. Fast (multiscale) wavepacket transforms enable us to develop fast (multiscale) Gaussian beam methods for these equations. To demonstrate the power of these fast algorithms, I will outline two exciting applications in kinetic inverse problems: traveltime tomography and photoacoustic tomography. This lecture will take place at 234 Nethken Hall, Louisiana Tech University. Access Grid viewing will be in 338 Johnston Hall.

Speaker's Bio:
Jianliang Qian currently is an Associate Professor of Mathematics at Michigan State University in East Lansing, Michigan. He earned his Ph.D. degree at Rice University under the supervision of William W. Symes in May 2000. From September 2000 to August 2002, he was a Postdoctoral Research Associate at the Institute for Mathematics and Applications (IMA), University of Minnesota. From September 2002 to July 2005, he was a CAM Assistant Professor at UCLA. From August 2005 to July 2007, he was an Assistant Professor at Wichita State University. From August 2007 to June 2010, he was an Assistant Professor at Michigan State University. He was promoted to be an associate professor with tenure at Michigan State University in July 2010. He has published more than 35 journal papers. He has organized the 2010 IMA Participating Institute Graduate Summer School on Computational Wave Propagation. His research interest is on high frequency wave propagation and related applications in inverse problems, seismic imaging and medical imaging. His research is mainly supported by NSF and DOD, and he has received four research grants with a cumulative budget of more than $600K.