Weekly CEAFM Seminar: Fall 2015

JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

Date: **Friday, November 13, 2015**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. Eric Johnsen** (University of Michigan at Ann Arbor)

Title: ***"Modeling and Simulating Cavitation-Bubble Dynamics in Ultrasound Imaging and Therapy"***

Abstract

The use of ultrasound in medicine is widespread, ranging from imaging in echocardiography to therapy, e.g., shock-wave lithotripsy for kidney stone treatment and histotripsy for pathogenic tissue ablation. In several of these procedures, pressure waves produce and/or interact with cavitation bubbles, whose dynamics and collapse may lead to tissue injury, unintentional or deliberate. This presentation summarizes our efforts to develop and use numerical modeling and high-fidelity simulations techniques to investigate cavitation dynamics in tissue-like media, with application to contrast-enhanced ultrasound and histotripsy. By considering simple model problems, we can identify mechanisms of ultrasound-induced cavitation in tissue. Numerical modeling of spherical bubble dynamics shows that the viscoelasticity of the medium strongly affects the growth, frequency and energy dissipation of the bubble oscillations, and may lead to previously unknown damage mechanisms. Numerical simulations of shock-bubble interaction demonstrate that the presence of individual cavitation bubbles amplifies the incoming pulse pressure and produce sufficient tension to generate cavitation in histotripsy.

Bio

Eric Johnsen is an Assistant Professor with the Mechanical Engineering Department at the University of Michigan in Ann Arbor. He received his Ph.D., in Mechanical Engineering from Caltech in 2008, his M.S., in Mechanical Engineering from Caltech in 2002 and his B.S., in Mechanical and Environmental Engineering from UCSB in 2001. His research interests lie in the development of numerical methods and models for massively parallel computations of fluid mechanics problems on modern computing architectures, including GPUs. He specifically focuses on high-order accurate finite difference/volume/element and spectral methods desgined for robust, accurate and efficient simulations. With his codes, he investigates the basic physics of multiphase flows, high-speed flows and shock waves, turbulence and mixing, interfacial instabilities, complex fluids and plasmas. Target applications include biomedical engineering, energy, aeronautics and naval engineering.