# DEPARTMENT OF MECHANICAL ENGINEERING
# WILLIAM MAXWELL REED SEMINAR SERIES

**"Can Microscopic Gas Bubbles help cure Cancer?"**

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**Abstract:** Microscopic gas bubbles in the form of Ultrasound Contrast Agents have been recently shown to have therapeutic applications under the action of ultrasound. High Intensity Focused Ultrasound (HIFU) has been approved by FDA in 2016 for treatment of sub-surface prostate cancer using the ablative effect created by focusing the ultrasound on the affected area. However, this technique is not suitable for deep-seated cancer where very high intensity ultrasound is needed to achieve acoustic penetration which has deleterious side effects due to pre-focal heating. This talk explores the idea of injecting microbubbles in the vicinity of the tumor to enhance the heat deposition due to ultrasound while maintaining moderate ultrasound intensity levels. The interaction between the injected bubbles and the HIFU field is investigated using a recently developed 3-D numerical model. The propagation of non-linear ultrasonic waves in the tissue or in a phantom medium is modeled using the compressible Navier-Stokes equations on a fixed Eulerian grid, while the microbubbles dynamics and motion are modeled as discrete singularities, which are tracked in a Lagrangian framework. These two models are coupled to each other such that both the acoustic field and the bubbles influence each other. The resulting temperature rise in the field is calculated by solving a heat transfer equation applied over a much longer time scale. The presence of microbubbles modifies the ultrasound field in the focal region and significantly enhances heat deposition. The various mechanisms through which heat deposition is increased are then examined. The effects of the microbubble cloud size and its location in the focal region are studied, and the effects of these parameters in altering the temperature rise and the location of the temperature peak are discussed. It is found that concentrating the bubbles adjacent to the focus and farther away from the acoustic source leads to effective heat deposition.

**Bio**: Dr. Aswin Gnanaskandan is an Assistant Professor in the Department of Mechanical Engineering, WPI. He completed his bachelor's degree in Aeronautical Engineering from Madras Institute of Technology, India. He graduated with a M.S (2012) and PhD (2015) in Aerospace Engineering and Mechanics from the University of Minnesota, where he was the recipient of the "John and Jane Dunning Copper" fellowship. During his PhD, he worked on numerical modeling of multiphase cavitating flows and developed a low dissipative, massively parallel, unstructured methodology to simulate multiphase flows. Subsequently he moved to California Institute of Technology as a post-doctoral researcher where he worked on physical and subgrid scale modeling of high-pressure multispecies flows for which he received a "NASA certificate of recognition" in 2018. Prior to joining the faculty at WPI, he was a Research Scientist at Dynaflow Inc., where he worked on developing numerical models for multiphase flows for applications in aerospace engineering, marine engineering, and biomedicine. At WPI, his research mainly focuses on developing high-fidelity mathematical models for multiphase flows and leverage their applications to answer critical questions in engineering and biomedicine.

**Date: Friday, Apr. 2nd**
**Place: https://uky.zoom.us/j/92940732923**

**Time: 3:00PM EST**
**Contact: Dr. Alexandre Martin 257-4462**

Attendance open to all interested persons

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