Department of Electrical and Computer Engineering
UNIVERSITY OF WISCONSIN-MADISON

SEMINAR NOTICE

Wednesday, February 14, 2018
3:00 – 4:00pm, RM 1610 EH

Prof. Mahta Moghaddam

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Clinical Microwave Imaging, Therapy, Monitoring Applications Through Accelerated Computational Electromagnetics Methods

Abstract - Electromagnetic waves in the microwave regime have been proposed for a variety of medical applications in the past several decades. Microwave imaging was perhaps the first such application, motivated by the goal of enhancing imaging depth as compared to, for example, ultrasound, and enhancing imaging specificity and safety as compared to, for example, X-ray modalities. Relatively low resolution and high computational complexity even for idealized renditions of microwave imagers have been some of the impediments in their widespread adoption. More recently, non-contact hyperthermia (microwave) and invasive probe-based ablation (radio frequency (RF) and microwave) methods have seen clinical use for thermal therapeutic purposes. The attraction of such methods is the highly efficient and deep heat deposition property of microwaves in biological tissue, especially those with high water content. A main challenge with such systems, however, is monitoring the temporal and spatial progress of heat deposition for proper treatment: real-time thermal monitoring is necessary to guide the location, intensity and time of heat delivery such that the desired elevated temperature is reached for sufficient time to achieve cell death throughout the target region, as well as to monitor and prevent inadvertent heating up of surrounding tissue. This talk gives an overview of our recent work on the development of microwave imaging, thermal therapy, and thermal monitoring systems, with emphasis on the latter. We will present a realistic novel computational method that allows us to fully represent the therapy and monitoring system, including antennas and other elements of the hardware setup. The results show successful retrieval of temperature fields with a precision of better than 1^{o} C and spatial resolution of about 2-3 cm. New approaches for cost function definition and minimization, along with GPU-acceleration, allow an accurate temperature map refresh rate of about 1 frame per second, which makes this method realistically useful in a clinical setting. Furthermore, the temperature mapping method is independent of the method of heat delivery, and therefore useful in conjunction with most any thermal therapy modality.

Biography - **Mahta Moghaddam** is Professor of electrical engineering at the University of Southern California (USC) Ming Hsieh department of electrical engineering and the Director of New Research Initiatives at the USC Viterbi School of Engineering. Until 2011, she was on the faculty at the University of Michigan. She received her Ph.D. degree in electrical and computer engineering from the University of Illinois, Urbana, in 1991. From 1991 to 2003, she was with the Jet Propulsion Laboratory (JPL), Pasadena, CA. During the past ~25 years of active involvement in microwave systems and remote sensing, Mahta has introduced new approaches for quantitative interpretation of synthetic aperture radar imagery, has developed new radar measurement technologies for subsurface and subcanopy characterization, has developed forward and inverse scattering techniques for random surfaces and media, and has led the development of sensor web technologies for in-situ environmental sensing. Her group has also been strongly engaged in transforming concepts of radar remote sensing to high-resolution medical imaging, focused microwave therapy, and image-guided thermal therapy. She is a member of the NASA Soil Moisture Active and Passive (SMAP) mission Science Team, member of the Arctic-Boreal Vulnerability Experiment (ABoVE) Science Team, and the PI for AirMOSS NASA Earth Ventures Suborbital 1 Mission. Mahta has served on the NASA Advisory Council Earth Science Subcommittee, and has been a 2016 recipient of the NASA Honor Award of Outstanding Public Leadership Medal for “Outstanding leadership in the advancement of microwave remote sensing technologies.” She is a Fellow of IEEE and the Editor-in-Chief of the IEEE Antennas and Propagation Magazine.