

**Title:** Microwave Thermal Therapy for Minimally-Invasive Treatment of Cancer

**Speaker:** Nader Behdad, Wisconsin University, USA

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**Abstract:**

Microwave ablation (MWA) employs an interstitial antenna to deliver microwave energy directly into the tumor and heat it to cytotoxic temperatures. This thermoablative approach to cancer treatment is a promising alternative to surgical resection. MWA avoids the high costs, invasiveness, prolonged use of general anesthesia and other risks, and long recovery times associated with surgery. In comparison to other thermal ablation technologies such as radiofrequency ablation, MWA achieves higher temperatures, larger ablation volumes, and shorter ablation times. The vast majority of prior MWA studies have made use of frequencies below 2.5 GHz, in part due to concerns that smaller penetration depths of electromagnetic waves at higher frequencies would preclude the creation of sufficiently large ablation zones. However, our work in this area has shown that these concerns are not valid and higher microwave frequencies (e.g. 10 GHz) can indeed be used to perform efficient MWA. At higher frequencies, tissue heating can be performed more rapidly and smaller antennas can be used to perform ablation. In this talk, I will present the results of our recent investigation in the area of high-frequency MWA and discuss the potential clinical benefits of this approach. I will also present several new types of interstitial antennas that we have recently developed, which can considerably reduce the invasiveness of microwave ablation as a potential treatment for cancer and offer capabilities such as directional heating or local sensing of the tissue properties that are not available from conventional MWA antenna designs.



**Bio:** Nader Behdad received the B.S. degree in Electrical Engineering from Sharif University of Technology (Tehran, Iran) in 2000 and the M.S. and Ph.D. degrees in Electrical Engineering from University of Michigan - Ann Arbor in 2003 and 2006, respectively. Currently he is a Professor in the Department of Electrical and Computer Engineering and the Harvey D. Spangler Faculty Scholar in the College of Engineering of the University of Wisconsin-Madison. From 2009-2013 he was an Assistant Professor in the Department of Electrical and Computer Engineering of the University of Wisconsin and from 2006 to 2008, he was as an Assistant

Professor in the Department of Electrical Engineering and Computer Science of the University of Central Florida in Orlando, FL. Dr. Behdad's research expertise is in the area of applied electromagnetics. In particular, his research interests include electrically-small antennas, antenna arrays, antennas for biomedical applications, biomedical applications of RF/microwaves, periodic structures, frequency selective surfaces, passive high-power microwave devices, metamaterials, and biomimetics and biologically inspired systems in electromagnetics. Over the years, Dr. Behdad's research has been sponsored by various U.S. Federal agencies including the U.S. Navy, Air Force, National Science Foundation, and the National Institute of Health.

Dr. Behdad is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and was named the Harvey D. Spangler Faculty Scholar by the College of Engineering (2016-2019) and the H. I. Romnes Faculty Fellow (2016-2021) by the Office of Vice Chancellor for Research and Graduate Education (OVCRGE) of the University of Wisconsin. He is the recipient of the Vilas Associates Award from the OVCRGE of UW-Madison in 2016, the 2014 R. W. P. King Prize Paper Award, and the 2012 Piergiorgio L. E. Uslenghi Letters Prize Paper Award of the IEEE Antennas and Propagation Society. In 2011, he received the CAREER award from the U.S. National Science Foundation, the Young Investigator Award from the United States Air Force Office of Scientific Research, and the Young Investigator Award from the United States Office of Naval Research. Prior to 2009, he received five different fellowships and awards from the Office of Naval Research, the International Union of Radio Science (URSI), and the University of Michigan-Ann Arbor among others. His graduate students were the recipients of the 13 different awards/recognitions at the IEEE AP-S/URSI Symposium (2010, 2012, 2013, 2014, 2015), USNC/URSI National Radio Science Meeting (2018), IEEE Pulsed Power & Plasma Science (2013), and the Antenna Applications Symposium (2008, 2010, 2011). Dr. Behdad served serving as the general co-chair of the 4<sup>th</sup> Arab-American Frontiers in Science, Engineering, and Medicine Symposium and served as an Associate Editor for IEEE Antennas and Wireless Propagation Letters (2011-2015) and as the co-chair of the technical program committee of the 2012 IEEE International Symposium on Antennas and Propagation and USNC/URSI National Radio Science Meeting.