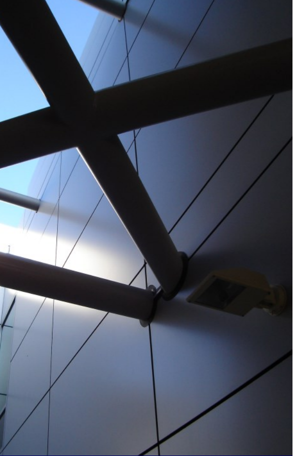

MECHANICAL ENGINEERING

DISSERTATION DEFENSE

The Department of Mechanical Engineering presents:

The Ph.D. Dissertation Defense of

Erfan Kosari

Tuesday, February 22, 2022,
5-7PM, Pacific time

Thermal Analysis of Biological Tissue Exposed to Magnetothermal Stimulation

Doctor of Philosophy, Mechanical Engineering
University of California, Riverside, February 2022
Dr. Kambiz Vafai, Chairperson

The Economic burden of Parkinson's Disease (PD) will continue to rise as the number of elderlies is growing rapidly. It is estimated that 1.2 million people will be living with PD by 2030 and it poses a major concern to discover effective therapies. The well-known deep brain stimulation (DBS) as a treatment for Parkinson's disease (PD) has irredeemable impacts on the brain tissue. Deep brain stimulation (DBS) is a conventional method for Parkinson's treatment. This method manages Parkinson's symptoms, *e.g. tremor, by surgically implanting an electrode to deliver constant stimulation in deep brain levels. The fatal* impacts of DBS motivated scientists to propose a minimally invasive treatment, termed as "Magnetothermal Stimulation". Magnetothermal stimulation is a good alternative though, it is still invasive due to stereotactic injection for nano-particle delivery.

In this investigation, firstly, we advance a computational approach to optimize thermal neuromodulation, based on Pennes' equation, that results in minimum damage on the target tissue. By using thermal analysis, the key parameters affecting on the stimulation are identified. Then, by implementing an optimization method, optimized values for the stimulation are found. Thereby, it leads to a reduction of thermal damage by %20.

The second section of this study focuses on resolving the invasive particle delivery in magnetothermal stimulation. A good solution to stereotactic injection is to take advantage of microvasculature and excite the nano-particles inside the brain capillaries. Hence, the transport and dynamic analysis of blood flow through a brain capillary is crucial. This manuscript presents a two-dimensional theoretical study of a blood flow with magnetic nano-particles through a capillary when exposed to an alternating magnetic field (AMF). The magnetic nano-particles are localized within the domain over time. The particle transport impacts and the dynamic interactions with the blood flow are elaborately investigated.