USC Viterbi School of Engineering
Ming Hsieh Department of Electrical Engineering

Seminar Announcement

Engineering Challenges in Next Generation Neurosurgery

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Abstract: Neurosurgery is a surgical subspecialty that treats diseases of the brain, spine, and peripheral nervous system. Common diseases treated include brain tumors, mood and movement disorders, cerebrovascular disease, spinal disorders, peripheral nerve, and surgical management of pain.

New advances in technology are bringing about a new paradigm in the management of many neurosurgical diseases. Traditional neurosurgery used a scalpel, focused radiation, insertion of RF probes, or insertion of stimulating electrodes to treat tumors and movement disorders. Engineering advances are changing this paradigm and minimizing the morbidity from these procedures. One example is the use of noninvasive high intensity MRI guided focused ultrasound (MRgFUS). MRgFUS is a promising new technology that utilizes a phased area of transducers which can compensate for variations in skull thickness to focus a pressure wave to a spot a few millimeters in diameter. This allows the creation of small 3-5mm lesions in deep brain nuclei for the treatment of movement disorders such as Essential Tremor (ET) and tremor dominant Parkinsons disease (PD). UVA is a leader in the use of focused ultrasound and has completed numerous trials proving both efficacy and safety of this technology. Although promising, this technology has limitations in the treatment of larger lesions and off axis lesions and is the focus of significant ongoing engineering research. Another promising technology is the use of minimally invasive laser interstitial thermal therapy (LITT). LITT utilizes a high power laser source at 980nm or 1064nm with a diffusive fiber which is actively cooled. The small diameter fiber is advanced into the brain from a small 1-2mm incision to the target location. The treatment of mesial temporal sclerosis (a form of epilepsy) using this technique has enabled patients to go home the day after surgery, previously unthinkable. LITT has also had significant success in the treatment of tumors and radiation necrosis. A limitation of LITT is the maximum volume which can be treated by a single fiber insertion owing to the properties of laser – tissue interaction. Active research areas include ways to increase the maximum treatment volumes in a single pass to maintain the minimally invasive advantage of this technology.

In conjunction with reducing the invasiveness of neurosurgical procedures, there is significant research in the area of targeting and understanding the connections and interdependencies within the brain. At UVA we are using diffusion tensor imaging (DTI) to aid in the identification of targets in the treatment of common movement disorders.

In this talk, I will highlight the current state of MRgFUS technology, LITT, and DTI and discuss the engineering challenges which remain to enable widespread implementation of these new technologies.

Biography: Aaron Bond is a resident in Neurosurgery at the University of Virginia School of Medicine. He holds an MD from USC Keck School of Medicine, a PhD in EE from USC Viterbi School of Engineering as well as an MS and BS in Electrical Engineering from USC. He was formerly the founder, SVP and CTO of Apogee Photonics (formerly T-Networks) (2000-2007) and a Member of Technical Staff at Bell Labs Lucent Technologies (1998-2000). His current research interests are interoperative MRI and CED guided targeting during functional neurosurgery. He has several publications in medical journals and in the area of photonics.

Hosted by Prof. P. Daniel Dapkus