

# Seminar Talk

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**Friday, April 17, 2015**

**3:00 p.m. KH 224**

**Title:** Ablation of cardiac tissue with nanosecond pulsed electric fields

**Abstract:**

Cardiac ablation for the treatment of cardiac arrhythmia is usually performed by heating tissue with radio-frequency (RF) electrical current, to create conduction-blocking lesions in order to stop the electrical wave propagation. Problems associated with RF ablation are tissue loss beyond the targeted tissue, long duration of the ablation procedure, and thermal side effects including thrombus formation that may lead to stroke. Here, we propose a new, non-thermal ablation method using nanosecond pulsed electric fields (nsPEFs) with controlled ablation volume, shorter procedure time. Our goals are to create non-conductive transmural and complete lesions using nsPEFs, increasing the nsPEF ablation speed, testing other electrodes configurations, building a numerical model including twisted fiber orientations, and possibly to modify an ablation tool by the company AtriCure to include nsPEF technology.

To demonstrate the feasibility of this approach, we have developed a life support system with Langendorff-perfused rabbit heart and an optical mapping system to study the electrical activity of hearts. We further developed the capability to apply short sequences of nanosecond pulses through a pair of customized piercing electrodes to tissue. In order to characterize the 3D geometry of an ablated volume, we have adopted propidium iodide and TTC staining in conjunction with tissue sectioning. It is found that by using 2 mm electrodes spacing, 2.3 kV amplitude of 5 pulses at the frequency of 3 Hz can successfully create transcultural lesions with 3 mm width, which is good enough to block the action potential propagations. Besides the penetrating electrodes configuration, we also tested the another electrodes configuration, and it is found transmural ablated volume can be obtained.

In order to better predict the nsPEFs ablation for human, we modeled the electric field distribution with different electrodes configurations. It is found the experimental and numerical results are consistent and suggest a critical electric field strength of 3kV/cm can lead to the death of cardiac tissue. This threshold obtained by the numerical model can function as a guideline for future nsPEFs treatment of atrial fibrillation for human beings.

In summary, we propose to develop nsPEF ablation for the treatment of cardiac arrhythmia to provide better control over the ablated volume than RF ablation in a faster way, without having thermal side effect and better shape of ablated region. Our goal is to bring this technology closer to clinical use.

**Bio:**

Fei Xie received his B.Eng degree in Telecommunications Engineering from Chongqing University in 2000, and Msc degree in RF Communications System from University of Southampton in 2006. He is a current PhD candidate in Biomedical Engineering in ODU and expected to graduate in May 2015. His research focus on using nanosecond pulsed electric fields (nsPEFs) to ablate cardiac tissue, for the treatment of atrial fibrillation. It is been verified from experimental results this technique is faster, better to control, and no thermal side effects compared with traditional RF ablation.