Surface Mapping of Cardiac Electrical Activity using Implantable Electrodes

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Atrial fibrillation affects 2.7 million Americans every day. This abnormal rhythm of the heart is patient specific, increases the risk of stroke fivefold, and affects 25 to 30 percent of patients after open heart surgery. Current electrical activity mapping technologies aid in the treatment of arrhythmias by forming 3D images to locate sites for ablation. However, existing systems, such as CARTO and Ensite NavX, do not provide any insight on arrhythmic development. The low spatial resolution and numerous predictive algorithms of these non implantable invasive systems render them ineffective postoperatively. Furthermore, detection technologies require subsequent measurements of multiple contact points instead of providing a continuous map in real time. For this reason, there is a need to develop tools and techniques for predicting postoperative arrhythmias as well as a convenient solution to map cardiac electrical pathways during open heart surgery.

In this study, we propose a protocol that can be used with a biocompatible conformal device to map electrical pathways and gather data on arrhythmias from the pericardium with high resolution. To account for the complex nature of the heart, an experimental test bench is created using a biomimicking cardiac gel into which known electrical signals replicating the heart’s activity are supplied. This study is focused on developing implantable needle electrode arrays for temporal electrical activity measurement on the surface of the pericardium and within the myocardium. We present a comparison of the testbench data to contemporary electrocardiogram (EKG) signals in real time to test for accuracy and demonstrate the feasibility of the mapping system. The data will then be used to better understand the causes of patient specific postoperative arrhythmias and focus on how to treat them.