Developing MATLAB® Code for Analysis of Heterogeneous Engineered Cardiac Tissue During Contraction

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This project attempts to create a comprehensive interface for analyzing videos of calcium propagation through contracting engineered cardiac tissue. Engineered cardiac tissues are stained with a calcium indicator dye and imaged using a high-speed camera to capture the changes in fluorescence associated with calcium propagation. In order to analyze changes in fluorescence, the contracting cardiac tissues must be treated with a compound called blebbistatin to prevent mechanical motion. This compound is cytotoxic and can change cellular behavior. Producing an interface that can account for mechanical motion may give more accurate readings of calcium propagation through the tissue, and the tissue will better mimic hearts *in vivo.* As a result, it is essential to be able to isolate and remove motion artifacts from the videos so propagation can be analyzed.

After reviewing the literature, several methods were tested based on the current experimental setup. The first method tested involved using a block-matching algorithm[1]. In this method, an analysis was conducted to determine when a pixel contained cardiac tissue for every frame. These data were fed into the block-matching algorithm to find motion vectors that were then removed from the initial video data. In practice, the algorithm could not remove all motion effectively enough, and the resulting video data were unusable.

The second method used two videos taken of the same sample. One video captured the fluorescence changes of the contracting tissue, and the second video of the sample used a filter to record only the mechanical contractions. The motion of the second video can theoretically be used to subtract the motion in the first. However, due to the experimental setup, the videos could not be taken at the same time. The filters used also caused the difference in fluorescence between the tissue and the surroundings to be different in the two videos. None of the pairs of videos tested using this method were viable for analysis.

My attempts to account for motion revealed that the current experimental set up would need to be modified to include tissue markers for distinguishing mechanical contraction from changes in fluorescence. Using tissue markers will provide explicit reference points for subtracting motion and allow the researcher to continue imaging without cytotoxic compounds.

Statement of Research Advisor

Michaela's knowledge of computer programming is well beyond that of most undergraduate students. Using her experience from both high school Java courses and her computer science minor, Michaela has been able to have an immediate impact in our lab. The goal of her research project is to develop a MATLAB® code to analyze electrophysiology of engineered cardiac tissues using optical mapping data. She has spent the semester researching and applying current methods of motion subtraction while giving feedback on better ways for collecting optical mapping data.

– *Elizabeth Lipke, Chemical Engineering*

References

[1] Barjatya, A. (2004). Block matching algorithms for motion estimation. *IEEE Transactions Evolution Computation*, 8, 225-239.