Graphics User Interface for Processing and Analyzing Cardiac Optical and Electrical Mapping Recorded During Animal Arrhythmic Models

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Introduction: Cardiac arrhythmias, a leading cause of global morbidity and mortality, often stems from acquired heart disease and genetic channelopathies. Animal models are vital for studying these mechanisms. This study aimed to create a freely accessible GUI for analyzing arrhythmias induced in animal models with optical and electrical mapping data.

Methods: The GUI called MapECor, built with MATLAB App Designer, processes raw experiment data by converting it to MATLAB-compatible files. Optical data is normalized, and filtered with a Butterworth filter to remove baseline noise. It undergoes additional filtering with a Gaussian kernel for each frame. Similarly, electrical data is filtered with a Butterworth filter to eliminate baseline wandering, a low-pass filter for high-frequency noise, and a notch filter for powerline noise. The filter parameters are user defined and of linear phase. The optical and electrical data are synchronized using TTL signal data, captured at each rising edge during the experiment and recorded in the electrical data as an event. This GUI generates investigative cardiac maps for electrophysiology analysis. The Local Activation Time Map (LAT) is calculated by finding the midpoint in a linear regression between minimum and maximum signal values. The Conduction Velocity Map (CV) uses the circle method. The Dominant Frequency Map (DF) employs MATLAB's Fast Fourier Transform. The Phase Map is computed using the Hilbert transform. These methods are used for both electrical and optical data.

Results: The developed GUI is a robust tool for optical and electrical mapping data analysis in cardiac electrophysiology. It facilitated the generation of investigative cardiac maps, such as the LAT, CV, DF, and Phase Maps, offering valuable insights into heart electrophysiology.

Conclusion: The MapECor is a valuable tool for analyzing optical and electrical mapping data in cardiac electrophysiology. Its user-friendly design enhances accessibility, aiding in understanding and diagnosing cardiac arrhythmias mechanisms.