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Fiber optical measurements of electrical activity in canine ventricular preparations AMGAD SQUIRES, GISA E. LUTHER, MICHAEL ENYEART, ROBERT F. GILMOUR, EBERHARD BODENSCHATZ, STEFAN LUTHER, Department of Biomedical Sciences, Cornell University, NY, and Max Planck Institute for Dynamics and Self-Organization, Goettingen, Germany — Ventricular fibrillation (VF) is a cardiac arrhythmia that kills over 300,000 people every year in the US alone, yet efforts at finding a cure have been stymied by our incomplete information about patterns of electrical activity in the whole heart. As an excitable medium, the heart is a pattern forming system; but only a very limited subset of patterns is compatible with life. In particular, spiral waves have been associated with both tachycardia and VF, but their origin and spatial and temporal dynamics is not fully understood. We propose a novel measurement technique that combines optical mapping of the epicardial surface with data from intramural fiber optical probe arrays. The data obtained from the fiber optical probes is sparse in space but dense in time. The data processing is based on sequential data assimilation using an ensemble Kalman filter. The ensemble Kalman filter provides a numerically efficient (sub-) optimum state space estimate based on the available spatial and temporal observations. The feasibility of the method is demonstrated with numerical data and arterially perfused canine heart preparations.

Stefan Luther

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