Integrating Computational Physiology and Machine Learning to Better Understand Ablation Outcomes

Speaker: Patrick MJ Boyle, University of Washington

Abstract: The pathophysiological basis of atrial fibrillation (AF) remains unknown. Catheter ablation delivers a cure in some patients, but outcomes are lackluster. Efforts to custom-tailor ablation using patient-specific imaging and computational simulation have not yet proved effective, with long-term success rates lingering around 50%. Machine learning has been used to predict ablation failure, but the algorithms involved are opaque. To address this issue, our team is exploiting new explainable machine learning (exML) tools, such as SHapley Additive exPlanations (SHAP) analysis. Here, we will discuss novel applications of exML in the context of simulation-based AF research. We will show how SHAP analysis can be applied to pinpoint properties of pro-arrhythmic ablation lesions. We will also show how a similar approach can predict recurrent AF using an exML model trained on data from electronic health records, medical imaging, and arrhythmia features from personalized simulations. SHAP analysis produces individualized summaries of decision drivers for each patient, greatly increasing model interpretability. We are optimistic this approach will help pave the way towards better, more effective AF treatments.