# Functional Personalization of Patient-Specific Atrial Models Using AF Dominant Frequency

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**Introduction:** Patient-specific atrial modeling is increasingly used to investigate arrhythmia mechanisms and support therapy planning. However, relying solely on anatomical and structural features may be insufficient to reproduce individual atrial fibrillation (AF) behavior. Direct assessment of repolarization from clinical signals is not feasible; however, dominant frequency (DF) during AF provides an indirect surrogate of local electrophysiological properties, particularly action potential duration (APD). Incorporating such functional information is therefore essential to more accurately capture AF dynamics. In this study, we propose a framework for functional personalization of atrial electrophysiology based on DF.

**Methods:** Ten patients with persistent AF undergoing de novo ablation were analyzed, with available left atrial (LA) CT imaging and electroanatomical mapping data, including sinus rhythm, paced, and AF maps. This preliminary investigation focuses on two representative patients. Atrial geometries were reconstructed from CT, and fiber orientation and regional labels were assigned using an atlas-based approach. In prior work, these models were structurally personalized by incorporating fibrosis distributions derived from intracardiac electrogram amplitudes recorded during coronary sinus pacing. Here, we extend personalization to electrophysiological properties using an electrically remodeled Courtemanche model. First, simulations were performed on a 7×7 cm 2D tissue to analyze rotor dynamics induced via an S1–S2 protocol under different levels of electrical remodeling, yielding varying APD. Subsequently, patient-specific DF was estimated from ECGs reconstructed from CARTO data, followed by QRST cancellation and spectral analysis of f-waves. Model personalization was then achieved by selecting cellular parameter sets that reproduced, in the 2D simulations, the DF observed in each patient.

**Results:** In 2D simulations, APD shortening led to a monotonic increase in DF ($\approx$ 4.5–9 Hz). Patient-specific DF values (5.4 - 6.8 Hz) were reproduced by selecting corresponding cellular parameters. In 3D LA models, this yielded sustained AF with global frequencies matching targets ($< 0.5$ Hz error).