# Role of the Fast Conduction System in Electrical Activation in Simple and Detailed Biophysical Heart Models

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Electrical activation in the ventricles follows a complex pattern which involves propagation through both specialized fast conduction tissues and contracting myocardium. Modelling the effects of the conduction system is essential to obtain meaningful simulation results. This is especially critical for in silico planning and optimisation of certain therapies such as Cardiac Resynchronisation Therapy (CRT), where events such as the retrograde Purkinje activation might play an important role.

There exist several models with different degree of complexity to simulate cardiac electrical activation. The complexity is usually selected as a function of the final application and has a great impact in computational times. It is not fully clear whether simple models that include the most important anatomical structures can reproduce results of complex biophysical models.

In this paper a comparison between simplified and complex electrical propagation models was carried out over a patient-specific anatomical model of the left ventricle from an asymptomatic patient, in which main substructures were mathematically modelled, i.e. the Purkinje network and myocardial fiber orientation. Complex biophysical modelling used ion kinetic dynamics at cellular level and reaction-diffusion equations for tissue propagation, whereas a simple model was based on Eikonal equations solved with a Fast Marching Method (FMM).

Anisotropic conductivity of the tissue was modelled in the electrical equations throughout the domains. Electrophysiological activation and propagation was modelled as a 3D conductive domain coupled to a 1D fast conductive structure. Coupling between the myocardium structure and fast conductive systems was provided on the terminals nodes.

The electrophysiological signal propagation on the myocardium was compared between both models by looking at local activation times and activation sequences. Results showed that simpler electrophysiology models coupled with a fast conductive system might provide results valid in applications where the focus is in the activation sequence of ventricles, such as CRT.