

Modeling of Cardiac Electrophysiology

Computational Electrocardiology Group

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Physiological Basis

Cell-Tissue

Action Potential
The cardiac action potential represents the electrical dynamics of a single cell over a cardiac cycle.

Propagation
Charge differences within the tissue direct the electrical wavefront.

Heart-Body

The heart is an electrical source situated in a complex volume conductor. The ECG is a measurement of this distant activity from the body surface.

Cardiac Models

Cell-Tissue

The bidomain model represents tissue dynamics by coupling the intra and extracellular spaces between cells.

Image-Based Modeling

Heart-Body

Using simulation software packages like CARP, we can simulate electrical activity across the heart. Projecting the resulting voltage onto a body surface model allows reconstruction of the ECG [1]

Application

Cell-Tissue

Altering parameters of the cellular domain can model the electrical behavior of healthy and damaged tissue in a cardiac digital twin.

Heart-Body

Simulations of propagation can replicate cardiac arrhythmias such as ventricular tachycardia. Reconstruction of the body surface allows for simulated ECG readings.