International Workshop on Mathematics and Physics
in Cardiovascular Research, Gdańsk Tech, April 19, 2023

Controlling and predicting cardiac dynamics

Ulrich Parlitz[1,2,3], Thomas Lilienkamp[1,4], Sebastian Herzog[1,3,5], Inga Kottlarz[1,2,3,6], and Stefan Luther[1,2,3,6]

[1] *Max Planck Institute for Dynamics and Self-Organization, Am Fassberg 17, 37077 Göttingen, Germany*
[2] *Institut for the Dynamics of Complex Systems, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany*
[3] *German Center for Cardiovascular Research (DZHK), Partner Site Göttingen, Robert-Koch-Straße 42a, 37075 Göttingen, Germany*
[4] *Computational Physics for Life Science, Nuremberg Institute of Technology Georg Simon Ohm, Nuremberg, Germany*
[5] *Department for Computational Neuroscience, Third Institute of Physics - Biophysics, University of Göttingen, 37077 Göttingen, Germany*
[6] *Institute of Pharmacology and Toxicology, University Medical Center Göttingen, Robert-Koch-Str. 40, 37075, Göttingen, Germany*

Currently, the only therapy to terminate life-threatening ventricular fibrillation is the application of very strong electrical shocks with adverse side effects. As an alternative to the clinical single pulse method, low-energy pulse trains have been suggested and successfully applied in ex vivo experiments. In a previous numerical study of cardiac excitable media, we showed that high success rates at low energies are possible with specific combinations of pulse frequency and pulse energy resulting in a non-monotonous behavior of the dose-response curve. Here we show that this sensitive dependence on control parameters can be overcome by decelerated pulse sequences, which can be derived from the Fourier spectrum of the ECG. Furthermore, we will briefly discuss applications of machine learning for reconstructing electrical excitation waves in a 3D excitable medium from surface observations.