

Abstract Submitted  
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**Optimal Pulse Configuration Design for Heart Stimulation. A Theoretical, Numerical and Experimental Study.**<sup>1</sup> NEIL HARDY, Georgia Institute of Technology, HILA DVIR, Israel Institute of Technology, FLAVIO FENTON, Georgia Institute of Technology — Existing pacemakers consider the rectangular pulse to be the optimal form of stimulation current. However, other waveforms for the use of pacemakers could save energy while still stimulating the heart. We aim to find the optimal waveform for pacemaker use, and to offer a theoretical explanation for its advantage. Since the pacemaker battery is a charge source, here we probe the stimulation current waveforms with respect to the total charge delivery. In this talk we present theoretical analysis and numerical simulations of myocyte ion-channel currents acting as an additional source of charge that adds to the external stimulating charge for stimulation purposes. Therefore, we find that as the action potential emerges, the external stimulating current can be reduced accordingly exponentially. We then performed experimental studies in rabbit and cat hearts and showed that indeed exponential truncated pulses with less total charge can still induce activation in the heart. From the experiments, we present curves showing the savings in charge as a function of exponential waveform and we calculated that the longevity of the pacemaker battery would be ten times higher for the exponential current compared to the rectangular waveforms.

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