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Modeling the Force Frequency Relation of a Cardiac Cell DUY MANH LE, Department of Physics and Graduate Institute of Biophysics, National Central University, Jhongli City 320, Taiwan, ALEXEY V. DVORNIKOV, Nizhny Novgorod State University, Russia, PIK-YIN LAI, Department of Physics and Graduate Institute of Biophysics, National Central University, Jhongli City 320, Taiwan, CHI-KEUNG CHAN, Institute of Physics, Academia Sinica, Nankang, Taipei 115, Taiwan — Recent pacing experiments with hearts of rat have discovered that the contractile response of the hearts can have an unexpected slow non-monotonic response. This later observation cannot be explained by the existing excitation-contraction coupling model. A new discrete map model of the EC coupling is developed to understand these experimental findings. It is found that the biphasic response and the slow time scale can be reproduced when a calcium feedback based on calcium regulation mechanism of the cell is introduced. Furthermore, this model can also reproduce the nonlinear dynamical properties of the system; such as the period doubling in the response of the contractile forces during a step change in the pacing period. The force frequency relation curve generated by the model also compare well with previous published data. Our findings suggest that the feedback is really needed to understand the calcium transient when pacing frequency is changed and the calcium regulation is very important for the calcium handling of cardiac myocytes.

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