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Motion artifact removal in the optical mapping of cardiac tissue GISA E. LUTHER, AMGAD SQUIRES, MICHAEL W. ENYEART, ROBERT F. GILMOUR, EBERHARD BODENSCHATZ, STEFAN LUTHER, Department of Biomedical Sciences, Cornell University, NY, and Max Planck Institute for Dynamics and Self-Organization, Goettingen, Germany — Optical mapping provides measurements of the transmembrane potential in cardiac tissue with high spatial and temporal resolution using voltage senitive dye. However, the contractile motion of cardiac tissue causes substantial artifacts in optical recordings. On the other hand, mechanical or pharmacological inhibition of motion is known to promote ischemia or alter the electrophysiological properties of the tissue and therefore limits the application of the optical mapping technique. Motion artifacts arise due to two dominant mechanisms: (a) Relative motion of the tissue with respect to the optical imaging system or the fiber optical probe. (b) Change of the optical properties of the tissue and of the dye associated with the variation of the tissues mean density. We present a novel model based algorithm, which accounts for both mechanisms. It combines a Lukas-Kanade feature tracking with two-wavelength ratiometric imaging. The robustness and accuracy of this approach is validated using numerical and experimental data. Our approach allows to rephrase the contamination of the signal with motion artifacts as a nonlinear mixing process. De-mixing the signal opens the perspective of retrieving information on both the transmembrane potential and contractile force.

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