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Modeling studies of induced internal transmembrane potentials and molecular motors in live cells VIJAYANAND VAJRALA, University of Houston, JAMES CLAYCOMB, Houston Baptist University, JOHN MILLER, University of Houston — Many cellular functions, including motility and receptor regulation, can be affected by applied electric fields, which perturb the transmembrane potentials across the plasma, mitochondrial, and nuclear membranes. We use the finite element method (FEM) to model the electromagnetic responses of the cell, cytoplasm, and intracellular membranes. In addition, we utilize Brownian ratchet models of molecular motors, notably the F0 subunit of ATP synthase, in order to interpret recently observed nonlinear response data. This remarkable molecular turbine is driven by the potential across the mitochondrial inner membrane. Induced changes in potentials across the plasma and mitochondrial membranes, exposed to various applied field amplitudes and frequencies, are studied in detail. The spatial variations of the transmembrane potentials are modeled for spheroidal, weakly conducting membrane shells enclosing a conductive cytoplasm with internal organelles. The modeling studies discussed here are compared to nonlinear harmonic response measurements of live cells.

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