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Computationally Efficient Method of Simulating Creation of Electropores JOHN NEU, University of California, Berkeley, WANDA KRASSOWSKA, Duke University — Electroporation, in which electric pulses create transient pores in the cell membrane, is an important technique for drug and DNA delivery. Electroporation kinetics is described by an advection-diffusion boundary value problem. This problem must be solved numerically with very small time and space steps, in order to resolve very fast processes occurring during pore creation. This study derives a reduced description of the pore creation transient. This description consists of a single integrodifferential equation for the transmembrane voltage V(t) and collateral formulas for computing the number of pores and the distribution of their radii from V(t). For pulse strengths corresponding to those used in drug and DNA delivery, relative differences in predictions of the reduced versus original problem are: voltage V(t), below 1%; number of pores, below 10%; pore radii, below 6%. Computational efficiency increases with the number of pores and thus with the pulse strength. For the strongest pulses, the run time of the reduced problem was below 1% of the original one. Such time savings can bridge the gap between problems that can be simulated on today's computers and problems that are of practical importance.

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