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A stochastic model for DNA electrotransfer with finite pulses MIAO YU, HAO LIN, Rutgers University — Gene electrotransfer is a non-viral method to introduce foreign DNA into cells using electric fields. The fundamental mechanism for DNA transfer is unknown and under debate. While previous research investigated the role of DNA-membrane interaction and endocytosis, we here explore electrophoresis as a possible mechanism to assist translocation. In this model, DNA strands are treated as long-chain polymers driven through pores on the cell membrane by applied electric fields. A stochastic model is constructed, and solved numerically to parametrically study the time process of DNA translocation. Numerical results indicate that there exists an optimal pulse length beyond which DNA delivery probability no longer increases. The optimal length correlates inversely with applied field strength, and increases nonlinearly with DNA length. The results show good agreement with data from both solid-state nano-pore and electroporation experiments, and suggest that electrophoresis may play a key role in electroporation-mediated gene delivery.

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