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Modeling the trajectory of Microparticles subjected to dielectrophoresis in a microfluidic device for field flow fractionation

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Abstract: This article details the development of an experimentally validated model for tracking the movement of microparticles in a continuous flow microfluidic device employing dielectrophoresis for purposes of field-flow fractionation. This device employs interdigitated transducer electrodes on the bottom surface of the microchannel. The electric potential inside the microchannel is defined by Laplace equation while the trajectory of the microparticles is described by governing equations based on Newton's second law. Forces due to inertia, gravity, buoyancy, dielectrophoresis and virtual mass are accounted for in this model. The governing equations are solved using finite difference method. The model is subsequently used for parametric study; the parameters analyzed include microparticle radius, applied voltage, volumetric flow rate, microchannel height and electrode/gap length. As per the model the levitation height, under steady state conditions, of the microparticles is independent of the microparticle radius, volumetric flow rate and microchannel height, it is dependent on the applied voltage and electrode/gap length. The levitation height, under transient conditions, is dependent on all these parameters.