Numerical simulation of the deformation and motion of a droplet under electric field using the level set method

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In microfluidics devices, fluid can be transported in a continuous or a digital fashion. In the latter cases, droplets are used for applications raging from a microarray to a drug delivery system owing to some nice properties. Droplets can be moved, deformed, split, and fused depending on the forces exerted on the droplet surfaces. For successful design of such a microfluidics system, it is required to predict motion and deformation of a droplet accurately. In the present work, presented are the numerical results on the deformation and motion of a liquid droplet subject to a uniform electric field. Direct numerical simulations are performed taking into account both the hydrodynamic and electrostatic forces exerted on the drop surface. The governing equations are solved for the flow field and the electric field by using the drop shapes that are determined by the stress balances and the kinematic condition. For an efficient and accurate determination of drop shape, the level set method is adopted along with the application of the kinematic condition.