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Numerical and asymptotic analysis of an electrified jet[1] SANTIAGO E. IBÁÑEZ, F.J. HIGUERA, ETS Ingenieros Aeronauticos, UPM, Madrid, Spain — A numerical study is presented of a liquid jet of finite electrical conductivity issuing at a constant flow rate from a metallic capillary set at a high voltage relative to a distant electrode. The electric field due to the applied voltage induces a conduction current in the liquid that accumulates electric charge at its surface and gives rise to electric stresses that stretch the jet. A quasi-unidirectional model of the flow is proposed and boundary elements and finite difference methods are used to compute the electric field, the flow of the liquid and the distribution of surface charge as functions of the applied voltage, the flow rate and the physical properties of the liquid. Asymptotic results for large and small values of the flow rate are worked out. At small values of the flow rate, the electric current increases as the square root of the flow rate and the surface of the liquid resembles a cone followed by a thin jet. The electric field at the surface attains a maximum in a certain current transfer region where convection of the surface charge becomes the dominant contribution to the electric current. At large values of the flow rate, the electric current and the length of the current transfer region become independent of the flow rate.

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