Non-linear numerical study of 2D electroconvection between parallel plates

P.A.Vázquez*, A.T. Pérez, P. Traoré, J. Wu
University of Seville
e-mail: pvazquez@us.es

***Abstract* — The electroconvection in a perfectly insulating liquid between two infinite parallel plates is a classical EHD problem. When an electric potential high enough is applied between the electrodes, injection of charge occurs at one of the electrodes. The electric force pushes the charges and the liquid is set into motion for a value of a stability parameter above a linear threshold Tc. This linear stability problem has been studied experimentally, analytically [1] and numerically extensively. If the electric potential is increased beyond the value corresponding to the linear stability parameter, we enter the non-linear regime. The weakly non-linear regime was studied analytically by Atten and Lacroix[2]. The highly non-linear regime has been analysed using different numerical methods in several papers [3-5]. In this work we study present some results about the highly non-linear regime of the problem. If the applied potential is further increased, several bifurcations appear and the flow pattern changes accordingly. Depending on the value of the ionic mobility, different branches may appear. We present a map of these non-linear branches for several values of different parameters. References 1. Stabilité électrohydrodynamique des liquides isolants soumis à une injection unipolaireJournal de Mécanique, 11, pp. 471-520, (1972) 2. Non-linear hydrodynamic stability of liquids subjected to unipolar injection, Journal de Mécanique, 18(3), pp. 469-510, (1979) 3 Numerical modelling of Coulomb-driven convection in insulating liquids, Journal of Fluid Mechanics, 344, pp. 43-66, (1997) 4. Two-dimensional numerical analysis of electroconvection in a dielectric liquid subjected to strong unipolar injection, Physics of Fluids, 24(3), pp 037102, (2012) 5. Numerical simulation of {EHD} flows using Discontinuous Galerkin Finite Element methods, 84, pp 270-278 (2013)**