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Suitability of commercial software for direct numerical simulations of chaotic electrokinetic transport[1] ELIF KARATAY, ALI MANI, Stanford Univ — Many microfluidic and electrochemical applications involve chaotic transport phenomena that arise due to instabilities stemming from coupling of hydrodynamics with ion transport and electrostatic forces. Recent investigations have revealed contribution of a wide range of spatio-temporal scales in such chaotic systems similar to those observed in turbulent flows. Given that these scales can span several orders of magnitude, significant numerical resolution is needed for accurate prediction of these phenomena. The objective of this work is to assess efficiency of commercial software for prediction of such phenomena. To this end we have considered Comsol Multiphysics as a general-purpose commercial CFD/transport solver, and have compared its performance against a custom-made DNS code tailored to the specific physics of chaotic electrokinetic phenomena [1]. We present comparison for small systems, which can be simulated on a single core, and show detailed statistics including velocity and concentration spectra over a wide range of frequencies. Our results indicate that while accuracy can be guaranteed with proper mesh resolution, commercial solvers are generally at least an order of magnitude slower than custom-made DNS codes.

[1] Druzgalski, Andersen, and Mani, Phys. Fluids 25, 1

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