Unsteady flow near front and rear stagnation points DMITRY KOLOMENSKIY, CERFACS, Toulouse, France, KEITH MOFFATT, DAMTP, University of Cambridge, UK, MARIE FARGE, LMD-IPSL-CNRS, ENS Paris, France, KAI SCHNEIDER, M2P2-CNRS and Aix-Marseille University, France — We consider unsteady flows near stagnation points on a cylindrical body immersed in a viscous incompressible fluid. This problem admits similarity solutions, assuming a hyperbolic time evolution of the free-stream velocity. These are exact solutions of the Navier–Stokes equations, having a boundary-layer character similar to that of classical steady forward stagnation-point flow. The velocity profiles are obtained by numerical integration of a non-linear ordinary differential equation. A wide range of possible behaviour is revealed, depending on whether the flow in the far field is accelerating or decelerating, and depending on the flow direction. For the forward-flow situation, the solution is unique for the accelerating case, but bifurcates for modest deceleration, while for sufficient rapid deceleration there exists a one-parameter family of solutions. For the rear-flow situation, a unique solution exists (remarkably!) for sufficiently strong acceleration, and a one-parameter family again exists for sufficient strong deceleration.

Dmitry Kolomenskiy
CERFACS, Toulouse, France