Rough dependence upon initial data exemplified
by explicit solutions and the effect of viscosity

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Abstract. We present some interesting non-steady explicit solutions to the
2D Euler and Navier-Stokes equations. Explicit calculations on the explicit
solutions show that Navier-Stokes (and Euler) equations have the novel property
of rough dependence upon initial data in contrast to the sensitive dependence
upon initial data found in chaos. Through the explicit calculations, we are able
to obtain a lower bound on the norm of the Fréchet derivative of the solution
operator at the explicit solutions to the Navier-Stokes equations. The lower
bound approaches infinity as the Reynolds number approaches infinity. For
Euler equations, this lower bound is indeed infinity. The rough dependence
property in the inviscid case is closely related to the theorem of Cauchy. The
viscous effect on the theorem of Cauchy and the rough dependence property is
also studied.