Uncertainties in Oseen Linearizations as Smooth Coprime Factor Perturbations

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Linearization based controllers for incompressible flows have been proven to work in theory and in simulations. To realize such a controller numerically, the infinite dimensional system has to be linearized and discretized. The unavoidable consistency errors add a small but critical uncertainty to the controller model which will likely make it fail, especially when an observer is involved. Standard robust controller designs can compensate small uncertainties if they can be qualified as a coprime factor perturbation of the plant. We show that for the linearized Navier-Stokes equations, a linearization error can be expressed as a coprime factor perturbation and that this perturbation smoothly depends on the size of the linearization error. In particular, improving the linearization makes the perturbation smaller so that, eventually, standard robust controller will stabilize the system.