Numerical Aspects of the Implementation of Artificial Boundary Conditions for Laminar Fluid-Structure Interactions

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Abstract

We discuss artificial boundary conditions for stationary Navier-Stokes flows past bodies in the half-plane, for a range of low Reynolds numbers. When truncating the half-plane to a finite domain for numerical purposes, artificial boundaries appear. We present an explicit Dirichlet condition for the velocity at these boundaries in terms of an asymptotic expansion for the solution to the problem. We show a substantial increase in accuracy of the computed values for drag (Figure 1) and lift (Figure 2) when compared with results for traditional boundary conditions. We also analyze the qualitative behavior of the solutions in terms of the streamlines of the flow (Figure 3). The new boundary conditions are universal in the sense that they depend on a given body only through one constant, which can be determined in a feed-back loop as part of the solution process.

Figures used in the abstract

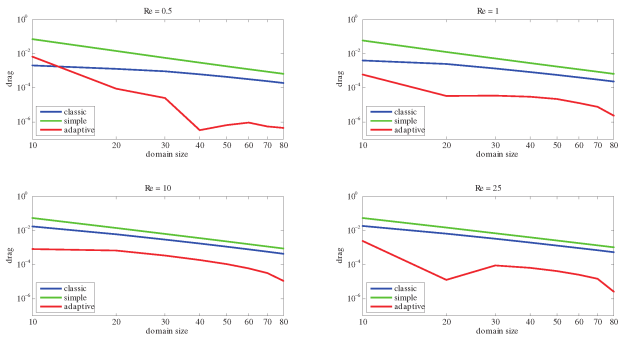

Figure 1: Error on drag.

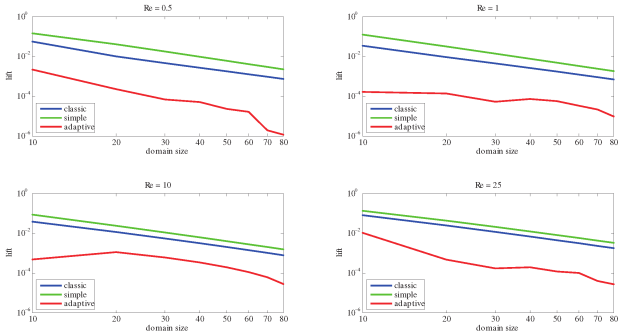

Figure 2: Error on lift.

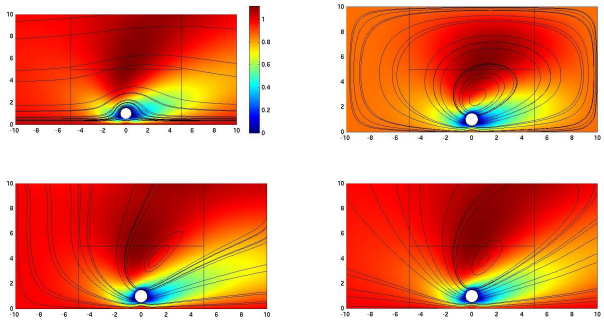

Figure 3: Qualitative behavior based on b.c. type.