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Time-Adaptive Splitting Schemes for the Incompressible Navier-Stokes Equations

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ABSTRACT

In some applications of incompressible fluid dynamics, fast transients are present only in some periods of the overall time interval of interest. This is the case of blood flow problems, where the periodic action of the heart is split into two parts, called *systole* and *diastole* respectively. During systole, the heart contracts, the aortic valve is open and the blood is thrusted fastly into the arterial system. During diastole the aortic valve is closed and blood dynamics is essentially driven by vessel compliance (see Fig. 1 and, e.g., [1]).

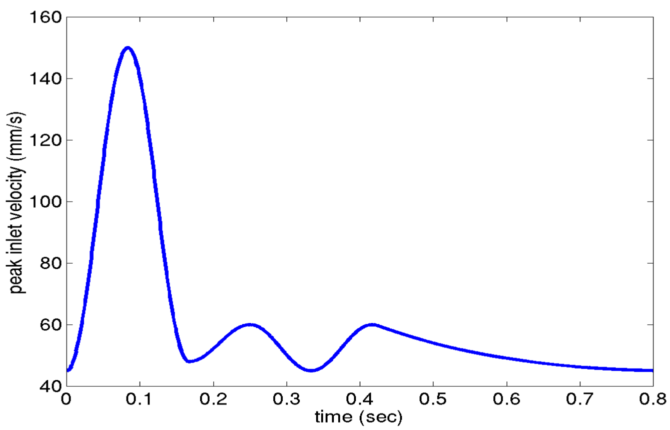

Figure 1: Sequence of Systole and Diastole in a heart beat on the time evolution of maximum velocity at the inflow of a carotid artery.

Presence of fast transients requires therefore to use small time steps for solving the incompressible Navier-Stokes equations. Intrinsic computational costs of this solver are replicated at each time step.

Computational costs reduction can be obtained by splitting the problem into an appropriate sequence of subproblems involving velocity and pressure separately. There are different approaches for pursuing this aim. In particular, in [2] it is presented a class of splitting schemes featuring second and third order time accuracy. The hierarchical structure of these schemes is prone to the definition of an effective time-error estimator, that can be used for furtherly reduce computational costs in a time-adaptive framework.

In this talk we present preliminary results about this time-adaptive splitting scheme.

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