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ON THE DESIGN OF FRACTIONAL STEP METHODS FOR FLOW PROBLEMS—APPLICATION TO VISCOELASTIC FLOWS AND COMPRESSIBLE FLOWS

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Classical fractional step methods for viscous incompressible flows aim to uncouple the calculation of the velocity and the pressure. In the case of viscoelastic flows, a new variable appears, namely, a stress, which has an elastic and a viscous contribution. In the case of compressible flows written in primitive variables, also the temperature needs to be taken into account. The purpose of this article is to present a family of fractional step methods for the time integration of this type of flows whose objective is to permit the uncoupled calculation of velocities and the rest of variables, these methods being designed at the algebraic level. This means that the splitting of the equations is introduced once the spatial and the temporal discretizations have been performed. This family of methods is based on the extrapolation of all variables except the velocity to predict this velocity, then a calculation of the variables that have been extrapolated and finally a correction of the velocity to render the scheme stable. This work presents an overview of methods previously proposed in our group, applied in particular to compressible flows [1, 2, 3] and to viscoelastic flows [4, 5].

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