A Half-Explicit, Non-Split Projection Method for Low Mach Number Flows

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In the context of the direct numerical simulation of low MACH number reacting flows, the aim of this presentation is to propose a new approach based on the integration of the original differential algebraic (DAE) system of governing equations, without further differentiation. In order to do so, while preserving a possibility of easy parallelization, it is proposed to use a one-step index 2 DAE time-integrator, the Half Explicit Method (HEM). In this context, we recall why the low MACH number approximation belongs to the class of index 2 DAEs and discuss why the pressure can be associated with the constraint. We then focus on a fourth-order HEM scheme, and provide a formulation that makes its implementation more convenient. Practical details about the consistency of initial conditions are discussed, prior to focusing on the implicit solve involved in the method. The method is then evaluated using the Modified KAPS Problem, since it has some of the features of the low MACH number approximation. Numerical results are presented, confirming the above expectations. A brief summary of ongoing efforts is finally provided.