Split and Unsplit Methods for Advection-Diffusion-Reaction Equations

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Fractional step or time-split methods often provide an effective means of solving equations that combine hyperbolic and parabolic terms along with potentially stiff reaction terms. By alternating between solving various subproblems, it is possible to use optimal methods for each piece. In some cases, however, special care must be used to choose methods which combine well together. In other cases, specialized unsplit methods are much more successful. I will discuss some examples arising in specific applications, from chemotaxis to detonation.