Einladung zum
Vortrag

Advances in Computational Mechanics

John N. Shadid, PhD
Computational Science Research & Development Group
Sandia National Laboratories, Albuquerque, USA

Accuracy and Stability of Operator Splitting Methods Applied to Diffusion/Reaction and Convection / Diffusion / Reaction Systems with Indefinite Operators

In this talk numerical results are reviewed that demonstrate that common second-order operator-splitting methods can exhibit subtle instabilities for diffusion/reaction and convection/diffusion/reaction systems. Our main interest is in evaluating the relative accuracy and asymptotic order of accuracy of methods on problems which exhibit an approximate balance between competing component time scales. Nearly balanced systems can produce a significant coupling of the physical mechanisms and introduce a slow dynamical time scale of interest. These problems provide a challenging test for this evaluation and tend to reveal subtle differences between the various methods.

The methods we consider include first- and second-order semi-implicit, fully implicit, and operator-splitting techniques. The test problems include a prototype propagating nonlinear diffusion/reaction and convection/diffusion/reaction wave, a Brusselator chemical dynamics system and a simplified convection/diffusion/reaction model of a chemotaxis problem. In this paper, we further analyze the operator splitting methods, and present a theorem for A-stability of operator-splitting methods applied to linear diffusion/reaction and convection/reaction/diffusion equations with indefinite reaction terms which controls both low and high wave number instabilities.

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Seminarraum LNM
MW 1237

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