

Numerical analysis of a reaction-diffusion-convection system

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Abstract:

This paper is concerned with the numerical analysis of the behavior of a homogeneous tubular reactor in which a cubic autocatalytic reaction is coupled to diffusion and convection transport. The set of one-dimensional partial differential equations describing the reaction-diffusion-convection system is analyzed using different standard reduction techniques (finite difference, orthogonal collocation, and finite element methods) within the framework of the method of lines. Both steady state and dynamic behaviors of the system are considered. Special high-resolution finite difference methods such as essentially non oscillatory (ENO) and total variation diminishing (TVD) are applied to the convectively dominant case. The calculation results that special high-resolution schemes such as ENO are essential to track efficiently steep moving fronts exhibited by the strongly convective problems. The strengths and limitations of the different numerical schemes considered are examined and discussed.

Keywords: [Reaction-Diffusion-Convection](#); [Mathematical modeling](#); [Dynamic simulation](#); [Model reduction](#); [Nonlinear dynamics](#); [ENO](#); [TVD](#)

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