Unconditionally positive finite difference and standard finite difference schemes for advection–diffusion reaction equations

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Abstract

A recently reported unconditionally-positive finite difference (UPFD) [1] and the standard explicit finite difference (EFD) schemes are compared to the analytical solution of the advection-diffusion reaction equation which describes the exponential traveling wave. It is found that although the unconditional positivity assures stability of the UPFD scheme regardless of the size of the discretization steps taken, this scheme is less accurate than the standard explicit finite difference scheme. This is because the UPFD scheme contains additional truncation-error terms in the approximations of the first and second derivatives with respect to x, which are evaluated at different moments in time. While these terms tend to zero as the mesh is refined, the UPFD scheme nevertheless remains less accurate than its standard explicit finite difference counterpart.

Keywords: advection-diffusion reaction equation, exponential traveling wave, finite difference schemes

References

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