Conference in Numerical Analysis 2014 (NumAn 2014)
September 2-5, 2014
Chania,Greece

Strong-stability-preserving additive linear multistep methods

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Abstract

Semi-discretization of a variety of partial differential equations results in ordinary differential systems containing terms with different stiffness properties. In such cases additive methods can be used to make the most of the special structure of the resulting system. We study the monotonicity properties of additive linear multistep methods. We show that for a fixed number of steps and order of accuracy, optimal strong-stability-preserving (SSP) additive methods attain the same time-step restriction as the optimal SSP linear multistep methods, regardless of the stiffness of the problem. The concept of SSP linear multistep methods is also extended to problems for which the upwind- and downwind-biased operators have different stiffness properties.

Key words: strong-stability-preservation (SSP), monotonicity, linear multistep methods, time integration