PHASE SPACE THETA ERROR CONTROL WITH GENERAL EXPLICIT RUNGE KUTTA METHODS FOR DYNAMICAL SYSTEMS

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Variable time-stepping algorithms are often used to solve the dynamical systems, defined by autonomous initial value ordinary differential equations $y_t = f(y), \quad y(0) = y^0 \in \Re^m$, where $f : \Re^m \to \Re^m$ is a Lipschitz continuous function. Standard adaptive algorithms used to solve the above system, performed well during the finite time integration with fixed initial conditions. However, these methods performed poorly in three areas; stable fixed points, in spurious fixed points and near saddle points and hence, new Phase Space error control was introduced. A generalized Phase Space Theta error control had been introduced by other researchers. This error control had been analysed only for forward Euler method applied to the linear systems, whose coefficient matrices had both real and negative eigenvalues, and complex eigenvalues with negative real parts with new step-size selection strategy. In this study, we established new theoretical results for general s-stage explicit Runge-Kutta methods, applied to the linear systems, whose coefficient matrices had real negative eigenvalues under this Phase Space Theta error control. It is to be emphasized that, the step-size selection strategy used in this study is entirely satisfactory. The present results are more general than those obtained for forward Euler method used by others. Further, the results of this study confirm several numerical experiments.

Keywords: Adaptive, Fixed point, Linear systems, Phase space theta error control.

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