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Runge–Kutta Restarters for Multistep Methods in Presence of Frequent Discontinuities

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Abstract

Differential equations with discontinuities or differential equations coupled to discrete systems require frequent re-initializations of the numerical solution process. The classical starting process of multistep methods, based on winding-up the order in the initialization phase, is computationally expensive when frequent discontinuities occur. Instead we propose to use the stage values or weight vectors of these specially constructed explicit Runge–Kutta methods for starting processes. Two practical examples demonstrate these methods.

Keywords:. Multistep methods, Runge–Kutta methods, Discontinuities, Error estimation

1. Introduction

The overall performance of the simulation of models with discontinuities depends strongly on the methods for restarting the integration after an event detection. Initialization of k-step methods requires k starting values.

There are three alternative starting strategies for obtaining the initial values; however, only two of these starting schemes have been implemented and tested. The first strategy is to apply a high order Runge–Kutta (RK) method repeatedly to generate the starting values. This requires several costly evaluations of the equation. The second one is to approximate the required starting

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