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Minimal Truncation Error Constants for Symplectic Partitioned Runge-Kutta Method for Stochastic Optimal Control Problems

Gerhard-Wilhelm WEBER [1]✉, Hacer ÖZ BAKAN [2], Fikriye Nuray YILMAZ [3]

[1] *Institute of Applied Mathematics, Middle East Technical University, Ankara, Turkey*
[2] *Department of Mathematics, Atılım University, Ankara, Turkey*
[3] *Department of Mathematics,Gazi University, Ankara, Turkey*

Abstract

In this study, we contribute to an emerging area of applied mathematics which very closely related to the real-world areas of Finance, Economics, Biology, Medicine, Operational Research and Social Sciences. These problems are characterized by stochastic fluctuatcion depending on time, given in terms of stochastic processes, and governed by optimization and control, we say: stochastic optimal control. Actually, we are interested in most advanced algorithmical solution techniques of such challenging problems.

We derive the strong order-1 conditions with minimal local truncation error constants of the symplectic partitioned Runge-Kutta (SPRK) scheme for the stochastic optimal control problems. For this reason, we compare Stratonovich-Taylor expansion of the exact solution and Stratonovich-Taylor expansion of the approximation method defined by the SPRK scheme successively. Then, we find additional strong order-1 conditions with minimal local truncation error constants to the classical Runge-Kutta schemes for stochastic differential equations (SDEs). Therefore, by choosing the step-size *h* small enough, the accuracy of the scheme is obtained. We confirm our results in a numerical application.

Our presentation ends with a conclusion and an outlook to future works on both scientific research challenges and real-life implementations.

Keywords: *Optimal control, stochastic differential equations, symplectic partitioned Runge-Kutta method*

✉ *Corresponding Author Email: gweber@metu.edu.tr*