

# **Numerical study of third-order ordinary differential equations using a new class of two derivative Runge-Kutta type methods**

## **ABSTRACT**

This study introduces new special two-derivative Runge-Kutta type (STDRKT) methods involving the fourth derivative of the solution for solving third-order ordinary differential equations. In this regards, rooted tree theory and the corresponding B-series theory is proposed to derive order conditions for STDRKT methods. Besides, explicit two-stages fifth order and three-stages sixth order STDRKT methods are derived and stability, consistency and convergence of STDRKT methods are analysed in details. Accuracy and effectiveness of the proposed techniques are validated by a number of various test problems and compared to existing methods in the literature.

**Keyword:** Runge-Kutta type methods; B-series; Rooted tree; Third-order ordinary differential equations; Algebraic order