On two derivative Runge-Kutta type methods for solving u''' = f (x, u(x)) with application to thin film flow problem

ABSTRACT

A class of explicit Runge–Kutta type methods with the involvement of fourth derivative, denoted as two-derivative Runge–Kutta type (TDRKT) methods, are proposed and investigated for solving a special class of third-order ordinary differential equations in the form $u'''(x)=f(x,u(x))$. In this paper, two stages with algebraic order four and three stages with algebraic order five are presented. The derivation of TDRKT methods involves single third derivative and multiple evaluations of fourth derivative for every step. Stability property of the methods are analysed. Accuracy and efficiency of the new methods are exhibited through numerical experiments.

Keyword: Runge–Kutta type methods; Third-order ordinary differential equations; Algebraic order; Stability property; Rooted-tree