A three-stage fifth-order Runge-Kutta method for directly solving special third-order differential equation with application to thin film flow problem

ABSTRACT

In this paper, a three-stage fifth-order Runge-Kutta method for the integration of a special third-order ordinary differential equation (ODE) is constructed. The zero stability of the method is proven. The numerical study of a third-order ODE arising in thin film flow of viscous fluid in physics is discussed. The mathematical model of thin film flow has been solved using a new method and numerical comparisons are made when the same problem is reduced to a first-order system of equations which are solved using the existing Runge-Kutta methods. Numerical results have clearly shown the advantage and the efficiency of the new method.