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A Family of Second Derivative Methods for Numerical Integration of Stiff Initial Value Problems in Ordinary Differential Equations

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Abstract : Stiff initial value problems in ordinary differential equations are problems for which a typical solution is rapidly decaying exponentially, and their numerical investigations are very tedious. Conventional numerical integration solvers cannot cope effectively with stiff problems as they lack adequate stability characteristics. In this article, we developed a new family of four-step second derivative exponentially fitted method of order six for the numerical integration of stiff initial value problem of general first order differential equations. In deriving our method, we employed the idea of breaking down the general multi-derivative multistep method into predator and corrector schemes which possess free parameters that allow for automatic fitting into exponential functions. The stability analysis of the method was discussed and the method was implemented with numerical examples. The result shows that the method is A-stable and competes favorably with existing methods in terms of efficiency and accuracy.

Keywords : A-stable, exponentially fitted, four step, predator-corrector, second derivative, stiff initial value problems
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