Two step optimized hybrid methods for the integration of highly oscillatory systems of ODEs

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The use of collocation process for constructing numerical methods for solving ordinary differential equations has been attractive for stiff and problems with highly oscillatory solutions. In this paper, a class of block hybrid collocation methods has been developed which can efficiently solve stiff and highly oscillatory differential equations in block solution form. The block hybrid collocation methods are derived based on collocation at the polynomial nodes which are very effective for solving highly oscillatory systems. The block solution methods arising from the continuous formulation are discussed for various examples with applications. The methods are self-starting and produce dense output within the integration interval. The convergence of the derived methods is determined theoretically and asymptotic error constants are calculated. Improved performance over some known standard methods is achieved for a broad class of problems with oscillating solutions. Preliminary numerical calculations using our new methods clearly show improved performance, efficiency and effectiveness of the derived methods compared to some methods with strong algebraic stability property. Efficiency curves of the solutions plotted show rapid convergence of the proposed second-derivative block hybrid collocation methods.
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