Exponentially Fitted Second Derivative Adams Bashfort Methods for the Numerical Integration of Oscillatory Ordinary Differential Equations

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Abstract

This study developed a new class of Exponentially Fitted second-Derivative Adams–Bashforth (EFSEDAB) methods for the numerical integration of second-order ordinary differential equations with oscillatory solutions was developed. The schemes were developed using the Ixaru six-step flowchart procedure by incorporate exponential fitting to capture properly the intrinsic frequency of oscillatory problems. The procedure yielded EFSEDAB1 and EFSEDAB2) methods for k=2,3.The convergence analysis of the new integration methods carried shows they are zero-stable, consistent, hence convergent and of order p=2k-1. The stability plots of the new methods show they are A-stable and suitable for oscillatory systems, providing improved phase properties over standard methods. The new EFSEDAB methods applied to oscillatory initial value problems of ordinary differential equations reveals their efficiency and accuracy in comparison to the classical Adams–Bashforth methods and other known numerical methods in the Literature.

Keywords

Second-order ordinary differential equations, exponentially fitted methods, oscillatory IVPs, second-derivative schemes, Adams–Bashforth methods, phase accuracy.