

Formulation of a new implicit method for group implicit BBDF in solving related stiff ordinary differential equations

ABSTRACT

This paper proposed a new alternative approach of the implicit diagonal block backward differentiation formula (BBDF) to solve linear and nonlinear first-order stiff ordinary differential equations (ODEs). We generate the solver by manipulating the numbers of back values to achieve a higher-order possible using the interpolation procedure. The algorithm is developed and implemented in C++ medium. The numerical integrator approximates few solution points concurrently with off-step points in a block scheme over a non-overlapping solution interval at a single iteration. The lower triangular matrix form of the implicit diagonal causes fewer differentiation coefficients and ultimately reduces the execution time during running codes. We choose two intermediate points as off-step points appropriately, which are proven to guarantee the method's zero stability. The off-step points help to increase the accuracy by optimizing the local truncation error. The proposed solver satisfied theoretical consistency and zero-stable requirements, leading to a convergent multistep method with third algebraic order. We used the well-known and standard linear and nonlinear stiff IVP problems used in literature for validation to measure the algorithm's accuracy and processor time efficiency. The performance metrics are validated by comparing them with a proven solver, and the output shows that the alternative method is better than the existing one.

Keyword: Implicit method; Off-step; Stiff problems