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Imaginary Axis Coverage of the Stability Domains of Adams Multistep Methods.

Multistep methods are one method used for approximating solutions to ordinary differential equations; the Adams methods are one kind of multistep method. Stability domains tell for a given method what eigenvalues and stepsizes in time will lead to stable solutions. In this project, we have explored for which orders the stability domain of various kinds of Adams methods contains part of the imaginary axis, which corresponds to the method being useful for approximating solutions with wavelike behavior. We observe an interesting pattern: all kinds of Adams methods have imaginary axis coverage of the stability domain only for either orders 3, 4, 7, 8, ... or for orders 1, 2, 5, 6, ... This includes Adams-Bashforth (AB), Adams-Moulton (AM), staggered AB, and, the subject of our latest work, two classes of predictor-corrector methods: AB-AM, both of the same order and with orders off by one. Our proof of these results for all orders requires the use of asymptotics, complex variables, number theory, Lagrange interpolating polynomials, the Binomial Theorem, and mathematical induction. (Received September 20, 2007)