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A Robust Integration Method for Stiff Transport Equations JOSE ESCOBAR, ISMAIL CELIK, West Virginia University — Numerical simulation of reactive flows is one of the most difficult problems in Computational Fluid Dynamics (CFD). The difficulties are mainly due to the wide range of characteristic time scales present in the mass production/consumption sources which lead to a stiff system of governing equations. Classical integration methods such as explicit Euler method are restricted by the smallest characteristic time scale, and the explicit Runge-Kutta (RK) methods require intermediate predictor-corrector steps which make the problem computationally expensive. Implicit methods are also computationally expensive due the calculation of the Jacobian which makes their implementation difficult for reactive systems with tens of chemical species and hundreds of reactions. The current study explores the possibility of solving the transport equations for species concentrations faster than the standard methods without compromising accuracy. The present approach is based on transformation of the variable of interest using the hyperbolic tangent function. The proposed transformation also has the advantage of ensuring that the value of the variable of interest to be always in the range from zero to one, which is highly desirable when solving for specie mass or molar fractions. The possibility of using much larger time steps compared to the classical methods is an additional advantage.

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