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Solving Atmospheric Chemical Kinetics with an Integration-Based Physics-Informed Randomized Neural Network

Communication Info

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Abstract

Atmospheric chemical kinetics leads to stiff systems of ordinary differential equations due to strongly coupled reactions and widely separated time scales. In this work, we consider a reduced subset of the Regional Atmospheric Chemistry Mechanism (RACM) and model the kinetics using a production–loss formulation $dC/dt=P(t,C)-L(t,C)C$.

We propose an Integration-Based Physics-Informed Randomized Neural Network (IPIRNN) to approximate the solution over successive time intervals by enforcing the governing dynamics and initial conditions through residual minimization. The study is designed to evaluate accuracy, stability, and computational cost by comparison with a reference stiff integrator (implicit Radau) on representative RACM-based test configurations.

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