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A GPU-based High-order Multi-resolution Framework for Compressible Flows at All Mach Numbers CHRISTOPHER J. FORSTER, Georgia Institute of Technology, Sandia National Laboratories, MARC K. SMITH, Georgia Institute of Technology — The Wavelet Adaptive Multiresolution Representation (WAMR) method is a general and robust technique for providing grid adaptivity around the evolution of features in the solutions of partial differential equations and is capable of resolving length scales spanning 6 orders of magnitude. A new flow solver based on the WAMR method and specifically parallelized for the GPU computing architecture has been developed. The compressible formulation of the Navier-Stokes equations is solved using a preconditioned dual-time stepping method that provides accurate solutions for flows at all Mach numbers. The dual-time stepping method allows for control over the residuals of the governing equations and is used to complement the spatial error control provided by the WAMR method. An analytical inverse preconditioning matrix has been derived for an arbitrary number of species that allows preconditioning to be efficiently implemented on the GPU architecture. Additional modifications required for the combination of wavelet-adaptive grids and preconditioned dual-time stepping on the GPU architecture will be discussed. Verification using the Taylor-Green vortex to demonstrate the accuracy of the method will be presented.

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