A New Theory for One-Dimensional Adaptive Grid Generation and its Applications

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The theory of a new approach to adaptive grid generation in one dimension is developed. The approach is based on approximating either the resolution or the grid spacing ratio on discrete lattice points by continuous variables. The order of accuracy of these approximations in a suitable reference frame characterizes the various methods. Approximations that are first- or second-order accurate in a suitable reference coordinate are derived in this paper. The free parameters associated with these methods provide flexibility in generating a large family of adaptive grids with smooth grid spacing ratio and high resolution. A selected group of this family of adaptive grids may prove very useful in adaptive computations of partial differential equations. The adaptive grids are numerically generated using these approximations. Numerical examples are given that exemplify the usefulness of these adaptive grids.

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