A Nonlinear Piecewise Bicubic Interpolation Method for Cell-Averaged Data on Regular Grids

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In many scientific and engineering applications, data is available as cell averages rather than point values, requiring specialized interpolation techniques for accurate reconstruction. This paper presents a nonlinear piecewise bicubic interpolation algorithm tailored for cell-averaged data on regular rectangular grids. Inspired by the Weighted Essentially Non-Oscillatory (WENO) methodology, the approach constructs local polynomial reconstructions by estimating first-order and mixed partial derivatives from cell averages. The resulting piecewise bicubic interpolant achieves high-order accuracy in smooth regions while avoiding spurious oscillations near discontinuities. Unlike classical bicubic methods, which rely on exact pointwise values and may suffer from Gibbs phenomena, our algorithm provides a robust and flexible solution that is well suited for applications in image processing and numerical simulations. Numerical experiments demonstrate the method's effectiveness in preserving fine-scale features and reducing interpolation artifacts, with performance comparable to or better than existing point-based WENO schemes.

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