

Radial Basis Function-Generated Finite Differences (RBF-FD): New Computational Opportunities in the Geo-Fluid Modeling

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A novel numerical approach, based on radial basis function-generated finite differences, is presented for modeling a wide array of geo-fluid flows. Due to its independence of any grids or mappings for irregular geometries (as is needed with finite difference, volume or element methods), where the physics is resolved can be directly connected to where the observational data is sampled. As a result, it gives far better physical representations than any other methods at coarser resolutions, allowing the data to be better assimilated for initialization of models. It combines high levels of accuracy with complete geometric flexibility, essential for local refinement needed to follow complex features in the flow. In recent benchmarking tests on the three dominant architectures composing high-performance computing systems today, Intel Multicore, Manycore and Nvidia GPUs, it has demonstrated excellent performance due to the very sparse compact structure of its differentiation matrices.