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AN EFFICIENT EDGE BASED DATA STRUCTURE FOR A COMPRESSIBLE NAVIER-STOKES SOLVER

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The efficient edge based data structure proposed in [1] has been extended for a three-dimensional vertex based finite volume algorithm in order to demonstrate its efficiency compared to the classical edge based implementations. In the present approach, the data structure is tailored to meet the requirements of the algorithm by considering the data access pattern and cache efficiency. The required data are packed and allocated in a way that they are very close to each other in physical memory. A special attention is given to reduce the number of required floating point operations by storing the areas related to dual volume construction for viscous gradients. Vertex/edge and neighbouring references are defined using pointers instead of array indices. Derived from the data structures designed for mesh generation [2], this approach inherently allows vertex insertion and deletion, which is particularly suitable for adaptive mesh refinement or local re-meshing. The present data structure is not limited with tetrahedrons; arbitrary polyhedrons are also supported in the mesh without putting any additional effort. The resulting large-scale algebraic equations from the fully implicit implementation are solved iteratively with the restricted additive Schwarz preconditioned GMRES algorithm provided within the PETSc [3] package. The proposed framework has been initially applied to the external flow around a sphere. The efficiency of the numerical algorithm has been tested by comparing the CPU times with the Stanford SU2 code and significant increase in computational performance has been achieved.

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