Abstract Submitted
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An efficient implementation of the ODE equilibrium wall model using Gauss quadrature method[1] IMRAN HAYAT, GEORGE ILHWAN PARK, University of Pennsylvania — Owing to its ease of implementation and reasonable accuracy at a moderate cost, the ODE equilibrium wall model has been popular for the computation of flows with complex wall geometries. The model implementation typically employs a finite-volume discretization, which entails the solution of a tridiagonal system on each wall face at each time step. Frequent inversion of these linear systems is the most expensive part of this wall-modeling approach. To this end, we develop a low-cost grid-free implementation for the ODE wall model based on Gauss-quadrature. The method is based on the integral form of velocity profile obtained from the constant-stress layer statement. The wall stress is then found iteratively using the shooting method and the spectral evaluation of the velocity integral using the Gauss-Lobatto-Legendre quadrature method. A priori validation of the model has been conducted using available data for the turbulent channel, pipe and boundary layer flows, for Reynolds number up to $Re_\tau \sim 10^5$. The costs of the finite-volume and the Gauss-quadrature approach will be contrasted. Additionally, the Reynolds number dependence of the wall-modeling cost and the number of quadrature points required for a fixed accuracy of the predicted wall-stress will be investigated.

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