An Incremental Improvement to the Feedback-Forcing Immersed Boundary Method JOHN CIMBALA, JASON DEGRAW, Penn State University — The immersed boundary method (IBM) has been applied in a variety of forms, but all of them represent a boundary implicitly on a grid that need not conform to the boundary contour. We confine our interest to one of the simpler forms of IBM, the feedback-forcing approach, and apply it via user-defined functions in the commercial cell-centered finite-volume CFD code, FLUENT. The only modification that we make is the addition of a forcing term $\vec{f} = C_{\text{IBM}} (\vec{v} - \vec{u})$, where C_{IBM} is a problem-dependent penalty parameter, $\vec{v}$ is the velocity of the immersed boundary, and $\vec{u}$ is the fluid velocity. For cells completely contained inside the boundary, we use the forcing term as-is. Cells that are only partially contained inside the boundary are more difficult to treat. In this situation, one approach that has been successfully applied in the literature is to scale the forcing by the fraction of cell volume contained within the boundary. We investigate a modification that scales the forcing in the coordinate directions separately. To test the concept, we applied this modification to two-dimensional flow over a circular cylinder. We found that this approach allows access to higher values of penalty parameter, which typically improves the solution. Tests with other flows are underway at the time of this writing.

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