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AN IMMERSED BOUNDARY METHOD WITH DIVERGENCE-FREE INTERPOLATION FOR UNSTRUCTURED POLYHEDRAL GRIDS

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A new immersed boundary interpolation method for discrete is presented. It decreases the spurious force oscillations (SFO) in the pressure field and consequently in the body force calculations, which is a common issue in several immersed boundary methods. The method applies a divergence-free constraint directly in the velocity interpolation. It also guarantees a field continuity between each adjacent interpolation polynomial. This approach strictly enforces a divergence-free velocity field in the reconstruction domain, reducing the time discontinuities caused by the applied boundary conditions near the solid boundary.

Due to its flexibility, the current method can be applied with any arbitrary unstructured grid. Several tests are carried out to validate the technique with different grid types: polyhedral, triangular and Cartesian. The method is shown to compute the correct velocity and pressure fields independently of the grid type. The effects of the cell topology in the SFO are studied and the polyhedral grids are proven to be superior to their Cartesian and triangular counterparts.

Finally, some examples of moving bodies are provided, in a computational domain with complex static boundaries. The new method allows the use of unstructured grids for the outer fixed boundaries, providing good geometry conformance and therefore good flow resolution.

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