# The Divergence-Conforming Immersed Boundary Method: Application to Microscale Blood Flow

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The divergence-conforming immersed boundary (DCIB) method is presented to tackle a long-standing issue of immersed boundary (IB) methods for fluid-structure interaction, namely, the challenge of accurately imposing the incompressibility constraint at the discrete level [1]. The DCIB method follows up on our previous works [2-4], where we developed discretizations of the mathematical model proposed by the IB method based on non-uniform rational B-splines (NURBS) and T-splines, respectively. In the DCIB method, the Eulerian velocity-pressure pair is discretized using divergence-conforming B-splines, which leads to *inf-sup* stable, $H^1$-conforming, and pointwise divergence-free Eulerian solutions. The Lagrangian displacement is discretized using NURBS, which enables to robustly handle large mesh distortions. By combining the generalized-α method and a block-iterative solution strategy, the DCIB method results in a fully-implicit discretization, which is key to impose accurately the no-penetration and no-slip conditions at the fluid-solid interface.

Various two- and three-dimensional problems are solved to show all the above-mentioned properties of the DCIB method together with mesh-independence studies, comparisons with other methods from the literature, and measurement of convergence rates. The DCIB method leads to completely negligible incompressibility errors at the Eulerian level and various orders of magnitude of increased accuracy at the Lagrangian level compared to other IB methods. Finally, we use the DCIB method to answer open questions in cell-scale blood flow.

## REFERENCES

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