Adaptive Embedded DG Methods for Optimal Control of Oseen Equations

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In this work, we analyze three hybridized discontinuous Galerkin finite element methods for the control constrained Oseen equations with a non-constant viscosity. This formulation reduces globally coupled degrees of freedom and provides a divergence-conforming and pointwise divergence-free velocity fileld. An optimal convergence of $O(h^2)$ in the diffusion- dominated regime and a sub-optimal $O(h^{3/2})$ in the convection-dominated regime is established for the velocity and control in the L^2-norm for all three schemes in a unified setting using a variational discretization approach for the control. Additionally, the optimal error estimates for the pressure variable are derived. We also derive a new reliable and efficient residual-based a posteriori error estimator for the proposed schemes. Lastly, we conclude with numerical examples in two and three dimensions to validate the performance of proposed schemes.

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