TRIVARIATE SPLINE APPROXIMATIONS OF 3D NAVIER-STOKES EQUATIONS

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We present numerical approximations of the 3D steady state Navier-Stokes equations in velocity-pressure formulation. We use trivariate splines of arbitrary degree d and arbitrary smoothness $r < d$. Using functional arguments, we derive the discrete Navier-Stokes equations in terms of B-coefficients of trivariate splines over a tetrahedral partition of any given polygonal domain. Smoothness conditions, boundary conditions and the divergence-free conditions are enforced through Lagrange multipliers. The discrete equations are solved by a variant of the augmented Lagrangian algorithm for which we prove a linear algebraic convergence rate. We have implemented this approach in MATLAB and present numerical evidence of the convergence rate as well as experiments on the lid driven cavity flow problem.