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Hybrid FOSLS/LL* for Navier-Stokes Equations

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First-Order System Least Squares (FOSLS) is a method for the discretization of systems of PDEs in which the set of equations is reformulated as a (generally larger) first-order system. The goal is the minimization the sum of the squares of the associated residuals (the FOSLS functional). Properly formulated, this functional is equivalent to the H1 norm (squared) of the error. This approach has a number of advantages over traditional methods. In some cases though (e.g. flow through a long channel), this equivalence can be rather loose, and large (generally smooth) L2 error can be present even when the functional is small. In such cases, one approach for linear system is to use FOSLL*, where the problem is posed to minimize the L2 error over the range of the adjoint of the operator. This can be problematic for nonlinear problems though, and a hybrid method was developed. There, both the FOSLS and FOSLL* functionals are used, along with a connecting term that ties the two together (by approximately projecting the FOSLL* approximation back into the original finite element space). This talk covers the approach taken and results obtained for 2D Stokes and Navier-Stokes flow.