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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 H_1 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) L_2 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 L_2 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.