

Matrix

$$\begin{bmatrix} F_{NS} & L^T \\ L & \end{bmatrix}$$

Augmented Jacobian

$$F_{NS} + L^T W^{-1} L = \begin{bmatrix} \tilde{F} & B^T \\ B & \end{bmatrix}$$

Modified Navier-Stokes Jacobian

$$\tilde{F} = \begin{bmatrix} F_{bb} & F_{bc} \\ F_{cb} & F_{cc} \end{bmatrix}$$

Navier-Stokes momentum block
partitioned into bulk and constrained DOF types

Corresponding Preconditioner

$$\begin{bmatrix} F_{NS} + L^T W^{-1} L & \\ & W \end{bmatrix}$$

Augmented Lagrangian preconditioner
(master preconditioner)

Solved with SuperLU

$$\begin{bmatrix} \tilde{F} & B^T \\ & -M_s \end{bmatrix}$$

Navier-Stokes LSC preconditioner

Pressure system solved with AMG

$$\begin{bmatrix} F_{bb} & F_{bc} \\ & F_{cc} \end{bmatrix}$$

Upper block triangular preconditioner

Solved with AMG