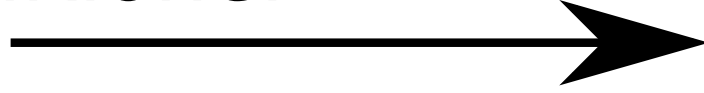


LSC preconditioner
without precomputed blocks
from a master preconditioner



$$\begin{array}{c} 0 \\ 1 \\ 2 \end{array} \begin{array}{c} u \\ v \\ p \end{array} \begin{bmatrix} F_{xx} & F_{xy} & B_x^T \\ F_{yx} & F_{yy} & B_y^T \\ B_x & B_y & \end{bmatrix}$$

Navier-Stokes matrix
Three DOF types

$$\begin{array}{c} 0 \\ 1 \\ 2 \end{array} \begin{array}{c} u \\ v \\ p \end{array} \begin{bmatrix} F_{xx} & F_{xy} & B_x^T \\ F_{yx} & F_{yy} & B_y^T \\ & & -M_s \end{bmatrix}$$

LSC preconditioner
Velocity-pressure block structure

$$\begin{array}{c} 0 \\ 1 \end{array} \begin{array}{c} u \\ v \end{array} \begin{bmatrix} F_{xx} & F_{xy} & B_x^T \\ F_{yx} & F_{yy} & B_y^T \\ B_x & B_y & \end{bmatrix}$$

Block structure required

$$\begin{array}{c} 0 \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} u \\ v \\ u_c \\ v_c \\ p \end{array} \begin{bmatrix} F_{xx} & F_{xy} & F_{x\hat{x}} & F_{x\hat{y}} & B_x^T \\ F_{yx} & F_{yy} & F_{y\hat{x}} & F_{y\hat{y}} & B_y^T \\ F_{\hat{x}x} & F_{\hat{x}y} & F_{\hat{x}\hat{x}} & F_{\hat{x}\hat{y}} & B_{\hat{x}}^T \\ F_{\hat{y}x} & F_{\hat{y}y} & F_{\hat{y}\hat{x}} & F_{\hat{y}\hat{y}} & B_{\hat{y}}^T \\ B_x & B_y & B_{\hat{x}} & B_{\hat{y}} & \end{bmatrix}$$

Modified preconditioner blocks
Need to be coarsened to use
LSC preconditioner

DOF type
coarsening
process

$$\begin{array}{c} 0 \\ 1 \\ 2 \end{array} \begin{array}{c} u \\ v \\ p \end{array} \begin{bmatrix} F_{xx} & F_{xy} & B_x^T \\ F_{yx} & F_{yy} & B_y^T \\ B_x & B_y & \end{bmatrix}$$

Navier-Stokes matrix
Precomputed (possibly modified)
preconditioner blocks

$$\begin{array}{c} 0 \\ 1 \\ 2 \end{array} \begin{array}{c} u \\ v \\ p \end{array} \begin{bmatrix} F_{xx} & F_{xy} & B_x^T \\ F_{yx} & F_{yy} & B_y^T \\ & & -M_s \end{bmatrix}$$

LSC preconditioner
Velocity-pressure block structure

$$\begin{array}{c} 0 \\ 1 \end{array} \begin{array}{c} u \\ v \end{array} \begin{bmatrix} F_{xx} & F_{xy} & B_x^T \\ F_{yx} & F_{yy} & B_y^T \\ B_x & B_y & \end{bmatrix}$$

Block structure required
The blocks are precomputed
(and possibly modified).

No change to the implmentation of the LSC preconditioner.
The BPF will handle the coarsening process and will use the
precomputed (and possibly modified) preconditioner blocks