Exact solutions

Pure dirichlet boundary conditions with analytical solution:

$$\boldsymbol{u}(x,y) = \begin{pmatrix} xy\exp(x+y) + x\exp(x+y) \\ -xy\exp(x+y) - y\exp(x+y) \end{pmatrix},$$

$$p(x,y) = \exp(y)\sin(x),$$

$$\boldsymbol{b}(x,y) = \begin{pmatrix} \exp(x+y)\cos(x) \\ \exp(x+y)\sin(x) - \exp(x+y)\cos(x) \end{pmatrix},$$

$$r(x,y) = x\sin(2\pi x)\sin(2\pi y).$$

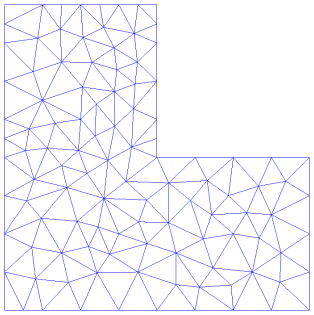

Figure 1: Lshaped domain

Preconditioner results - direct application of preconditioners

ℓ	DoF	$\text{time}_{\text{solve}}$	time_{NL}	it_{NL}	it_{av}
1	71	0.00	0.29	15	22.0
2	242	0.02	0.56	16	81.1
3	909	0.03	1.34	24	59.8
4	3,283	0.08	4.14	29	52.2
5	12,867	0.35	16.91	30	52.1
6	51,379	1.87	85.92	31	52.8
7	203,556	12.37	504.08	31	53.8

Convergence results - direct solves on linear system

ℓ	Dofs $\boldsymbol{u}_h/p_h$	$\|\boldsymbol{u}-\boldsymbol{u}_h\|_{L^2(\Omega)}$	order	$\|\boldsymbol{u}-\boldsymbol{u}_h\|_{H^1(\Omega)}$	order	$\|p-p_h\|_{L^2(\Omega)}$	order
1	42/8	8.8613e+00	0.00	5.5371e+01	0.00	4.5613e+02	0.00
2	146/23	4.1281e+00	1.10	4.5019e+01	0.30	1.0459e+02	2.12
3	554/78	6.5366e-01	2.66	1.2378e+01	1.86	2.7443e+01	1.93
4	2,010/268	1.1755e-01	2.48	2.9325e+00	2.08	4.6939e+00	2.55
5	7,898/1,020	2.5188e-02	2.22	8.7477e-01	1.75	1.1816e+00	1.99
6	31,578/4,012	6.3267e-03	1.99	2.7412e-01	1.67	3.3121e-01	1.83
7	125,186/15,777	1.4864e-03	2.09	7.4636e-02	1.88	7.6414e-02	2.12

Table 1: Convergence of velocity/pressure field

ℓ	Dofs $\boldsymbol{b}_h/r_h$	$\|\boldsymbol{b}-\boldsymbol{b}_h\|_{L^2(\Omega)}$	order	$\|\boldsymbol{b}-\boldsymbol{b}_h\|_{H(\mathrm{curl},\Omega)}$	order
1	13/8	9.8687e+00	0.00	1.2202e+01	0.00
2	50/23	4.6256e+00	1.09	8.8619e+00	0.46
3	199/78	1.8629e+00	1.31	4.6257e+00	0.94
4	737/268	8.7549e-01	1.09	2.1267e+00	1.12
5	2,929/1,020	4.2624e-01	1.04	1.0126e+00	1.07
6	11,777/4,012	2.1315e-01	1.00	5.4336e-01	0.90
7	46,816/15,777	1.0649e-01	1.00	2.6991e-01	1.01

Table 2: Convergence for magnetic field

ℓ	Dofs $\boldsymbol{b}_h/r_h$	$\|r-r_h\|_{L^2(\Omega)}$	order	$\|r-r_h\|_{H^1(\Omega)}$	order
1	13/8	9.7025e-01	0.00	1.0103e+01	0.00
2	50/23	1.5270e+00	0.65	1.2310e+01	0.29
3	199/78	4.3060e-01	1.83	5.0480e+00	1.29
4	737/268	8.5258e-02	2.34	2.3952e+00	1.08
5	2,929/1,020	2.2436e-02	1.93	1.1695e+00	1.03
6	11,777/4,012	5.4642e-03	2.04	5.7658e-01	1.02
7	46,816/15,777	1.3809e-03	1.98	2.9065e-01	0.99

Table 3: Convergence for multiplier variable