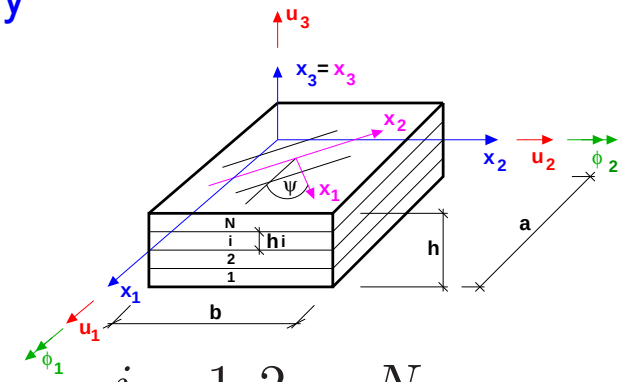
Parallel Solver for Multilayered Structures - FETI

Refined Mindlin-Reissner theory

- Mindlin kinematic assumptions

$$
\begin{aligned}
u_1^i(x_1,x_2,x_3) &= U_1^i(x_1,x_2) + x_3^i \phi_2^i(x_1,x_2) \\
u_2^i(x_1,x_2,x_3) &= U_2^i(x_1,x_2) - x_3^i \phi_1^i(x_1,x_2) \\
u_3^i(x_1,x_2,x_3) &= U_3^i(x_1,x_2),
\end{aligned}
$$



$$i = 1, 2, ...N$$

- Interface continuity conditions
- System of equations

$$
\begin{bmatrix} \boldsymbol{K} & \boldsymbol{Q}^T \\ \boldsymbol{Q} & \boldsymbol{0} \end{bmatrix} \begin{bmatrix} \boldsymbol{d} \\ \boldsymbol{\lambda} \end{bmatrix} = \begin{bmatrix} \boldsymbol{f} \\ \boldsymbol{0} \end{bmatrix}
$$

$$
\sum_{i=1}^{N} \boldsymbol{Q}^i \left(\boldsymbol{K}^i\right)^{-1} \left(\boldsymbol{Q}^i\right)^T \boldsymbol{\lambda} = \sum_{i=1}^{N} \boldsymbol{Q}^i \left(\boldsymbol{K}^i\right)^{-1} \boldsymbol{f}^i
$$

- K. Matouš, J. Kruis and Z. Dostál

Numerical examples

T-50 graphite : $E_L = 386.4$ GPa

$E_T = 7.6$ GPa

$G_L = 15.2$ GPa

$G_T = 2.6$ GPa

$\nu = 0.41$

6061 Aluminum : $E = 72.5$ GPa

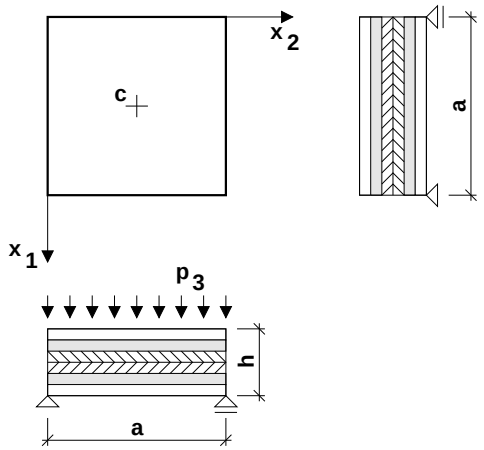
$G = 27.3$ GPa

$\nu = 0.33$

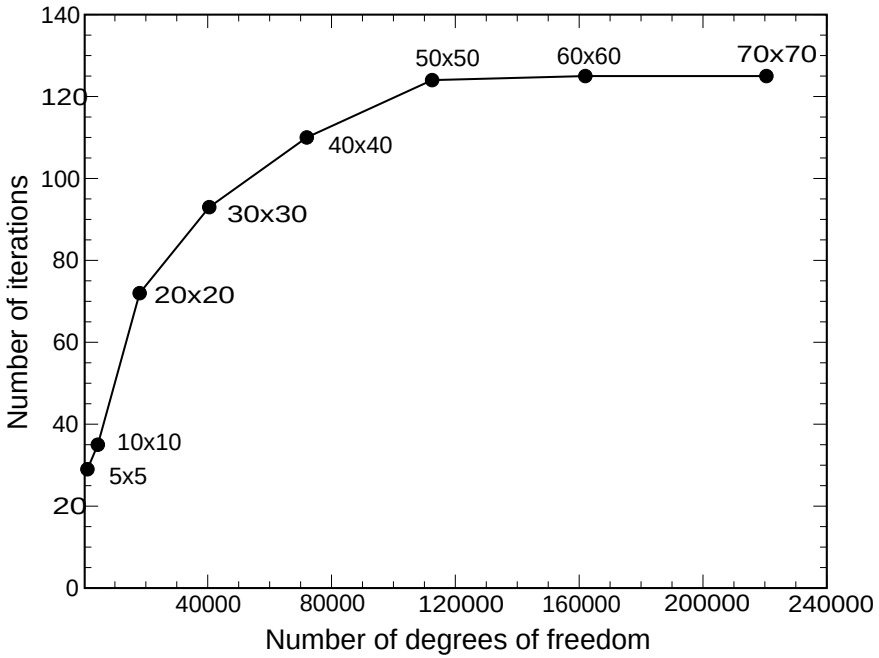
$a = 1.500$ m, $h = 0.027$ m

$h^i = 4.5$ mm, layup $[0, 60, 90]_s$

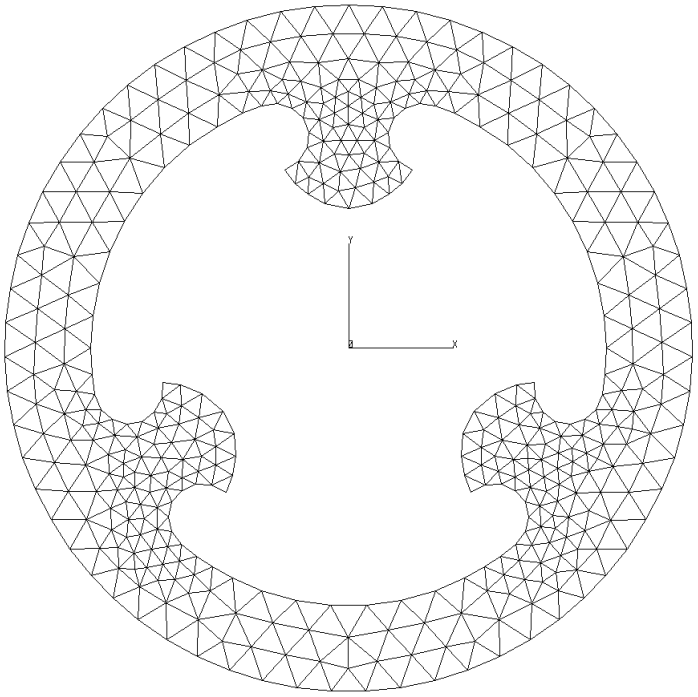
- 6 CPUs

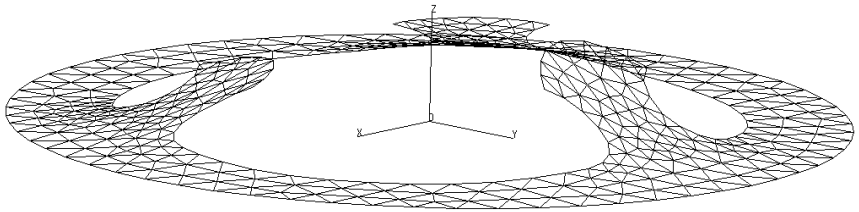


Convergence behavior

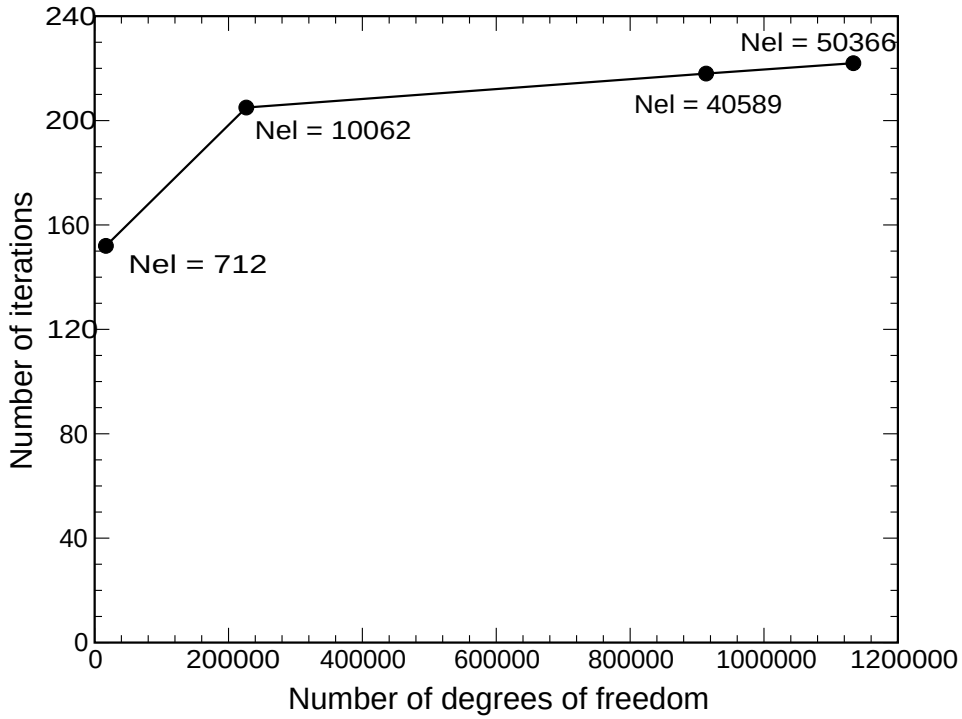


General domain





Convergence behavior



$h^i = 5.0$ mm, layup $[0, 90, +45, -45, 90, 0]$, 6 CPUs