PETSC01 - Validation of the solvor PETSc in linear elasticity 3D

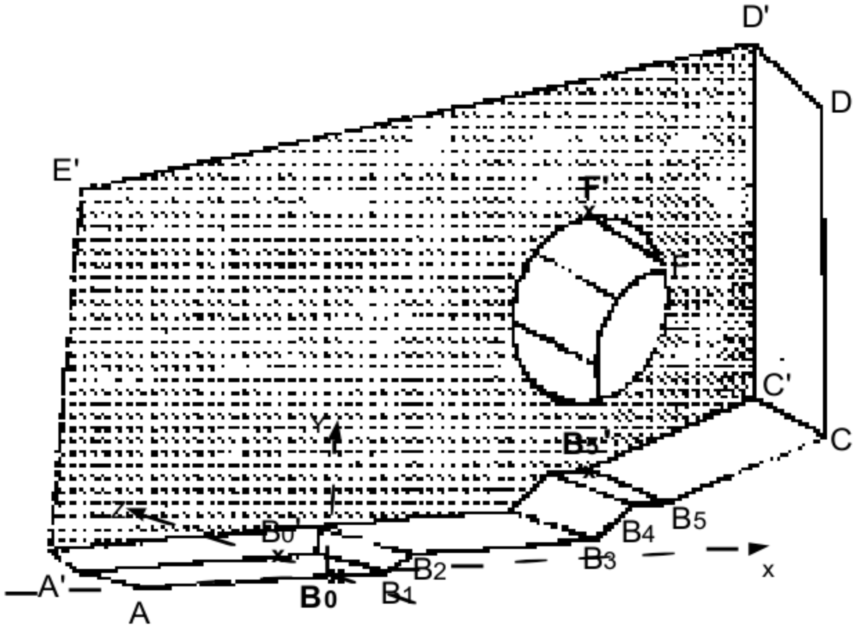
Summary:

This CAS-test makes it possible to validate the solvor PETSC in linear elasticity 3D under various configurations:

- Burst orders or total operators
- Dualisation and elimination of the boundary conditions (AFFE_CHAR_CINE/MECA)
- Use of PETSC with the method NEWTON_KRYLOV in the non-linear operator of dynamics

1 Problem of reference

1.1 Geometry



The geometry represents only one quarter of test-tube CTJ25:
symmetry planes: $(x\,B_0\,y)$ and $(x\,B_0\,z)$

Thickness: $DD'=12.5\,mm$

Face1: $(A, B0, B1, B2, B3, B4, B5, C, D, E)$

Face2: $(A, B0, B0', A')$

Coordinates of the points (mm):

	min	max	$B0$	F'	$B5'$
x	-20.	42.5	0.	30.	30.
y	0.	30.	0.	20.25	3.5
z	0.	12.5	0.	12.5	12.5

1.2 Properties materials

The elastic properties of material are the following ones:

- Young modulus: $E=2.027027\,10^{11}\,Pa$
- Poisson's ratio: $\nu=0.3$

1.3 Boundary conditions and loadings

All nodes of $face1$: $DZ=0$
All nodes of $face2$: $DY=0$

All nodes of the line FF' : $DX=0$ $DY=0.01$

2 Reference solution

2.1 Method of calculating used for the reference solution

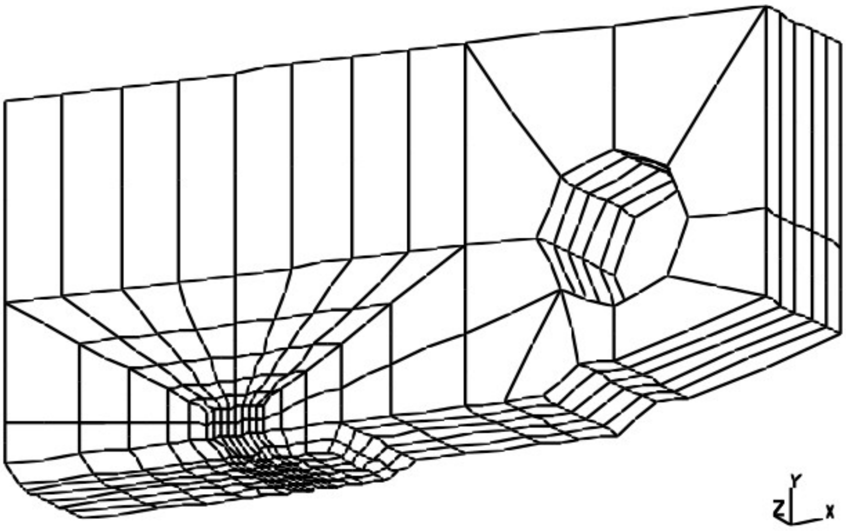
The reference solution is that obtained on the same grid with the code PERMAS, calculations carried out in 1997.

2.2 Results of reference and sizes tested

Localization		Reference (mm)	***Precision***
Not F'	DY	$1.\ 10^{-2}$	1.5E-4
	DZ	$1.0296\ 10^{-4}$	1.5E-4
Not $B5'$	DX	$4.3006\ 10^{-3}$	1.5E-4
	DY	$9.2890\ 10^{-3}$	1.5E-4
	DZ	$-2.9173\ 10^{-5}$	1.5E-4

3 Modeling of reference

3.1 Modeling common to all the tests



Grid: Many nodes: 3323 Many meshs: 630 HEXA20

Cutting:	Face1 $(A, B1, ..., B5, C, D, E)$	428 nodes
	Face2 $(A, B0, B0', A')$	198 nodes
	Segment FF'	11 nodes
Name of the nodes:	Not $F' = NO2958$	Not $B5' = NO2974$

Boundary conditions:

in all the nodes of $Face1$	(GROUP_NO=' Grno1', DZ=0)
in all the nodes of $Face2$	(GROUP_NO=' Grno8', DY=0)
in all the nodes of the segment FF'	(GROUP_NO=' Grno7', DX=0, DY=0.01)

4 Modeling A

Operator of resolution MECA_STATIQUE.
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and AFFE_CHAR_CINE).
Solvor PETSC, algorithms CR and CG (with prepacking LDLT incomplete with level of filling 0 and renumerotation RCMK).

5 Modeling B

Operator of resolution STAT_NON_LINE.
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and AFFE_CHAR_CINE).
Solvor PETSC, algorithm CR (with prepacking LDLT incomplete with level of filling 0 and renumerotation RCMK).

6 Modeling C

Burst orders CALC_MATR_ELEM , TO FACTORIZE and TO SOLVE .
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and CALC_CHAR_CINE).
Solvor PETSC, algorithm CR (with prepacking LDLT incomplete with level of filling 0 and renumerotation RCMK).

7 Modeling D

Operator of resolution MECA_STATIQUE.
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and AFFE_CHAR_CINE).
Solvor PETSC, algorithm CR (prepacking LDLT_SP of factorization single precision and without renumerotation).

8 Modeling E

Operator of resolution STAT_NON_LINE.
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and AFFE_CHAR_CINE).
Solvor PETSC, algorithm CR (prepacking LDLT_SP of factorization single precision and without renumerotation).

9 Modeling F

Burst orders CALC_MATR_ELEM , TO FACTORIZE and TO SOLVE .
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and CALC_CHAR_CINE).
Solvor PETSC, algorithm CR (prepacking LDLT_SP of factorization single precision and without renumerotation).

10 Modeling G

Operator of resolution MECA_STATIQUE.
Elimination of the boundary conditions kinematics (AFFE_CHAR_CINE).
Solvor PETSC, algorithms CR and GCR (5 resolutions without renumerotation with respectively prepacking JACOBI, prepacking SOR, WITHOUT prepacking, pre-packaging M1 and prepacking BOOMER).

11 Modeling H

Operator of resolution DYNA_NON_LINE.
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and AFFE_CHAR_CINE).
Solvor PETSC, algorithm GMRES (prepacking LDLT_SP by factorization single precision).

12 Modeling I

Operator of resolution DYNA_NON_LINE.
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and AFFE_CHAR_CINE).
Solvor PETSC, algorithm GMRES (prepacking LDLT_SP by factorization single precision).
Use of the method NEWTON_KRYLOV instead of the method NEWTON.

13 Modeling J

Operator of resolution MECA_STATIQUE.
Dualisation and elimination of the boundary conditions kinematics (AFFE_CHAR_MECA and AFFE_CHAR_CINE).
Solvor PETSC, algorithmS CG and GMRES with prepacking of Lagrangian type increased BLOC_LAGR.

14 Summary of the results

This CAS-test shows the good performance of the solvor PETSC in the various studied cases.