

PERF009 – Elastic design of the pump LAUGH

Summary:

The objective of this CAS-test is to measure the performances of an elastic design of a pump LAUGH subjected to a constant interior pressure.

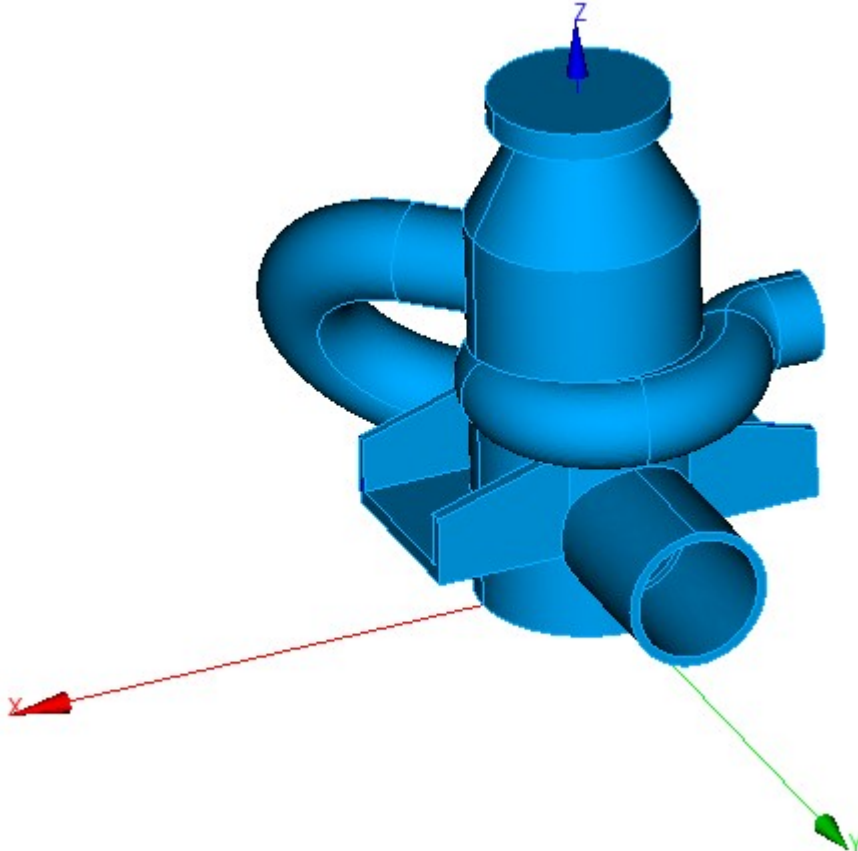
This case test is declined in 7 modelings which are identical. The differences are related on the change of solver and the number of processors,

- 1) Modeling a: solver MULT_FRONT on 1 processor,
- 2) Modeling b: solver MULT_FRONT on 2 processors,
- 3) Modeling C: solver MULT_FRONT on 4 processors,
- 4) Modeling D: solver MUMPS on 2 processors,
- 5) Modeling E: solver MUMPS on 4 processors,
- 6) Modeling F: solver MUMPS on 8 processors,
- 7) Modeling G: solver MUMPS on 16 processors,

1 Problem of reference

1.1 Geometry

The geometry of the pump is the following one:



1.2 Properties of material

- $E = 2 \cdot 10^5$ MPa
- $\nu = 0.3$

1.3 Boundary conditions and loadings

Imposed displacement:

$$\text{Lower face} \quad : \quad DX = DY = DZ = 0.$$

Imposed interior pressure:

$$P = 100 \text{ MPa}$$

2 Reference solution

2.1 Method of calculating

The result of reference was got by calculating the average of displacements in all the directions on the higher face of the pump with the solver 'MUMPS'.

2.2 Uncertainties

Digital solution (not-regression).

3 Modeling A

3.1 Characteristics of modeling A

Number of processor: 1

Modeling 3D:

Many nodes	261,520	That is to say:	SEG3	3,600
Many meshes	218,832		TRIA6	77,544
			TETRA10	137,688

3.2 Features tested

Order	Option
AFFE_MODELE	MODELING 3D
AFFE_CHAR_MECA	FACE_IMPO
	PRES_REP
MECA_STATIQUE	
SOLVEUR	MULT_FRONT

3.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MOY DX	3.83679	3.83679086	2.2E-05
DEPL MOY DY	-7.41447	-7.4144716	2.2E-05
DEPL MOY DZ	2.87533	2.8753262	1.3E-04

3.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		TO USE	SYSTEM	TO USE +SYS	ELAPSE D
Linux 64 bits (ia64) "Bull"	10.1.12	4,000	3,975	803,352	278.72	17.79	296.51	297.15

4 Modeling B

4.1 Characteristics of modeling B

Number of processor: 2

Modeling 3D:

Many nodes	261,520	That is to say:	SEG3	3,600
Many meshs	218,832		TRIA6	77,544
			TETRA10	137,688

4.2 Features tested

Order	Option
AFFE_MODELE	MODELING 3D
AFFE_CHAR_MECA	FACE_IMPO
	PRES_REP
MECA_STATIQUE	
SOLVEUR	MULT_FRONT

4.3 Results

Size	Reference	Code Aster	Relative error (%)
DEPL MOY DX	3.83679	3.83679086	2.2E-05
DEPL MOY DY	-7.41447	-7.4144716	2.2E-05
DEPL MOY DZ	2.87533	2.8753262	1.3E-04

4.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		TO USE	SYSTEM	TO USE +SYS	ELAPSE D
Linux 64 bits (ia64) "Bull"	10.1.12	4,000	3,975	803,352	300.73	16.79	317.52	232.68

5 Modeling C

5.1 Characteristics of modeling C

Number of processor: 3

Modeling 3D:

Many nodes	261,520	That is to say:	SEG3	3,600
Many meshes	218,832		TRIA6	77,544
			TETRA10	137,688

5.2 Features tested

Order	Option
AFFE_MODELE	MODELING 3D
AFFE_CHAR_MECA	FACE_IMPO
	PRES_REP
MECA_STATIQUE	
SOLVEUR	MULT_FRONT

5.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MOY DX	3.83679	3.83679086	2.2E-05
DEPL MOY DY	-7.41447	-7.4144716	2.2E-05
DEPL MOY DZ	2.87533	2.8753262	1.3E-04

5.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		TO USE	SYSTEM	TO USE +SYS	ELAPSE D
Linux 64 bits (ia64) "Bull"	10.1.12	4,000	3,975	803,352	388.16	17.25	405.41	212.47

6 Modeling D

6.1 Characteristics of modeling D

Number of processor: 2

Modeling 3D:

Many nodes	261,520	That is to say:	SEG3	3,600
Many meshes	218,832		TRIA6	77,544
			TETRA10	137,688

6.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	FACE_IMPO
	PRES REP
MECA_STATIQUE	
SOLVEUR	MUMPS

6.3 Results

Size	Reference	Code Aster	Relative error (%)
DEPL MOY DX	3.83679	3.83679086	2.2E-05
DEPL MOY DY	-7.41447	-7.4144716	2.2E-05
DEPL MOY DZ	2.87533	2.8753262	1.3E-04

6.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocated	Used		TO USE	SYSTEM	TO USE +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	10.1.15	2,200	888	803,352	149.31	7.11	156.42	166.46

7 Modeling E

7.1 Characteristics of modeling E

Number of processor: 4

Modeling 3D:

Many nodes	261,520	That is to say:	SEG3	3,600
Many meshes	218,832		TRIA6	77,544
			TETRA10	137,688

7.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	FACE IMPO
	PRES REP
MECA STATIQUE	
SOLVEUR	MUMPS

7.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MOY DX	3.83679	3.83679086	2.2E-05
DEPL MOY DY	-7.41447	-7.4144716	2.2E-05
DEPL MOY DZ	2.87533	2.8753262	1.3E-04

7.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		TO USE	SYSTEM	TO USE +SYS	ELAPSE D
Linux 64 bits (ia64) "Bull"	10.1.15	2,200	790	803,352	120.69	6.32	127.01	129.11

8 Modeling F

8.1 Characteristics of modeling F

Number of processor: 8

Modeling 3D:

Many nodes	261,520	That is to say:	SEG3	3,600
Many meshes	218,832		TRIA6	77,544
			TETRA10	137,688

8.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	FACE_IMPO
	PRES REP
MECA_STATIQUE	
SOLVEUR	MUMPS

8.3 Results

Size	Reference	Code Aster	Relative error (%)
DEPL MOY DX	3.83679	3.83679086	2.2E-05
DEPL MOY DY	-7.41447	-7.4144716	2.2E-05
DEPL MOY DZ	2.87533	2.8753262	1.3E-04

8.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocated	Used		TO USE	SYSTEM	TO USE +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	10.1.15	2,200	717	803,352	83.21	1.88	85.09	85.15

9 Modeling G

9.1 Characteristics of modeling G

Number of processor: 16

Modeling 3D:

Many nodes	261,520	That is to say:	SEG3	3,600
Many meshes	218,832		TRIA6	77,544
			TETRA10	137,688

9.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	FACE IMPO
	PRES REP
MECA STATIQUE	
SOLVEUR	MUMPS

9.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MOY DX	3.83679	3.83679086	2.2E-05
DEPL MOY DY	-7.41447	-7.4144716	2.2E-05
DEPL MOY DZ	2.87533	2.8753262	1.3E-04

9.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		TO USE	SYSTEM	TO USE +SYS	ELAPSE D
Linux 64 bits (ia64) "Bull"	10.1.15	2,200	684	803,352	67.41	1.69	69.10	70.33

10 Summary of the results

Machine	Aster	MO D.	Nb DDL	Memory (Mo)		Time execution (MECA_STATIQUE) (dryness)			
				Allocat ed	Used (*)	TO USE	SYSTEM	TO USE +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	10.1.12	With	803,352	4000	3,975	278.72	17.79	296.51	297.15
		B	803,352	4000	3,975	300.73	16.79	317.52	232.68
		C	803,352	4000	3,975	388.16	17.25	405.41	212.47
	10.1.15	D	803,352	2200	888	149.31	7.11	156.42	166.46
		E	803,352	2200	790	120.69	6.32	127.01	129.11
		F	803,352	2200	717	83.21	1.88	85.09	85.15
		G	803,352	2200	684	67.41	1.69	69.10	70.33

(*) for modelings with MUMPS (D, E, F, G), the memory used indicated is that of Aster, it does not include that necessary to MUMPS.

It is noted that one reaches a parallel effectiveness of 35% out of 4 processors with a OpenMP parallelism. This figure is to be compared with that obtained on CAS-test PERF010 (60% of effectiveness out of 4 processors). This shows that this kind of parallelism brings performances which are dependent on the studied problem (geometry, blockings, etc...).

The same report can be made on parallelism MPI with correct parallel performances but in withdrawal compared to CAS-test PERF010.