

SSNA102 - Contact multicorps elastic

Abstract:

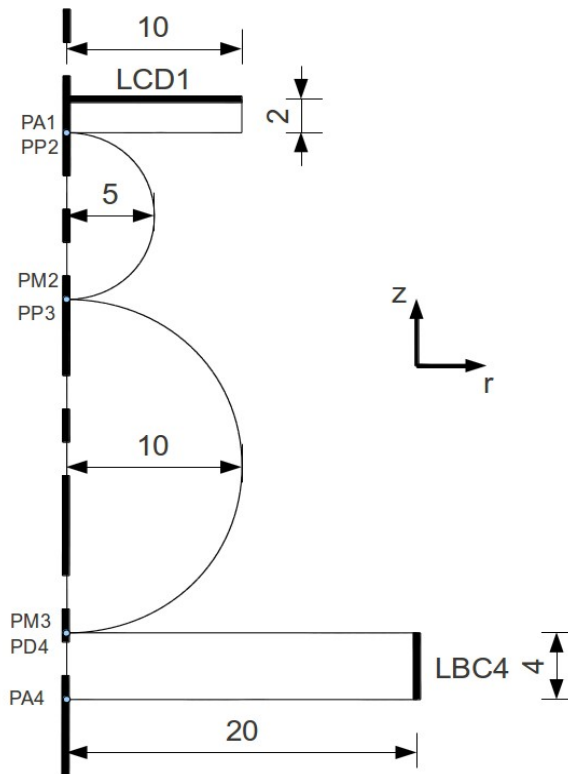
This problem of nonlinear static of an axisymmetric structure makes it possible to test the two alternatives of the contact algorithm in large displacements.

The computation consists of the modelization of a structure made up of several elastic bodies in unilateral contact without friction. This computation already was the object of a IPSI-Phi2AS benchmark describes in note HI - 75/97/034/0. The reference solution comes from computations carried out with codes ABAQUS, SYSTUS and the SAMCEF software.

1 Problem of Model

1.1 reference

Geometry: Axisymmetric
Units: *mm*



1.2 Properties of the linear

material elastic Material of characteristics: $E = 200000. MPa$
 $\nu = 0.3$

1.3 Boundary conditions and loadings

- DR and DZ blocked on $LBC4$
- DZ imposed $-2.0 mm$ on $LCD1$
- Connections between degrees of freedom:
 $DZ(PA1) = DZ(PP2)$
 $DZ(PM3) = DZ(PD4)$
- The first computation: conditions of unilateral contact between each side of solids in opposite, is 3 couples of paired surfaces
- the Second computation (modelization A only): conditions of unilateral contact between each side of solids in opposite, except that the top in mode $RESOLUTION = 'NON'$ (test of the mode without computation in multi-zones)

2 Reference solution

2.1 Method of calculating used for the Average reference solution

of the results got by various computer codes in mechanics, ABAQUS, SYSTUS, the SAMCEF software, in the frame of a case test IPSI-AS Φ_2 [bib1].

2.2 Results of reference

vertical Displacement of point: $PA4$

ABAQUS	-0,83 mm	
SYSTUS	-0,82 mm	Is a vertical average -0,81 mm
of	-0,78 mm	

the SAMCEF software Component of the reaction to the fixed support $LBC4$:

ABAQUS	110270 N	
SYSTUS	109500 N	Is an average of 108257 N
the SAMCEF software	105000 N	

NB:

The forces calculated by Aster into axisymmetric are it by radian. The value to be obtained is thus $108257/2\pi = 17229.58 \text{ N/rd}$

2.3 Uncertainties on the solution

dispersion around the mean value of vertical displacement $PA4$ is of 4%. Dispersion around the vertical reaction to the fixed support is of 3%.

2.4 Bibliographical references

1.1. VAUTIER: "Example of use of the features of contact in large displacements in the Code_Aster", HI-75/97/034/0 notes.

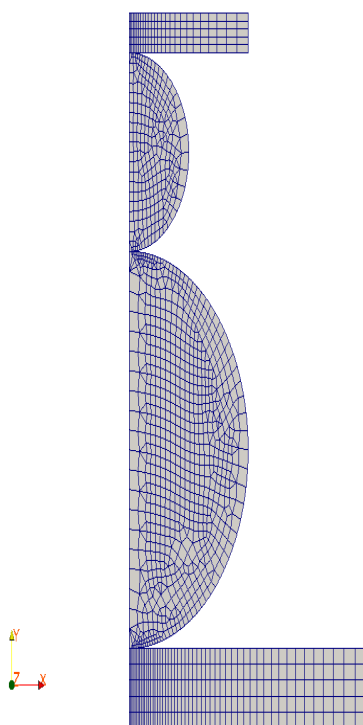
3 Modelization A

3.1 Characteristic of the modelization

The modelization is `AXIS`, two computations are carried out: the first to compute: the reference solution, the second to validate the contact without resolution (computation of clearances only). The contact algorithm used is that by default.

3.2 Characteristics of the mesh

Nodes: 4610
Meshes: 1348 QUAD8, 114 TRIA6



3.3 Quantities tested and results

the First Standard

computation	Identification of reference	Value of reference	Tolerance
<i>DY</i> at the point <i>PA4</i>	"SOURCE_EXTERNE"	-0,81 mm	4,0%
<i>DY</i> at the point <i>PA4</i>	"NON_REGRESSION"	-0,84 mm	1,0E- 8%
<i>FY</i> on edge <i>LBC4</i>	"SOURCE_EXTERNE"	17229,58 N	1,6%
<i>FY</i> on edge <i>LBC4</i>	"NON_REGRESSION"	17496,59 N	1,0E- 8%

the Second Standard

computation	Identification of reference	Value of reference	Tolerance
Minimum clearance upper surface	"NON_REGRESSION"	-1,749 mm	1,0E- 6%

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

Code Aster

**Version
default**

Titre : SSNA102 - Contact multicorps élastiques
Responsable : Thomas DE SOZA

Date : 27/06/2012 Page : 5/12
Clé : V6.01.102 Révision : 9202

Maximum clearance upper surface	"NON_REGRESSION"	3,28 mm	1,0E- 6%
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4 Modelization B

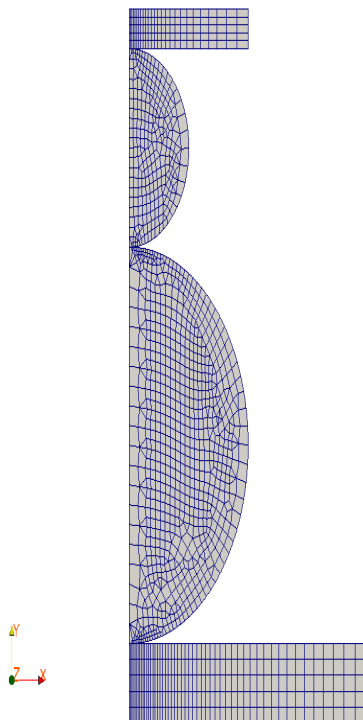
4.1 Characteristic of the modelization

The modelization is `AXIS`. The contact algorithm used is "LAGRANGIAN".

4.2 Characteristics of the mesh

Nodes: 4610

Meshes: 1348 QUAD8, 114 TRIA6



4.3 Quantities tested and Standard

Identification	results of reference	Value of reference	Tolerance
<i>DY</i> at the point <i>PA4</i>	"SOURCE_EXTERNE"	-0,81 <i>mm</i>	4,0%
<i>DY</i> at the point <i>PA4</i>	"NON_REGRESSION"	-0,84 <i>mm</i>	1,0E- 8%
<i>FY</i> on edge <i>LBC4</i>	"SOURCE_EXTERNE"	17229,58 <i>N</i>	1,6%
<i>FY</i> on edge <i>LBC4</i>	"NON_REGRESSION"	17503,14 <i>N</i>	1,0E- 8%

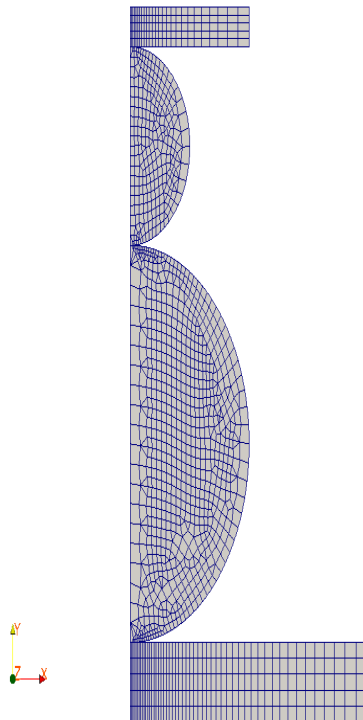
5 Modelization C

5.1 Characteristic of the modelization

The modelization is `AXIS`. The contact algorithm used is "LAGRANGIAN", the norm used is an average of the norms Master and slave.

5.2 Characteristics of the mesh

Nodes: 4610
Meshes: 1348 QUAD8, 114 TRIA6



5.3 Quantities tested and Standard

Identification	results of reference	Value of reference	Tolerance
<i>DY</i> at the point <i>PA4</i>	"SOURCE_EXTERNE"	-0,81 <i>mm</i>	4,0%
<i>DY</i> at the point <i>PA4</i>	"NON_REGRESSION"	-0,84 <i>mm</i>	1,0E- 8%
<i>FY</i> on edge <i>LBC4</i>	"SOURCE_EXTERNE"	17229,58 <i>N</i>	1,6%
<i>FY</i> on edge <i>LBC4</i>	"NON_REGRESSION"	17502,68 <i>N</i>	1,0E- 8%

6 Modelization D

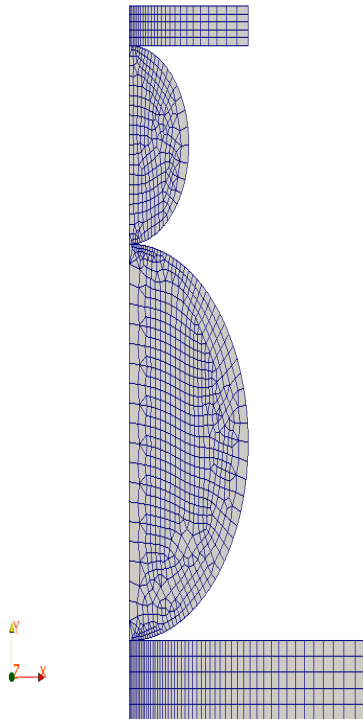
6.1 Characteristic of the modelization

The modelization is `AXIS`. The formulation of contact used is `"CONTINUE"`.

6.2 Characteristics of the mesh

Nodes: 4610

Meshes: 1348 QUAD8, 114 TRIA6



6.3 Quantities tested and Standard

Identification	results of reference	Value of reference	Tolerance
<i>DY</i> at the point <i>PA4</i>	"SOURCE_EXTERNE"	-0,81 <i>mm</i>	4,0%
<i>DY</i> at the point <i>PA4</i>	"NON_REGRESSION"	-0,841371811 <i>mm</i>	1,0E- 8%
<i>FY</i> on edge <i>LBC4</i>	"SOURCE_EXTERNE"	17229,58 <i>N</i>	1,6%
<i>FY</i> on edge <i>LBC4</i>	"NON_REGRESSION"	17501,437425187 <i>N</i>	1,0E- 8%

7 Modelization E

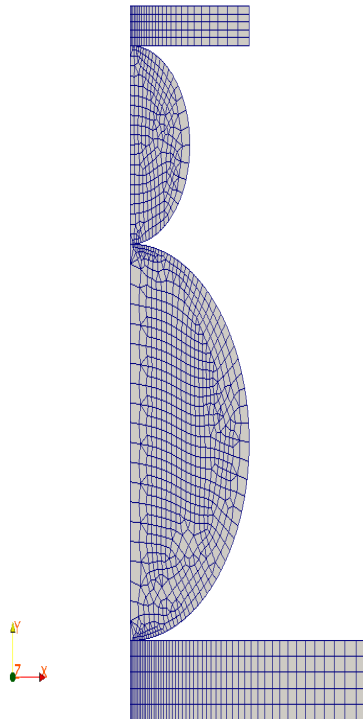
7.1 Characteristic of the modelization

The modelization is `AXIS`. The contact algorithm used is "GCP".

7.2 Characteristics of the mesh

Nodes: 4610

Meshes: 1348 QUAD8, 114 TRIA6



7.3 Quantities tested and Standard

Identification	results of reference	Value of reference	Tolerance
<i>DY</i> at the point <i>PA4</i>	"SOURCE_EXTERNE"	-0,81 mm	4,0%
<i>DY</i> at the point <i>PA4</i>	"NON_REGRESSION"	-0,84 mm	0,1%
<i>FY</i> on edge <i>LBC4</i>	"SOURCE_EXTERNE"	17229,58 N	1,6%
<i>FY</i> on edge <i>LBC4</i>	"NON_REGRESSION"	17496,59 N	0,1%

7.4 Remarks

With the convergence criterion of the conjugate gradient project (selected sufficiently small), one obtains the same solution exactly as that of the modelization A (algorithm "FORCED").

8 Modelization F

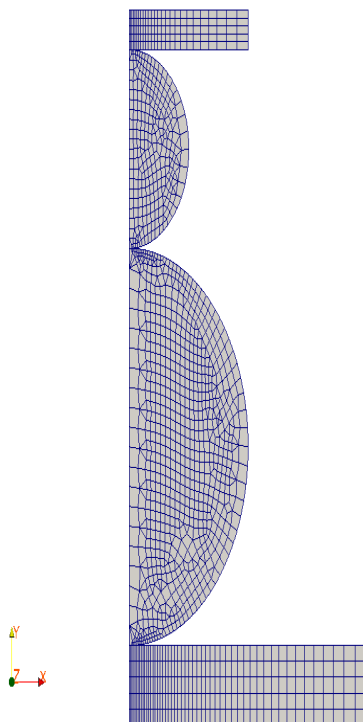
8.1 Characteristic of the modelization

The modelization is `AXIS`. The formulation of contact used is `"CONTINUE"`. In this modelization, friction is added on the contact zone of the medium with a very low coefficient of kinetic friction in order to validate the mixture of zone with contact alone and friction.

8.2 Characteristics of the mesh

Nodes: 4610

Meshes: 1348 QUAD8, 114 TRIA6



8.3 Quantities tested and Standard

Identification	results of reference	Value of reference	Tolerance
<i>DY</i> at the point <i>PA4</i>	<code>"SOURCE_EXTERNE"</code>	-0,81 <i>mm</i>	4,0%
<i>DY</i> at the point <i>PA4</i>	<code>"NON_REGRESSION"</code>	-0,84 <i>mm</i>	0,1%
<i>FY</i> on edge <i>LBC4</i>	<code>"SOURCE_EXTERNE"</code>	17229,58 <i>N</i>	3,0%
<i>FY</i> on edge <i>LBC4</i>	<code>"NON_REGRESSION"</code>	17496,15 <i>N</i>	0,1%

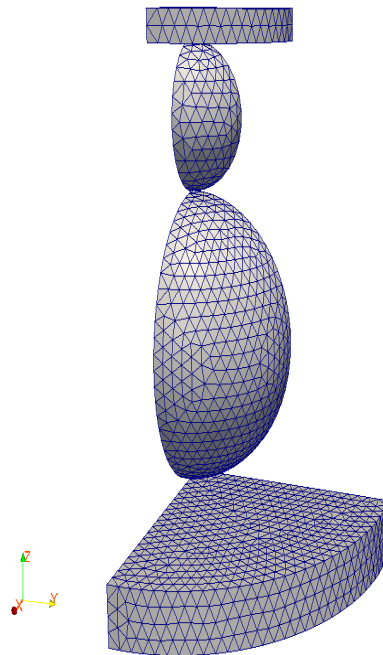
9 Modelization G

9.1 Characteristic of the modelization

The modelization is 3D. The formulation of contact used is "CONTINUE".

9.2 Characteristics of the mesh

Nodes: 4465
Meshes: 19389 TETRA4



9.3 Quantities tested and Standard

Identification	results of reference	Value of reference	Tolerance
<i>DZ</i> to point <i>PA4</i>	"SOURCE_EXTERNE"	-0,81 <i>mm</i>	4,0%
<i>DZ</i> to point <i>PA4</i>	"NON_REGRESSION"	-0,80 <i>mm</i>	1,0E- 10%
<i>FZ</i> on edge <i>ENCAST</i>	"SOURCE_EXTERNE"	27064,25 <i>N</i>	5,0%
<i>FZ</i> on edge <i>ENCAST</i>	"NON_REGRESSION"	28329,08 <i>N</i>	1,0E- 10%

10 Summary of the results

the results are satisfactory taking into account the diversity of the origin of the reference solution. The various contact algorithms give identical results in displacement and force.