ZZZZ189 – Circumferential directional sense by a loop Summarized

Python:

One treats the case of a concrete hemisphere with reinforcements orthoradiales under pressure in linear elasticity. One seeks to direct reinforcements circonférentiellement. This operation can be realized of two ways.

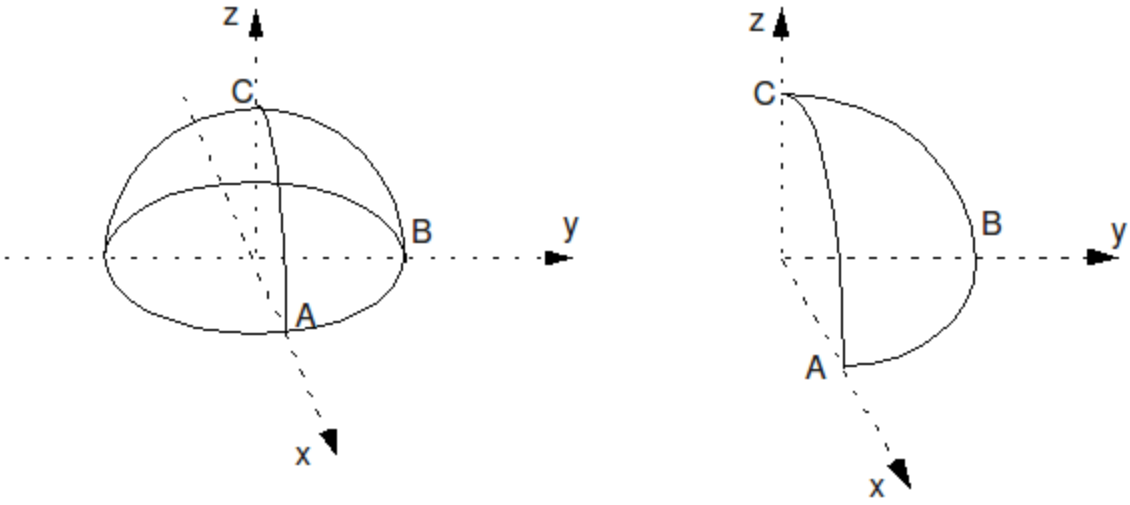
One proposes in the modelizations (A) and (C) a function Python which makes it possible to carry out this action, while directing meshes one by one.

In the modelizations (B) and (D), one uses command AXE of option GRILL of AFFE_CARA_ELEM which allows a setting in data much simpler of the command file to direct all reinforcements with only one command. The results of the modelization (B) are then compared with the modelization (A), and those of the modelization (D) with the modelization (C).

In the modelizations (A) and (B), the reference axis is $(0,0,1)$. In the modelizations (C) and (D), the reference axis is $(0,1,0)$. The two last modelizations were added in order to have non-zero values of nautical β angle.

1 Problem of reference

1.1 Geometry



Radius $R=10.m$
Thickness $t=0.04$

Coordinated of the points:

	A	B	C
x	10.	0.	0.
y	0.	10.	0.
z	0.	0.	10.

1.2 Material properties

the hemisphere is composed of concrete reinforced by grids. As the purpose is only to test commands, one gives the same properties to the concrete and the grids.

$E=200000\,Pa$, $\nu=0.3$

1.3 Boundary conditions and loadings

On a quarter of the hemisphere:

Not C	not of displacement in z
Side AC	symmetry compared to the plane xz
Side BC	symmetry compared to the free yz
Side AB	plane

internal Pressure: $P=10.Pa$

1.4 Problems of directional sense

One want that the grids of reinforcement are directed circonférentiellement compared to the axis given. However, seen the hemispherical form considered, one proposes a function Python to carry it out.

The principle is the following:

1) the axis of the hemisphere is noted Z

2) for each mesh, one calculates the vector indicating the ciconférentielle direction by $V = Z \wedge N$ where N is the norm with the mesh. One notes $V = [Vx, Vy, Vz]$ and one defines his projection on the plane (XOY) by $W = [Vx, Vy, 0]$
3) one calculates the values of ANGL_REP to be assigned to the current mesh by $\alpha = \arctan(Vy/Vx)$ and $\beta = -\arctan(Vz/norm(W))$

function called LIST_CARA_CIRCONF buckles on all meshes the grid, calculates α and β creates the key words:

```
_F (SECTION=20.0,
    MAILLE=Nom_Maille_Courante,
    EXCENTREMENT=0.0, ANGL_REP= (α, β)),
    COEF_RIGI_DRZ=1.E-10
),
```

and he adds them in a list. One provides then this list to AFFE_CARA_ELEM. The commands are thus obtained:

```
LIST_GRI=LISTE_CARA_CIRCONF (
    GROUP_MA=' GRILL',
    AXE= (0. , 0. , 1.),
    MODELE=MODEL,
    GRILL=_F (SECTION=20., EXCENTREMENT=0.,)
)

CARA_COQ=AFFE_CARA_ELEM (
    MODELE=MODEL,
    COEF_RIGI_DRZ=0.,),
    GRILL=LISTE_GRI,
)
```

Let us note finally that, formally, LIST_CARA_CIRCONF obeys the following catalog:

```
LIST_CARA_ CIRCONF (
    GROUP_MA=SIMP          (statut=' o', typ=grma, max=' ** "),
    AXE=SIMP                 (statut=' O", typ=' R', max=3, min=3),
    MODE=SIMP                (statut=' o', typ=modele_sdaster),
    GRILL=FACT             (statut=' f', max=1,
         SECTION=SIMP      (statut=' o', typ=' R'),
         EXCENTREMENT=SIMP   (statut=' f', typ=' R'),
         COEF_RIGI_DRZ=SIMP  (statut=' f', typ=' R'),
    ),
)
```

2 Modelization A

2.1 Characteristic of the modelization

1373 shell elements DKT
1373 elements of grid GRILLE_MEMBRANE

Modelization of a quarter of the hemisphere in TRIA3.

2.2 Characteristics of the mesh

Many nodes: 734
Number of meshes and types: 2746 TRIA3

2.3 Quantities tested and results

One tests values of NON-regression calculated with the Standard $V7.03.30$.

version	Identification of reference	Values of reference
Node 30, displacement DX	"NON_REGRESSION"	0
Node 30, displacement DY	"NON_REGRESSION"	3.139397E-05
Node 30, displacement DZ	"NON_REGRESSION"	1.533531E-05
Node 700, displacement DX	"NON_REGRESSION"	4.487504E-06
Node 700, displacement DY	"NON_REGRESSION"	3.321124E-05
Node 700, displacement DZ	"NON_REGRESSION"	1.515258E-05

3 Modelization B

The modelization B tests functionality AXE of option GRILL of AFFE_CARA_ELEM which makes it possible to direct reinforcements directly by Code_Aster. The results using the loops python are used to provide the reference solution.

3.1 Characteristics of the modelization

1373 shell elements DKT
1373 elements of grid GRILLE_MEMBRANE

Modelization of a quarter of the hemisphere in TRIA3.

3.2 Characteristics of the mesh

Many nodes: 734
Number of meshes and types: 2746 TRIA3

3.3 Quantities tested and results

One compares the values of displacement with those calculated by the loop Python (modelization A).

Standard	identification of reference	Values of reference
Node 30, displacement DX	"NON_REGRESSION"	0
Node 30, displacement DY	"NON_REGRESSION"	3.139397E-05
Node 30, displacement DZ	"NON_REGRESSION"	1.533531E-05
Node 700, displacement DX	"NON_REGRESSION"	4.487504E-06
Node 700, displacement DY	"NON_REGRESSION"	3.321124E-05
Node 700, displacement DZ	"NON_REGRESSION"	1.515258E-05

4 Modelization C

4.1 Characteristic of the modelization

1373 shell elements DKT
1373 elements of grid GRILLE_MEMBRANE

Modelization of a quarter of the hemisphere in TRIA3.

4.2 Characteristics of the mesh

Many nodes: 734
Number of meshes and types: 2746 TRIA3

4.3 Quantities tested and results

One tests values of NON-regression calculated with the version $V11.02.20$.

Standard	Identification of reference	Values of reference
Node 30, displacement DX	"NON_REGRESSION"	0
Node 30, displacement DY	"NON_REGRESSION"	3.8636255E-05
Node 30, displacement DZ	"NON_REGRESSION"	1.4680190E-05
Node 700, displacement DX	"NON_REGRESSION"	3.9129862E-06
Node 700, displacement DY	"NON_REGRESSION"	4.0527685E-05
Node 700, displacement DZ	"NON_REGRESSION"	1.4931766E-05

5 Modelization D

The modelization D tests functionality AXE of option GRILL of AFFE_CARA_ELEM which makes it possible to direct reinforcements directly by Code_Aster. The results using the loops python are used to provide the reference solution (modelization C).

5.1 Characteristics of the modelization

1373 shell elements DKT
1373 elements of grid GRILLE_MEMBRANE

Modelization of a quarter of the hemisphere in TRIA3.

5.2 Characteristics of the mesh

Many nodes: 734
Number of meshes and types: 2746 TRIA3

5.3 Quantities tested and results

One compares the values of displacement with those calculated by the loop Python (modelization C)

Standard	Identification of reference	Values of reference
Node 30, displacement DX	"NON_REGRESSION"	0
Node 30, displacement DY	"NON_REGRESSION"	3.8636255E-05
Node 30, displacement DZ	"NON_REGRESSION"	1.4680190E-05
Node 700, displacement DX	"NON_REGRESSION"	3.9129862E-06
Node 700, displacement DY	"NON_REGRESSION"	4.0527685E-05
Node 700, displacement DZ	"NON_REGRESSION"	1.4931766E-05

6 Summary of the results

This test presents a advanced use of the language Python within *Code_Aster* (modelizations A and C) which is used as reference to the validation as of the modelizations B and D. These modelizations use command AXE of option GRILL of AFFE_CARA_ELEM. The reference solutions are found.