# ZZZZ189 – Circumferential orientation by a loop Python

**Summary:**

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

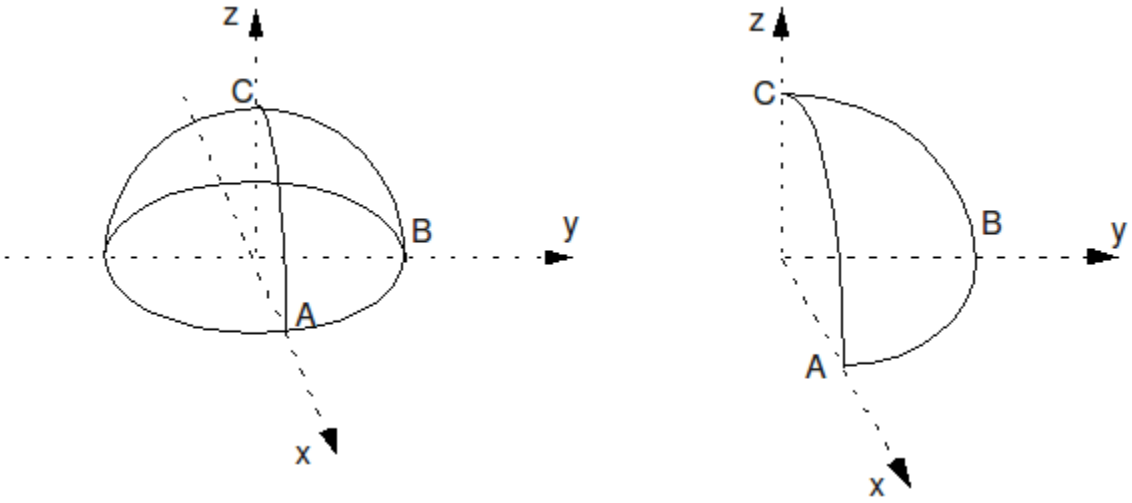
One proposes in modelings $(A)$ and $(C)$ a function Python which makes it possible to carry out this action, by directing the meshs one by one.

In modelings $(B)$ and $(D)$, the order is used AXIS option GRID of AFFE_CARA_ELEM who allows a setting in data much simpler of the command file to direct all the reinforcements with only one orders. Results modeling $(B)$ are then compared with modeling $(A)$, and those of modeling $(D)$ with modeling $(C)$.

In modelings $(A)$ and $(B)$, the reference axis is $(0,0,1)$. In modelings $(C)$ and $(D)$, the reference axis is $(0,1,0)$. Two last modelings were added in order to have values of nautical angle $\beta$ nonworthless.

# 1 Problem of reference

## 1.1 Geometry




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

Coordinates 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 objective is only to test orders, 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 $C$ | pas de displacement in $z$ |
| Side $AC$ | symmetry compared to the plan $xz$ |
| Side $BC$ | symmetry compared to the plan $yz$ |
| Side $AB$ | free |

Internal pressure: $P=10.Pa$

## 1.4 Problems of orientation

It is wanted 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 normal with the mesh. One notes $V = [Vx, Vy, Vz]$ and one defines his projection on the plan $(XOY)$ by $W = [Vx, Vy, 0]$
3) one calculates the values of ANGL_REP to assign to the current mesh by $\alpha = \arctan(Vy/Vx)$ and $\beta = -\arctan(Vz/norm(W))$

The function called LIST_CARA_CIRCONF buckle on all the meshs roasts, calculates $\alpha$ and $\beta$ and creates the keywords:

```
_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 orders are thus obtained:

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

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

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

```
LIST_CARA_ CIRCONF (
    GROUP_MA            =SIMP (statut=' o', typ=grma, max=' ** '),
    AXIS                =SIMP (statut=' o', typ=' R', max=3, min=3),
    MODE                =SIMP (statut=' o', typ=modele_sdaster),
    GRID=FACT (statute= ' f', max=1,
        SECTION         =SIMP (statut=' o', typ=' R'),
        OFFSETTING      =SIMP (statut=' f', typ=' R'),
        COEF_RIGI_DRZ   =SIMP (statut=' f', typ=' R'),
    ),
)
```

# 2 Modeling A

## 2.1 Characteristics of modeling

1373 elements of hull DKT
1373 elements of grid GRILLE_MEMBRANE

Modeling of a quarter of the hemisphere in TRIA3.

## 2.2 Characteristics of the grid

Many nodes: 734
Many meshs and types: 2746 TRIA3

## 2.3 Sizes tested and results

One tests values of not-regression calculated with the version $V7.03.30$.

| Identification | Type 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 Modeling B

Modeling B tests the functionality AXIS option GRID of AFFE_CARA_ELEM who allows to direct the reinforcements directly by Code_Aster. The results using the loops python are used to provide the reference solution.

## 3.1 Characteristics of modeling

1373 elements of hull DKT
1373 elements of grid GRILLE_MEMBRANE

Modeling of a quarter of the hemisphere in TRIA3.

## 3.2 Characteristics of the grid

Many nodes: 734
Many meshs and types: 2746 TRIA3

## 3.3 Sizes tested and results

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

| Identification | Type 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 Modeling C

## 4.1 Characteristics of modeling

1373 elements of hull DKT
1373 elements of grid GRILLE_MEMBRANE

Modeling of a quarter of the hemisphere in TRIA3.

## 4.2 Characteristics of the grid

Many nodes: 734
Many meshs and types: 2746 TRIA3

## 4.3 Sizes tested and results

One tests values of not-regression calculated with the version $V11.02.20$.

| Identification | Type 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 Modeling D

Modeling D tests the functionality AXIS option GRID of AFFE_CARA_ELEM who allows to direct the reinforcements directly by Code_Aster. The results using the loops python are used to provide the reference solution (modeling C).

## 5.1 Characteristics of modeling

1373 elements of hull DKT
1373 elements of grid GRILLE_MEMBRANE

Modeling of a quarter of the hemisphere in TRIA3.

## 5.2 Characteristics of the grid

Many nodes: 734
Many meshs and types: 2746 TRIA3

## 5.3 Sizes tested and results

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

| Identification | Type 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* (modelings $A$ and $C$) who is used as reference to the validation as of modelings $B$ and $D$. These modelings use the order AXIS option GRID of AFFE_CARA_ELEM. The reference solutions are found.