

MASTER SIS
Information and Systems Sciences

Meshes modifications and semantic information transfer

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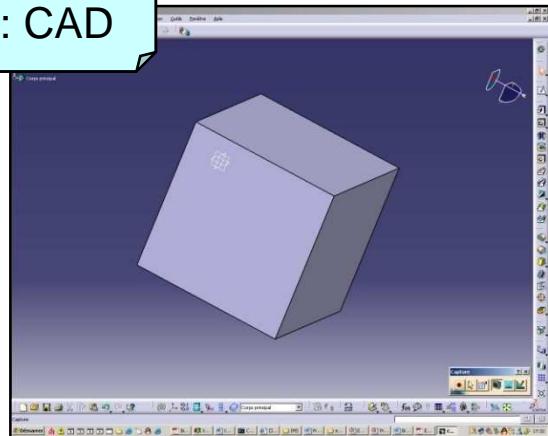
Information and Systems Science Laboratory (LSIS)
Engineering, Mechanics, Systems team (IMS)

Presentation program

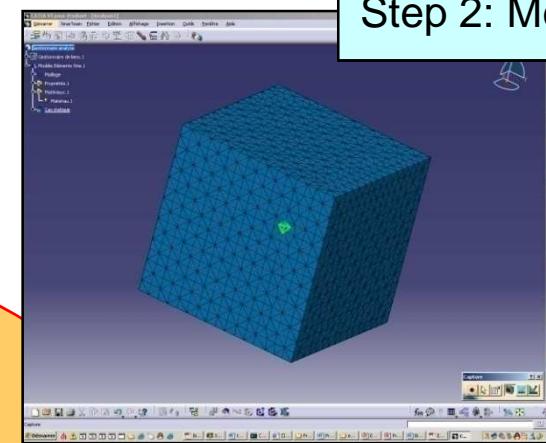
1. Introduction
2. Objectives
3. Step
4. Approaches et algorithms
5. Results
6. Conclusions & Perspectives

General contexte of this work (1/2)

Step 1: CAD

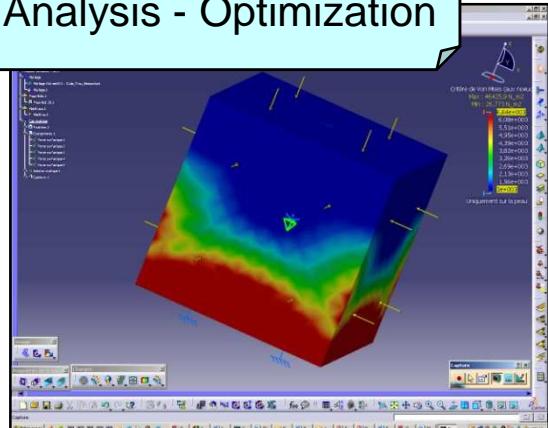


Step 2: Meshing

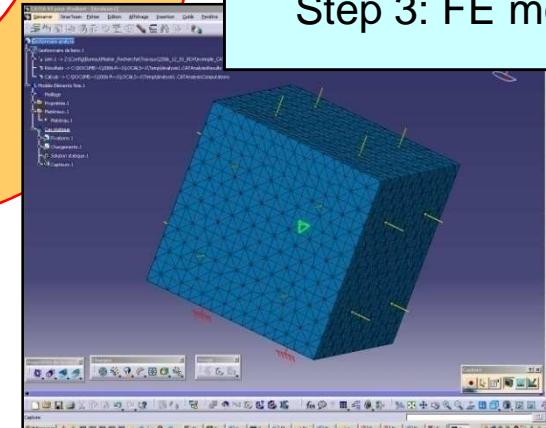


Classical loop of digital simulation realizationen for EF

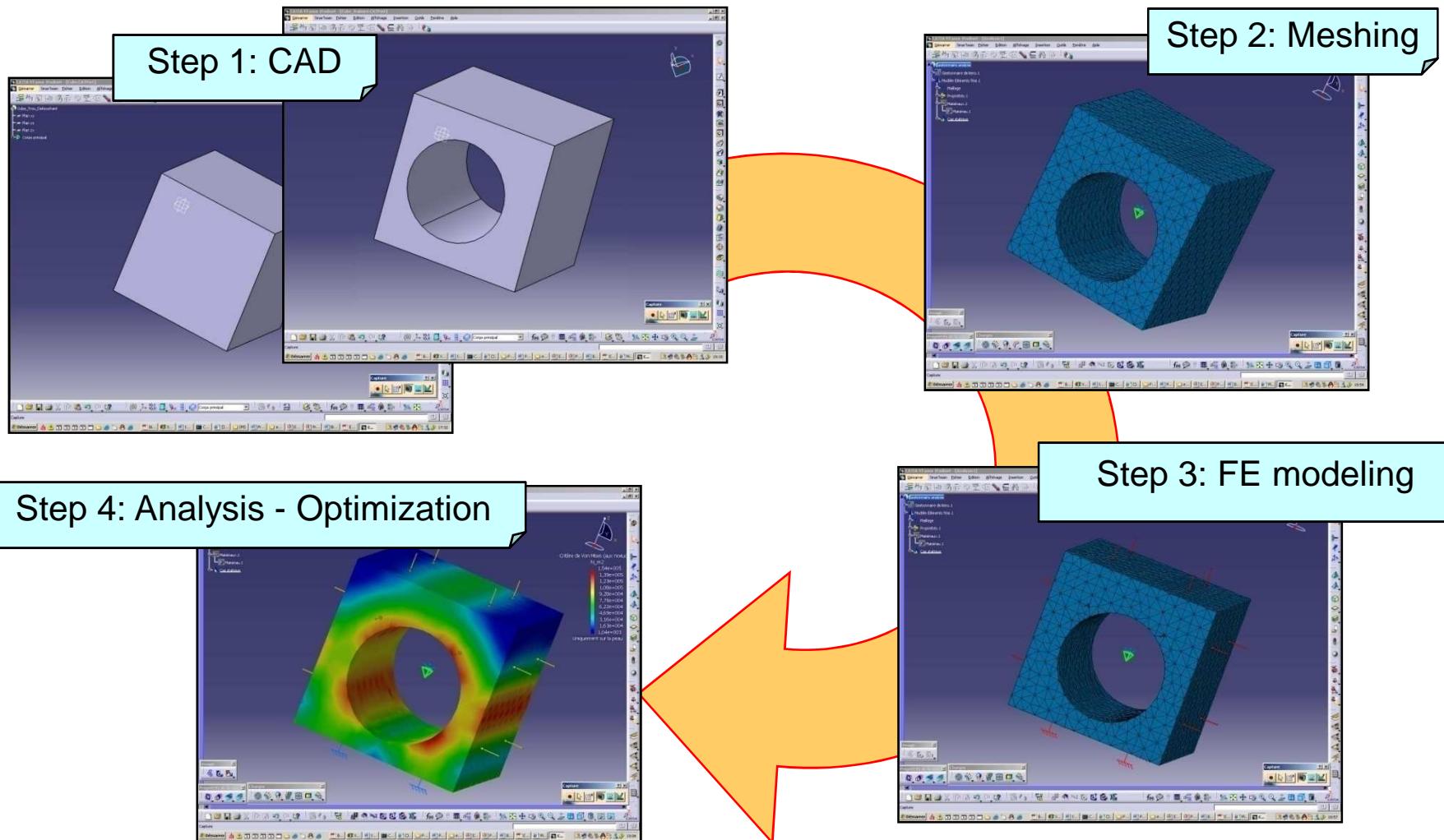
Step 4: Analysis - Optimization



Step 3: FE modeling

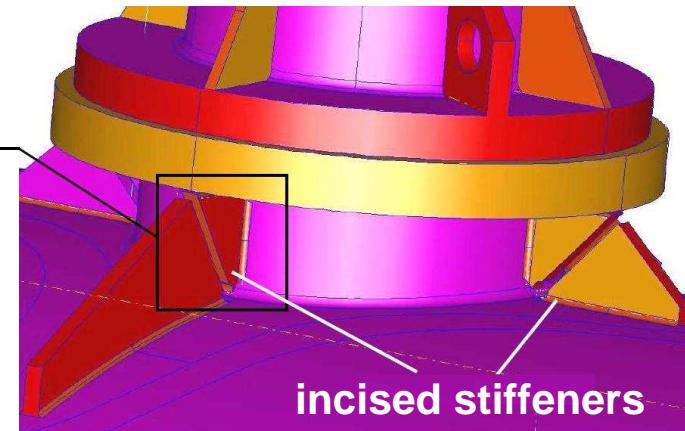
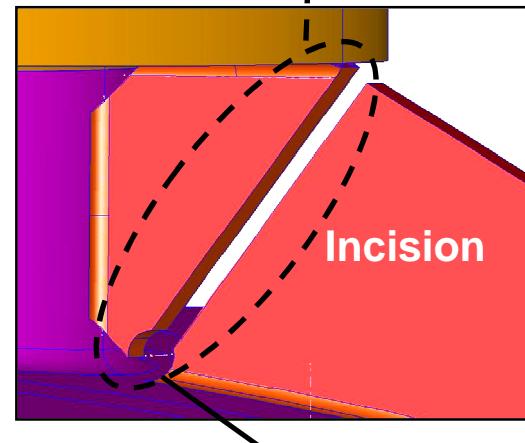
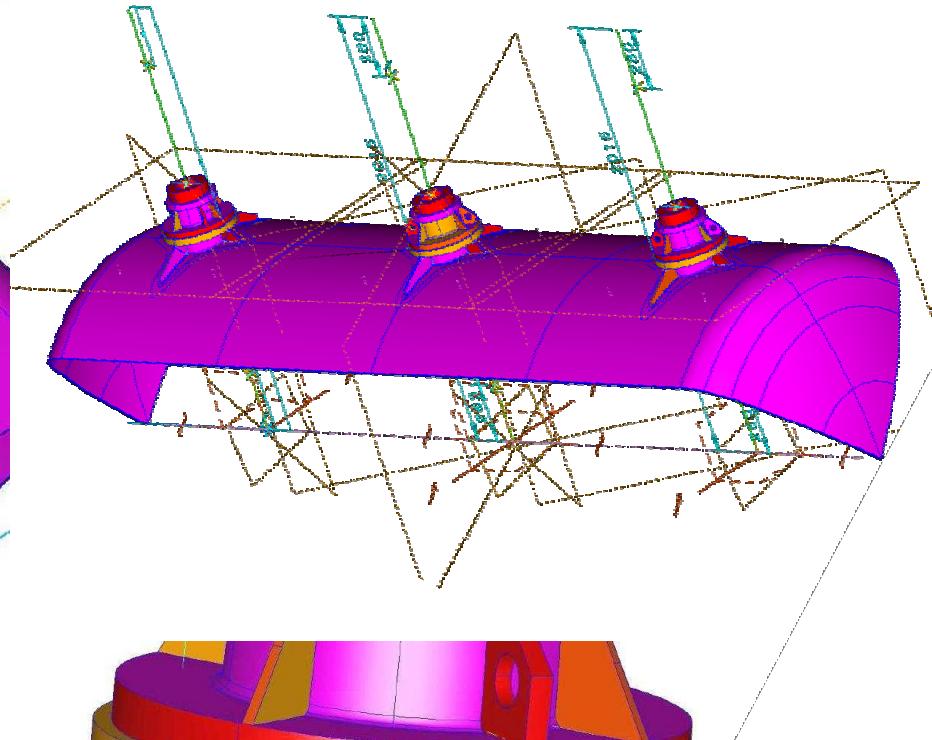
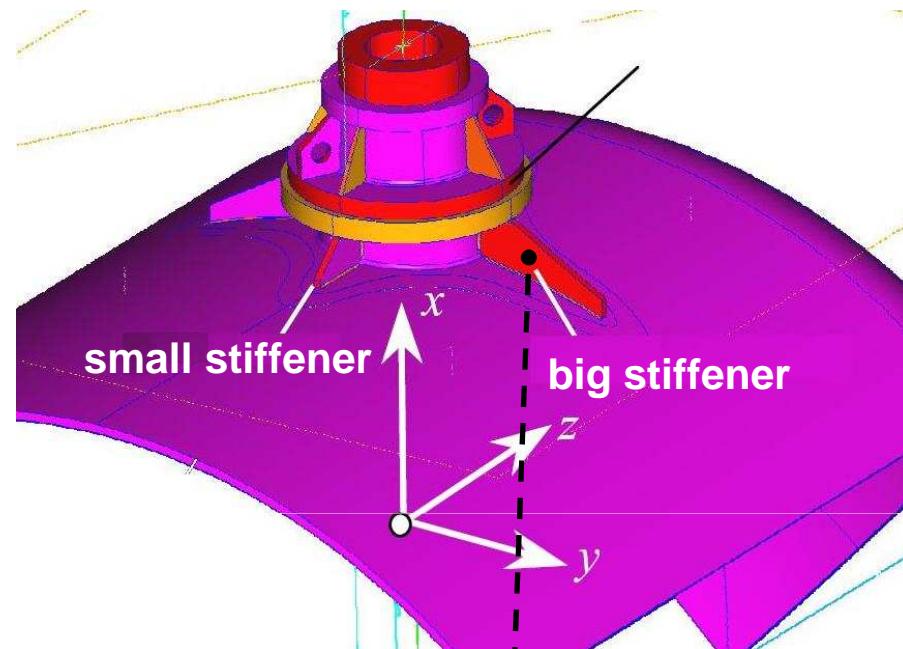


General contexte of this work (2/2)



A structural modification (drilling, tightener, etc.) is made by the CAD modification, the remeshing, limit conditions modification, etc... **The last takes much time!**

Study examples of EDF R&D (1/2)

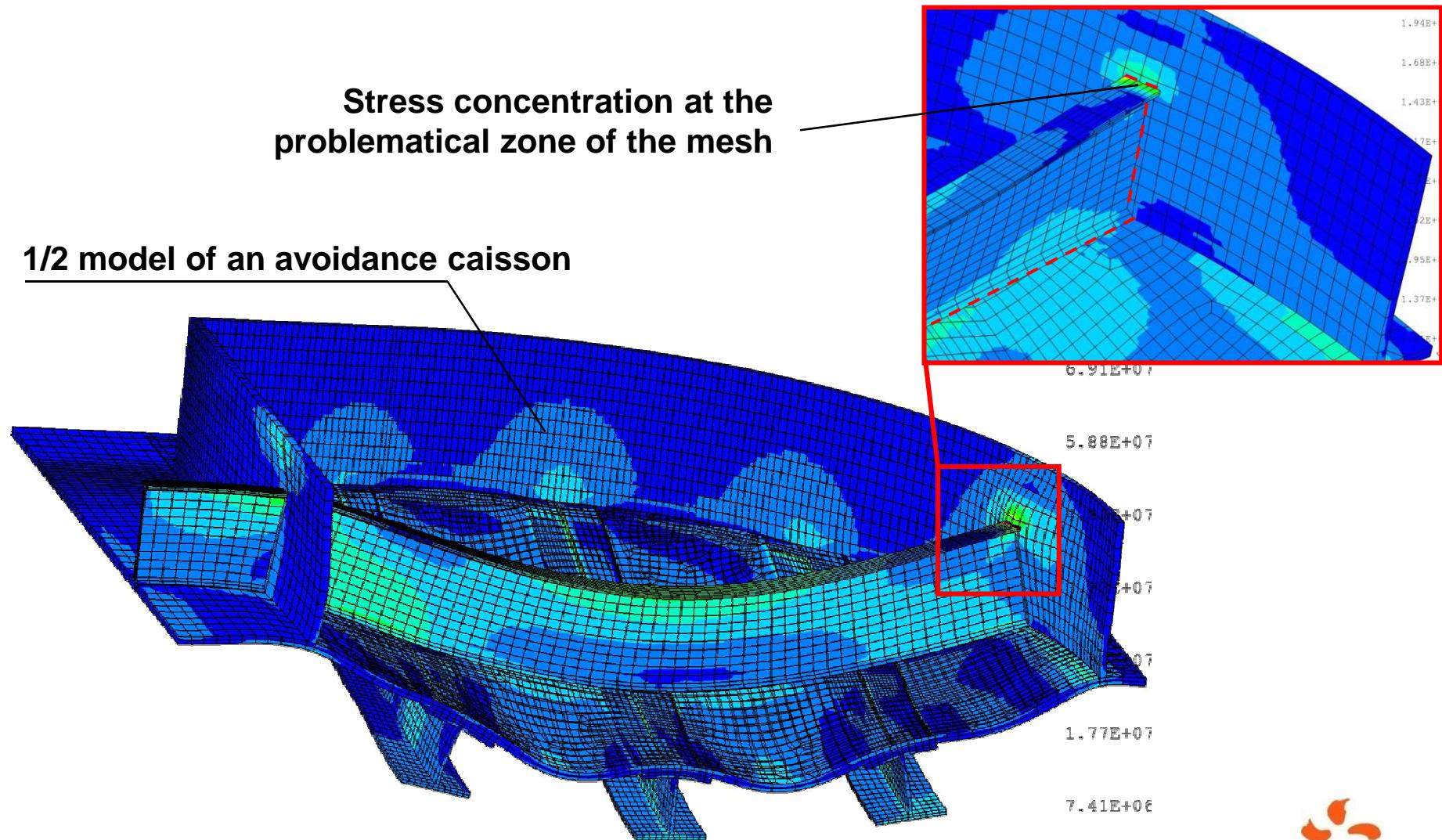


**Modifications are carried out on CAD
(for avoiding fissure)**

Study examples of EDF R&D (2/2)

Stress concentration at the problematical zone of the mesh

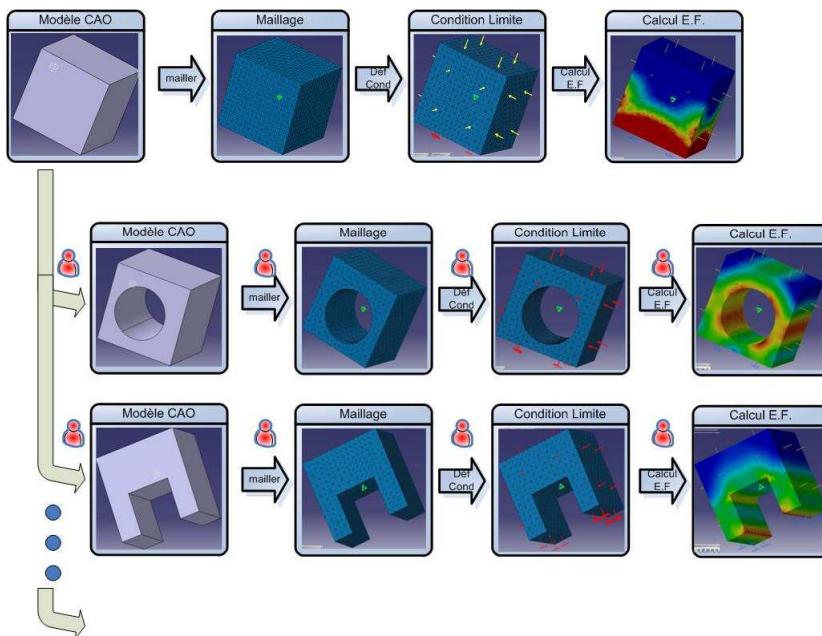
1/2 model of an avoidance caisson



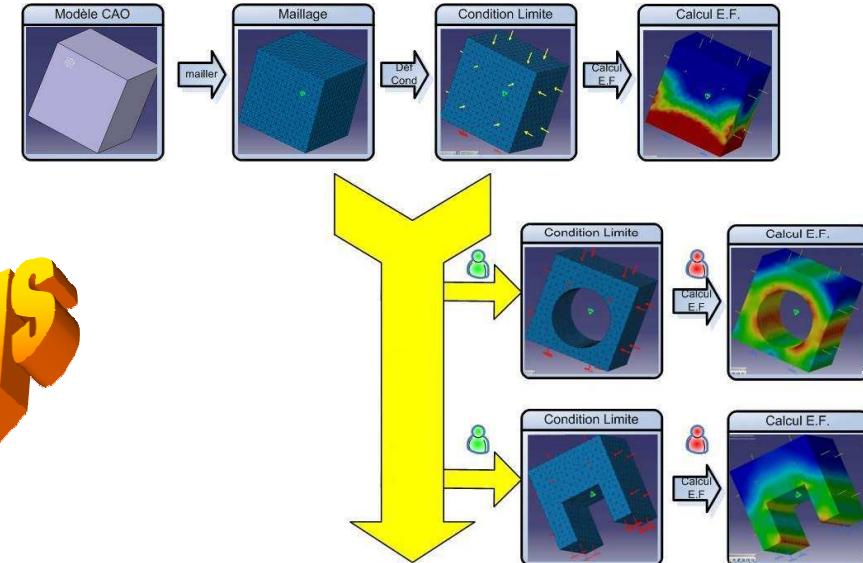
Merge the two models by CAD (for avoiding the boundary condition specification problems between two meshes).

General idea

To avoid returning to the CAD and
to allow direct meshes modifications



Classical solution



Proposed solution

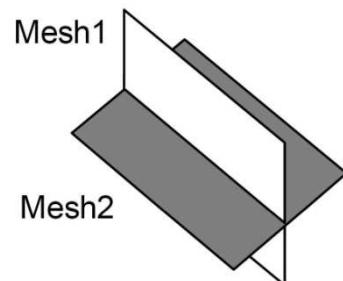
Meshes modifications
and semantics transfer

Objectives for double levels

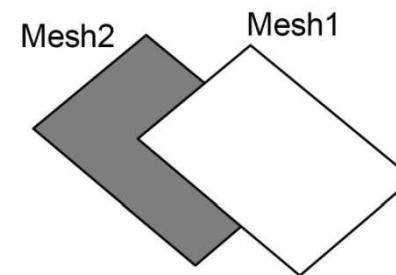
Triangular meshes modifications (2D)

Restriction to meshes merging by two modes:

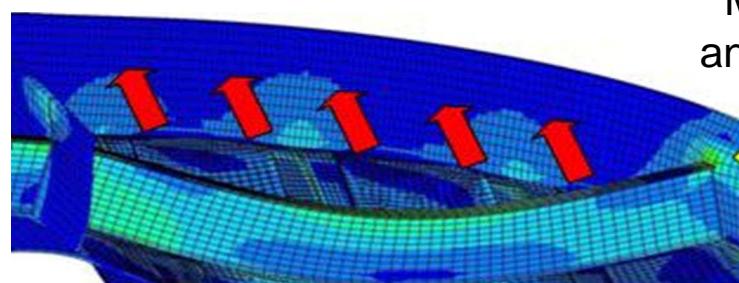
Face/Edge



Face/Face

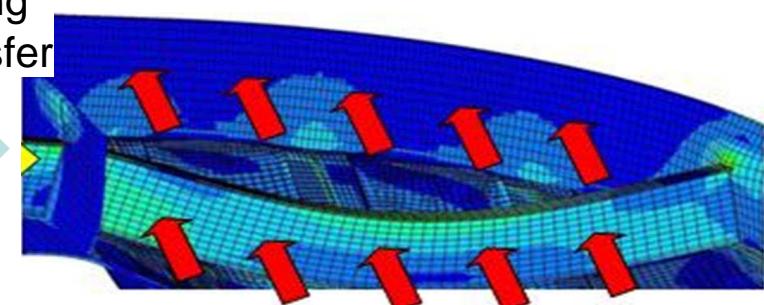


Semantic information transfer



Internal pressure on the caisson
Nothing is on the tightener

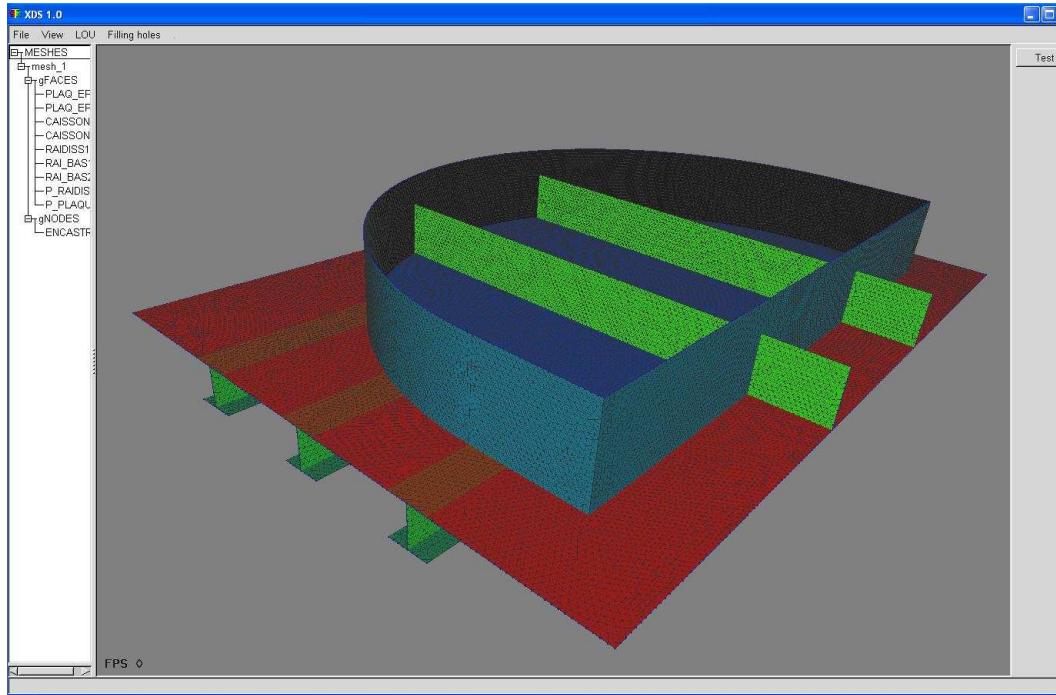
Mesh merging
and BCs transfer



Pressure on the caisson
AND on the tightener

Practical aspects

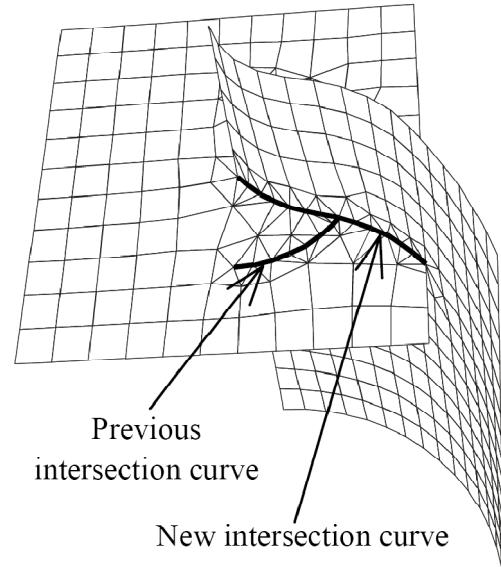
Development under XDS (C, Gtk, OpenGL)



Mesh file format '.unv' (IDEAS universal format)

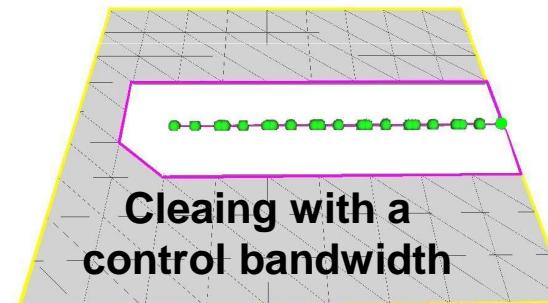
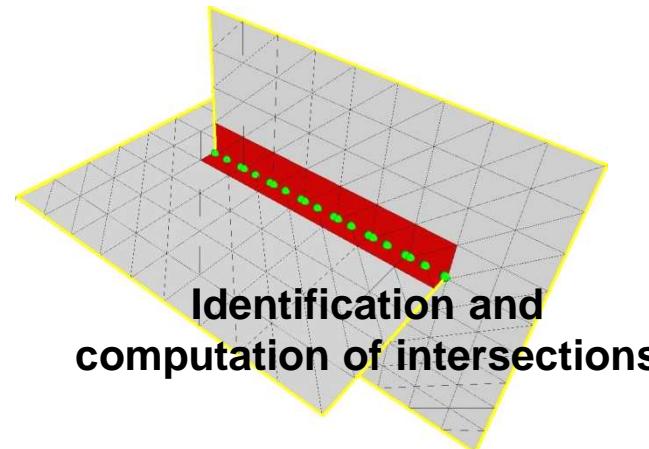
Semantics aspect (pressures, elements shifting, etc.) is taken account of by **entities group** (nodes, faces, edges) notion in files '**.unv**'

Face/Edge mode

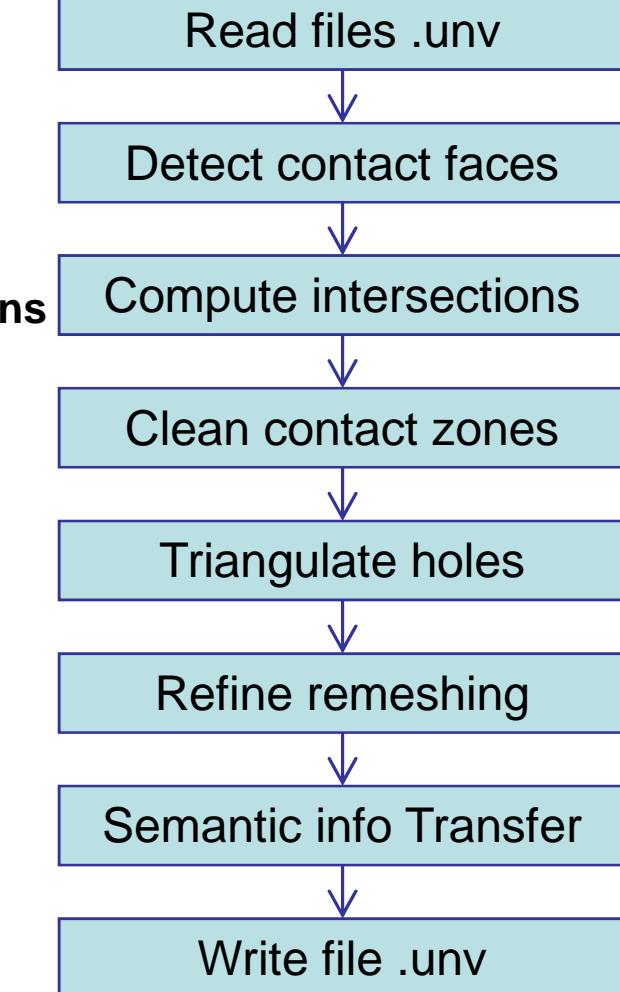
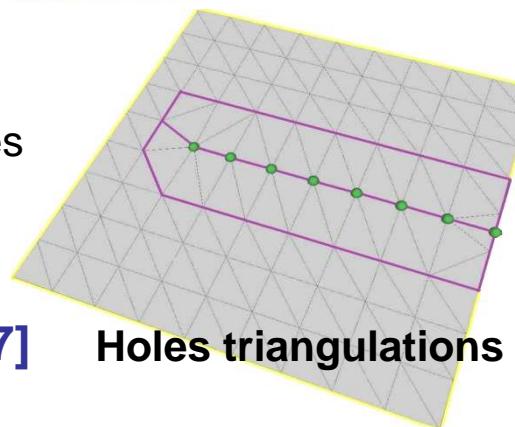


[Lira 2002]

- Compute directly intersections
- Degenerated triangles maybe created si densités très différentes



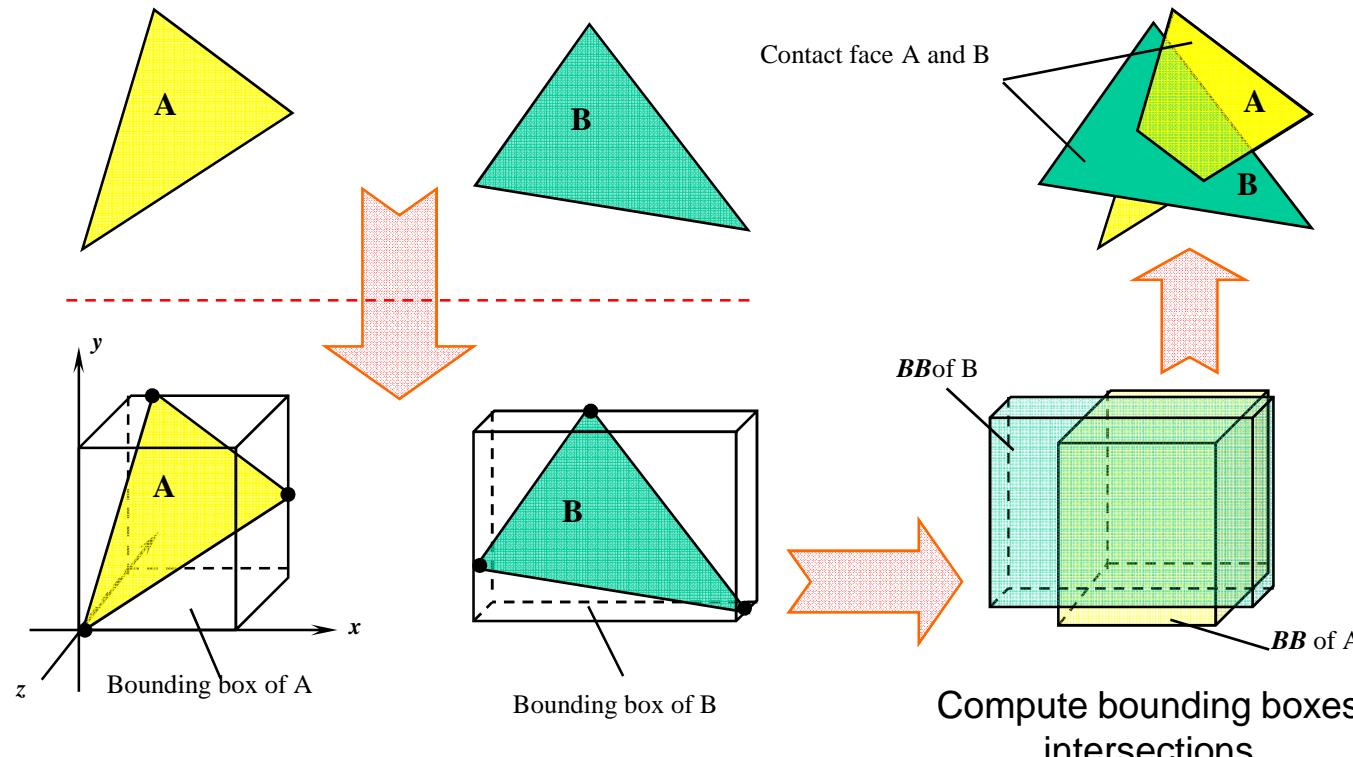
[Lou 2007]



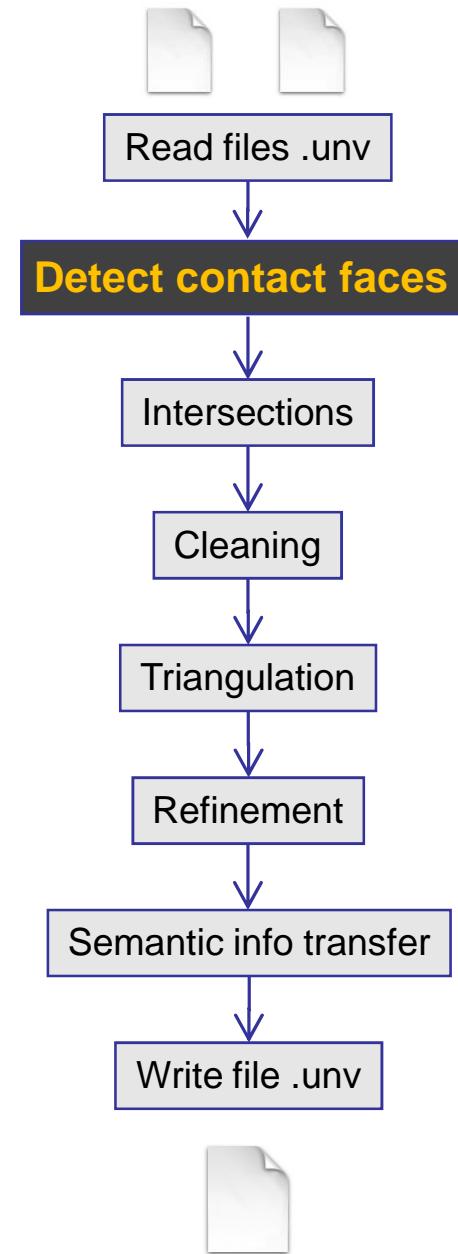
Detect contact faces contact

- Base on the algorithm of [Chouadria 2006]

Compute bounding boxes for each face of every models

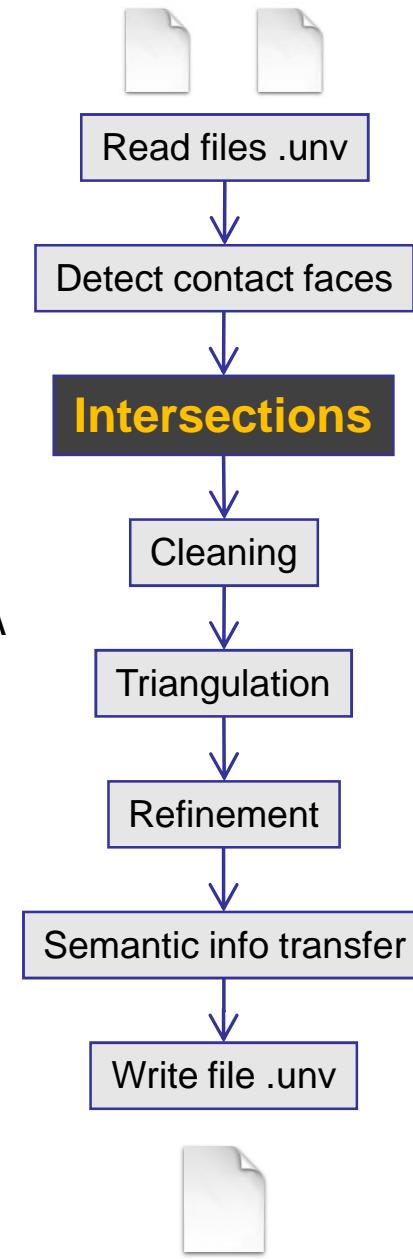
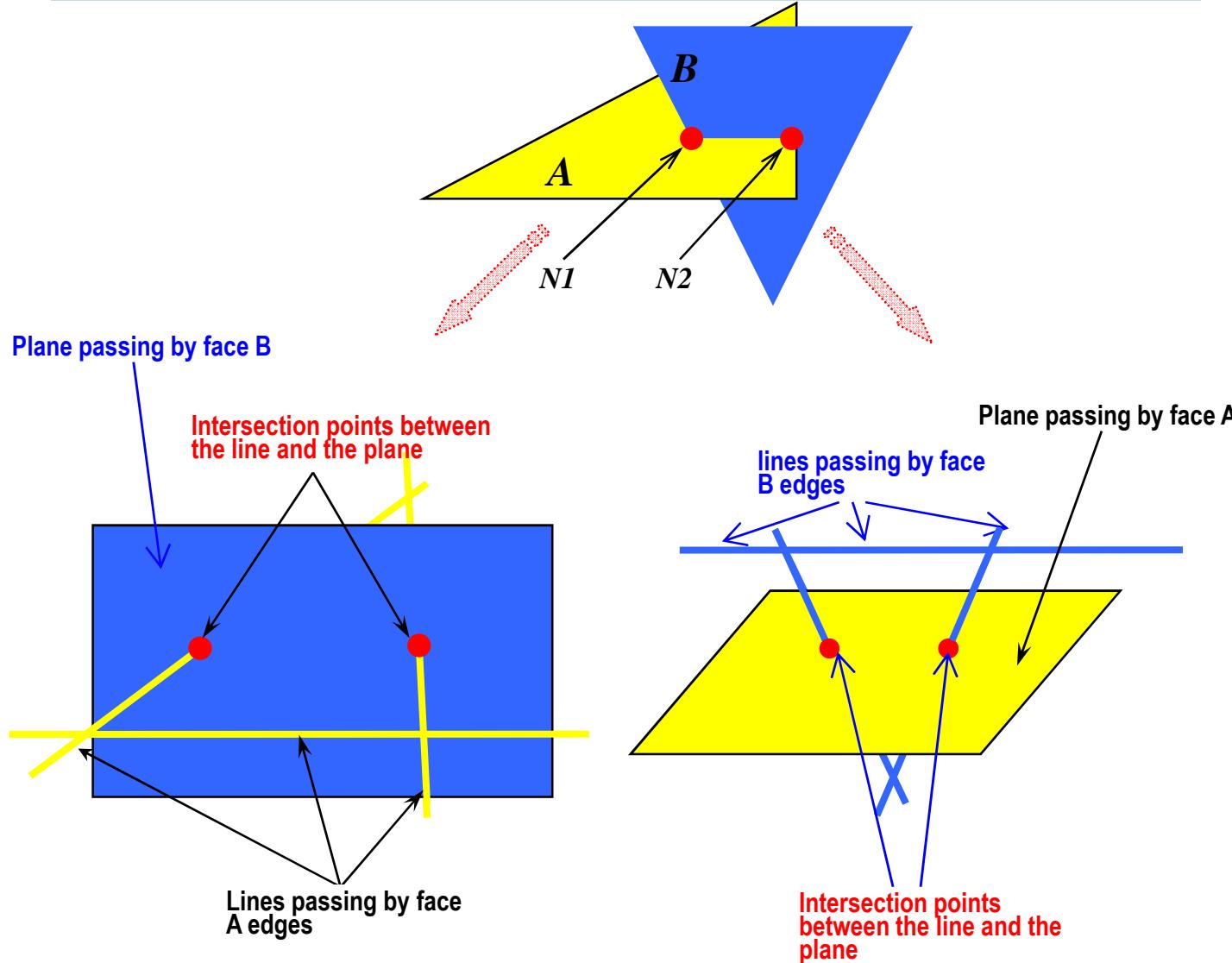


- Addition of a structure « octree » adapted for spatial search...



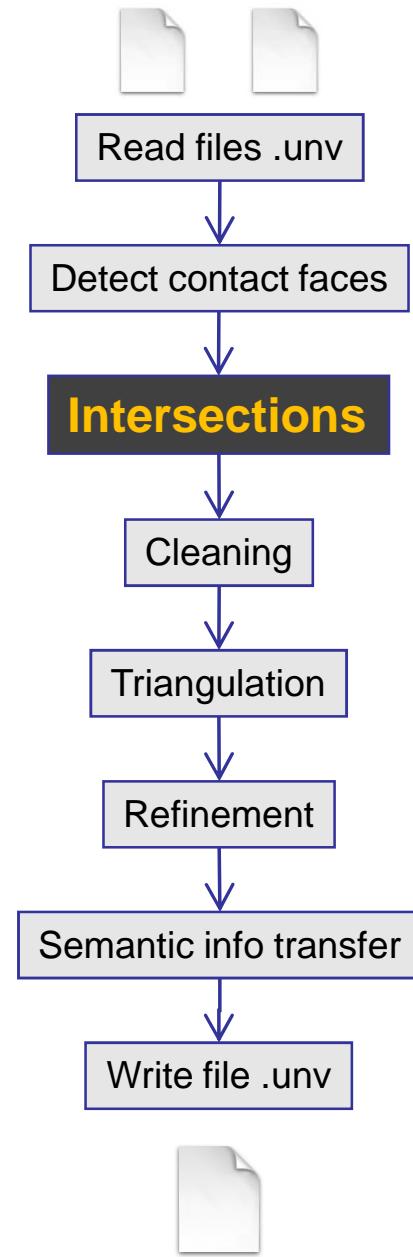
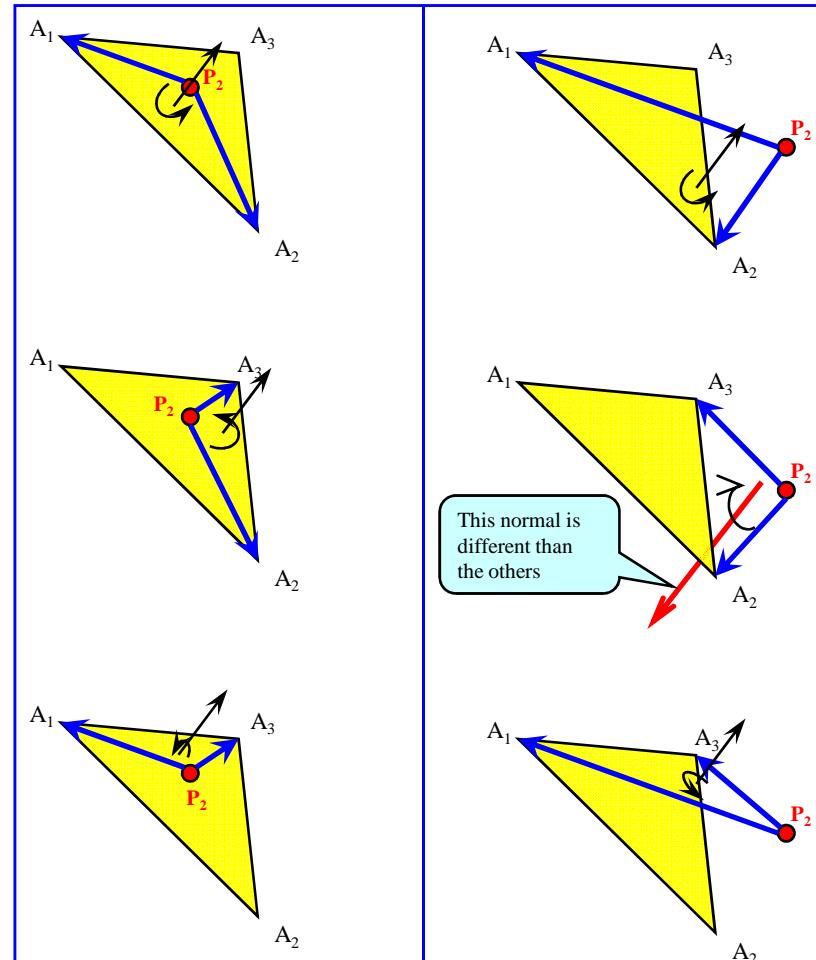
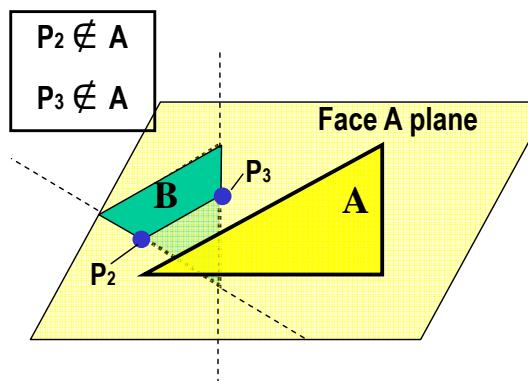
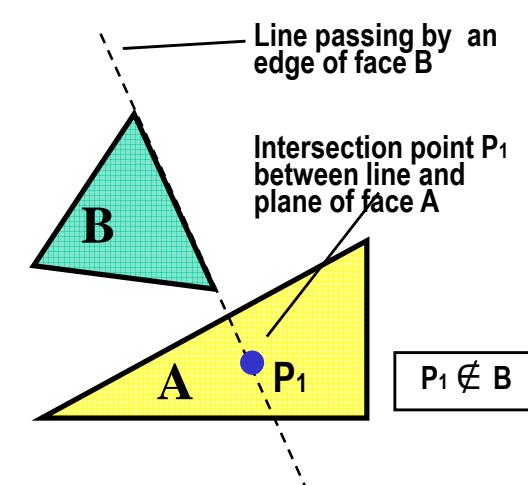
Compute intersection nodes (1/3)

- Compute intersection of line/plane



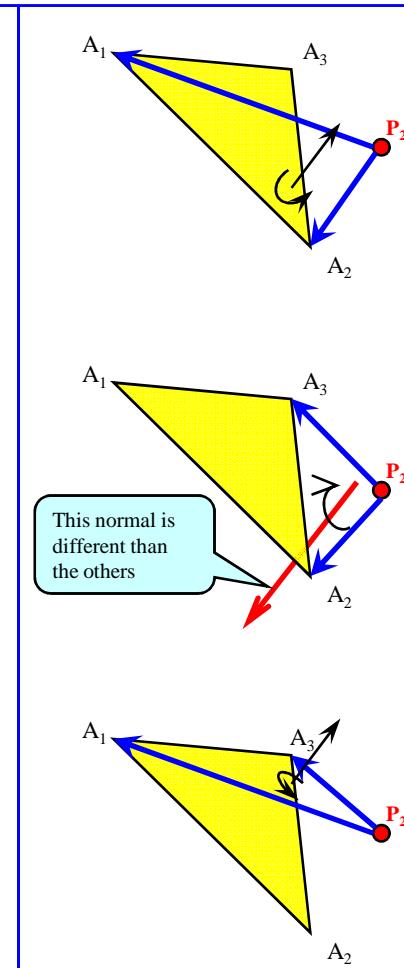
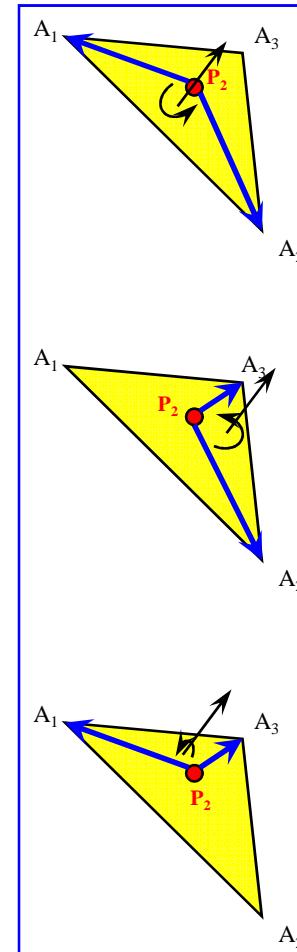
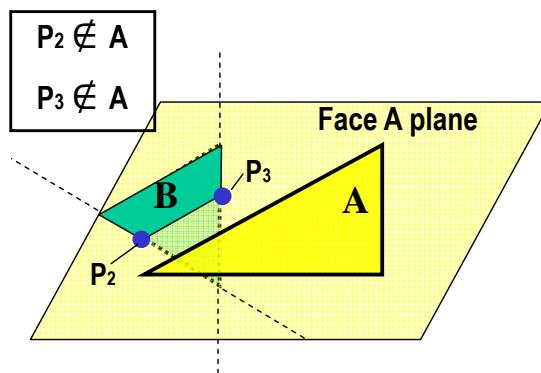
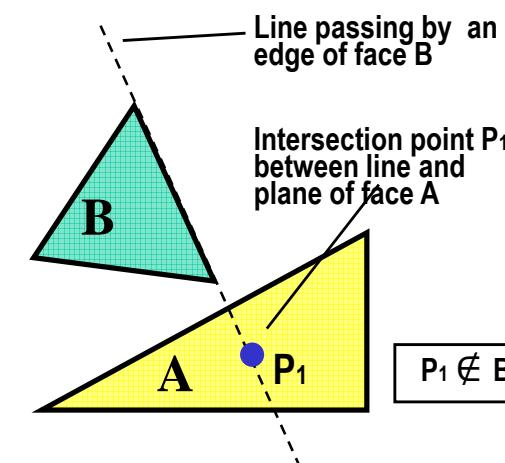
Compute intersection nodes (2/3)

- Check intersection nodes position



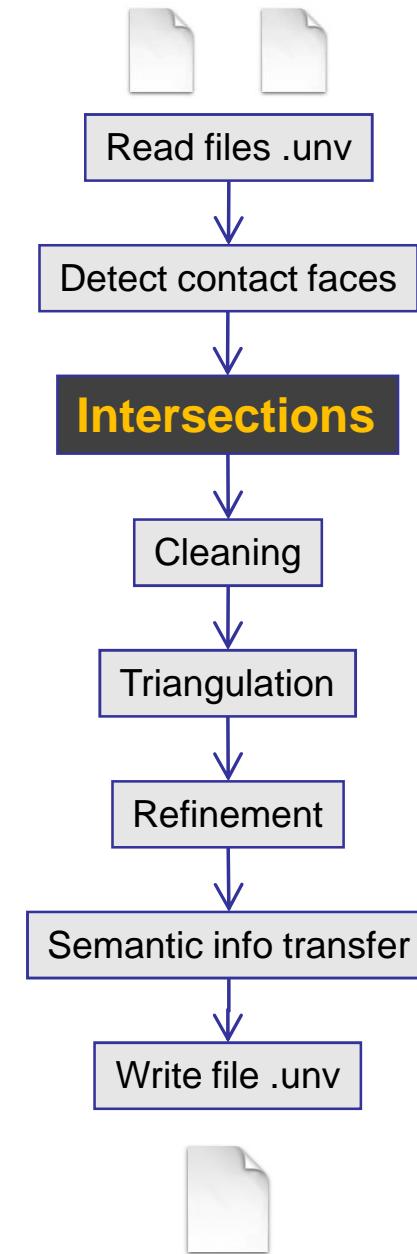
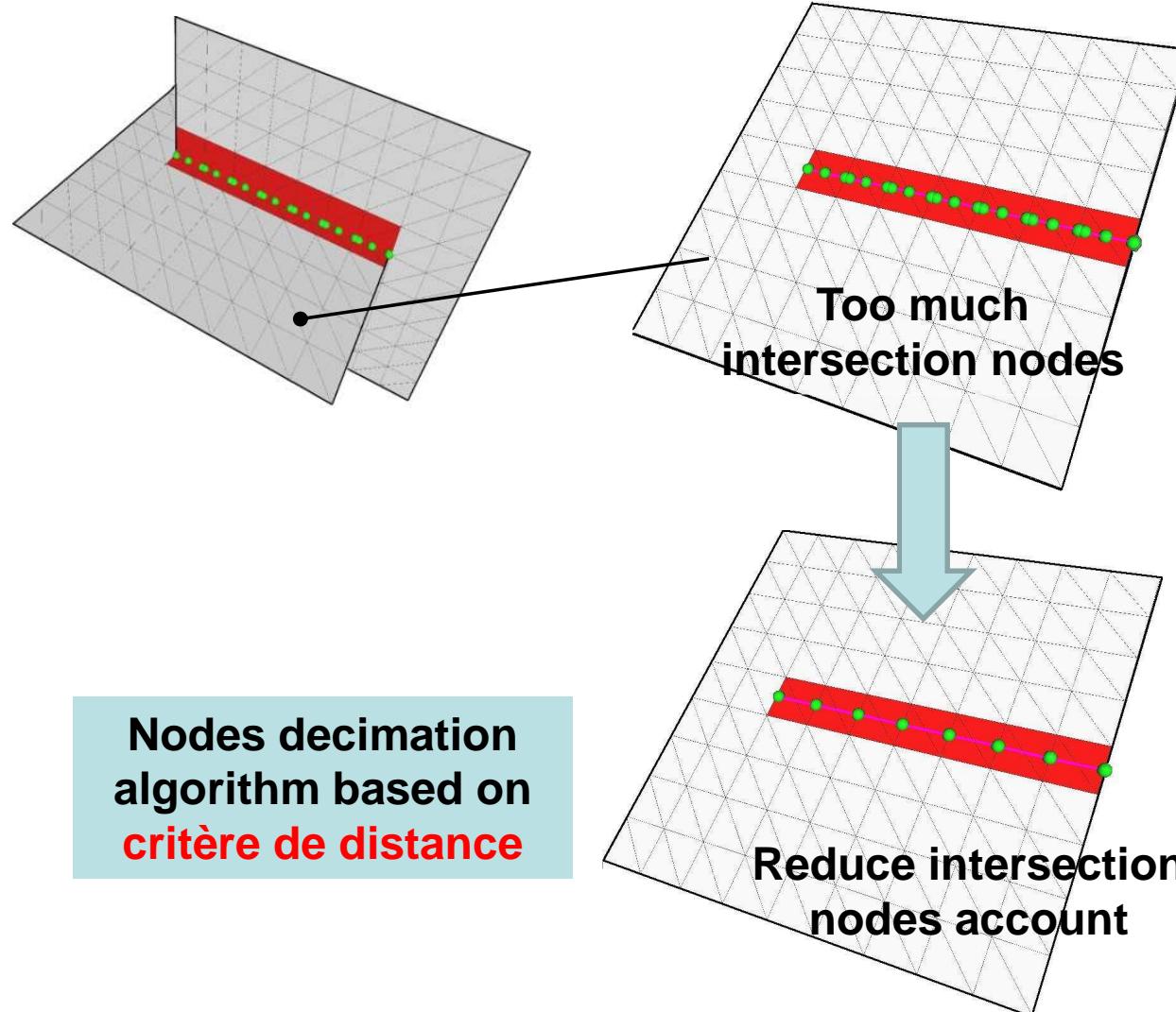
Compute intersection nodes (2/3)

- Check intersection nodes position



Compute intersection nodes (3/3)

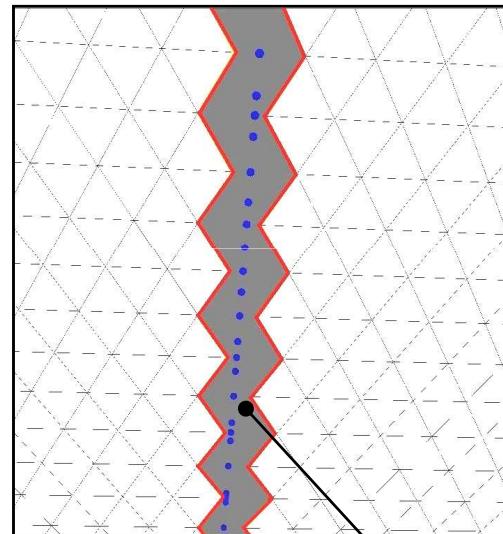
- Remove superabundant intersection nodes



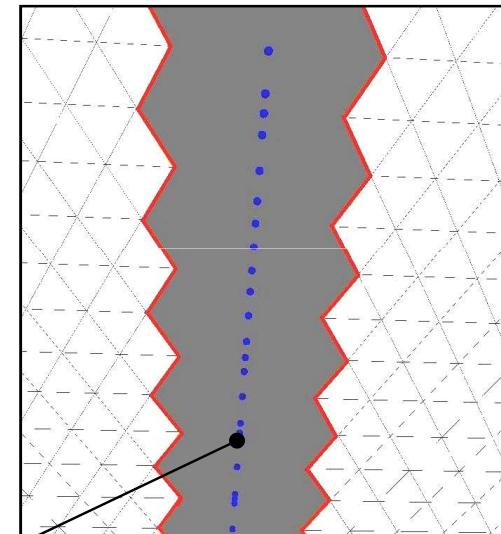
Clean a bandwidth

- Remove contact faces or faces included in a bandwidth

Remove contact faces

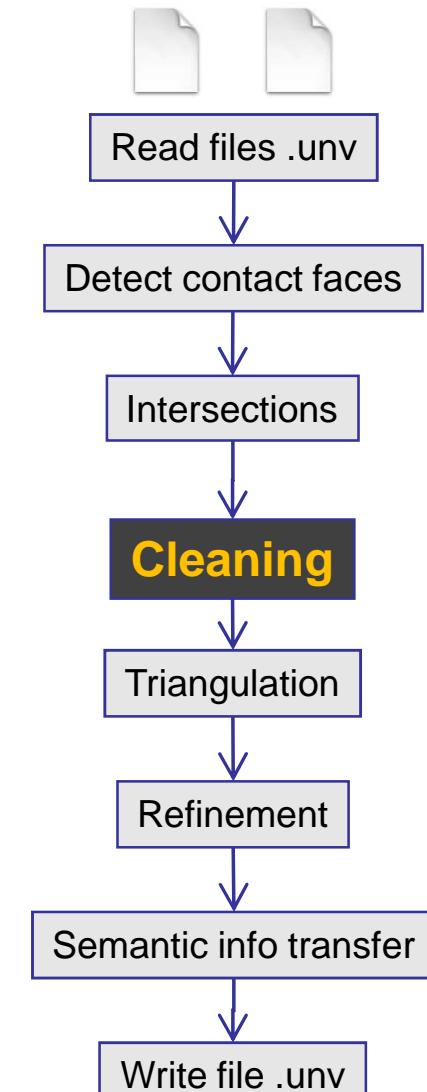


Remove faces included in a bandwidth (range = 1)



Intersection points on contact faces

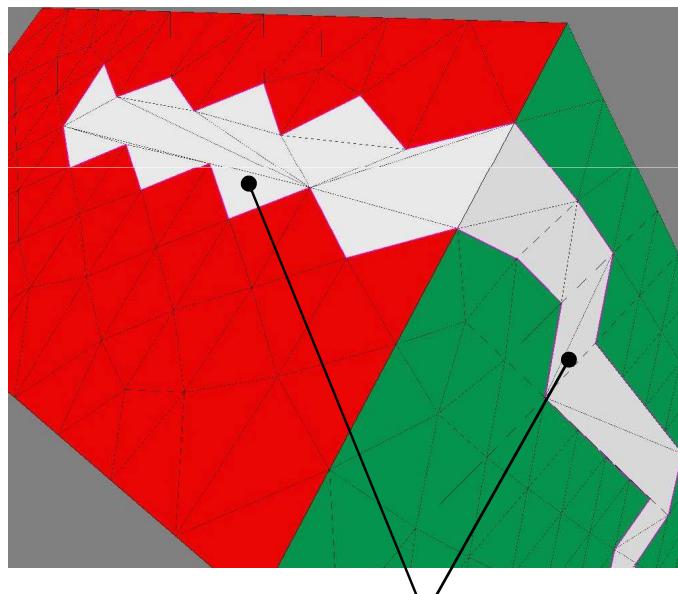
This idea allows **a more progressive transition** of the faces sizes between the two meshes that have to be merged.



Filling holes (1/2)

**Based on algorithm
of [Liepa 2003]**

**Triangulation that is based
on criterion of min area**

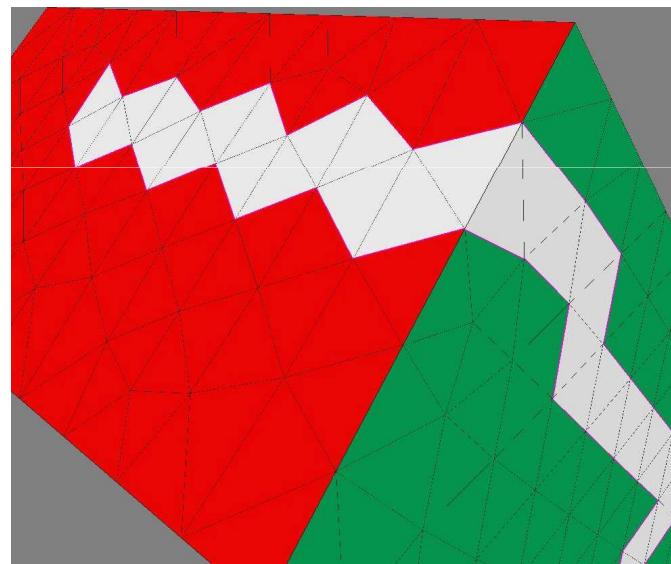


Degenerated triangles

Not fit to mesh of plane zone

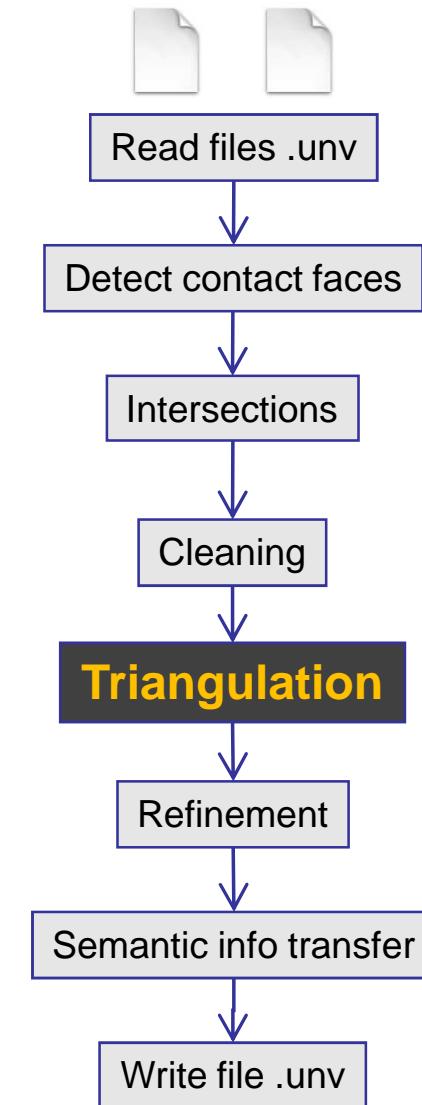
New criterion

**Another criterion of
equilaterality [Ciarlet 78]**



$$Q = \alpha \frac{S}{hp} \in [0,1] \quad \text{to maximize}$$

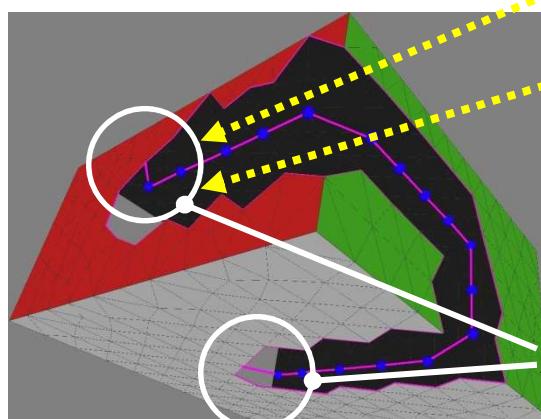
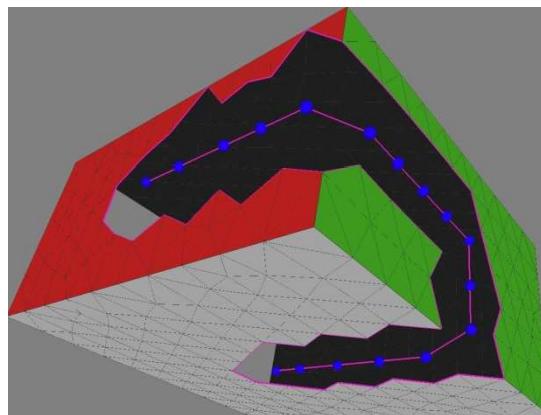
S – face area, h – longest edge length,
 p – triangle perimeter
 $\alpha = 2\sqrt{3}$



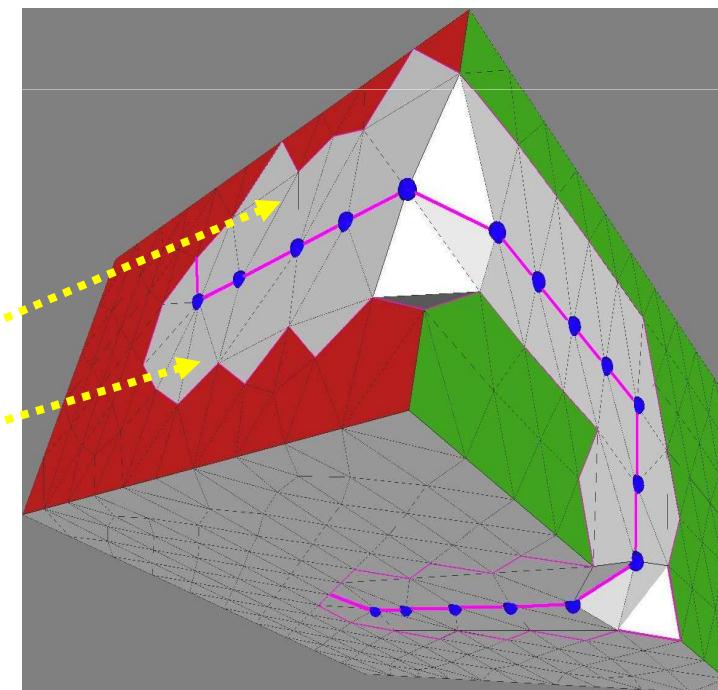
Filling holes (2/2)

- Algorithm adaptation for taking in account the intersection line.

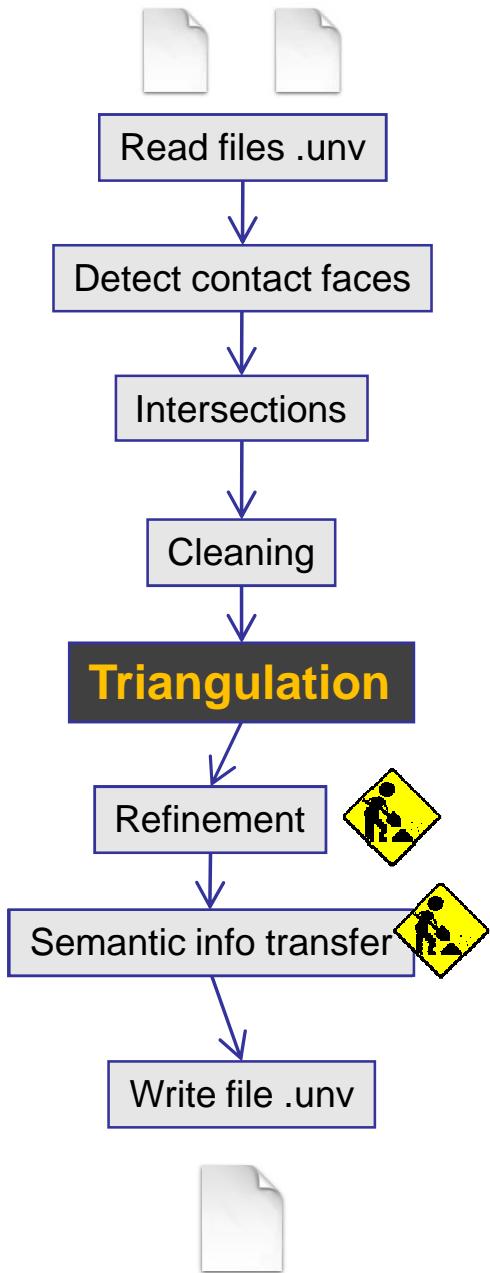
Nearest point for closing the hole



Recognitionde Algorithm of sub hole to fill



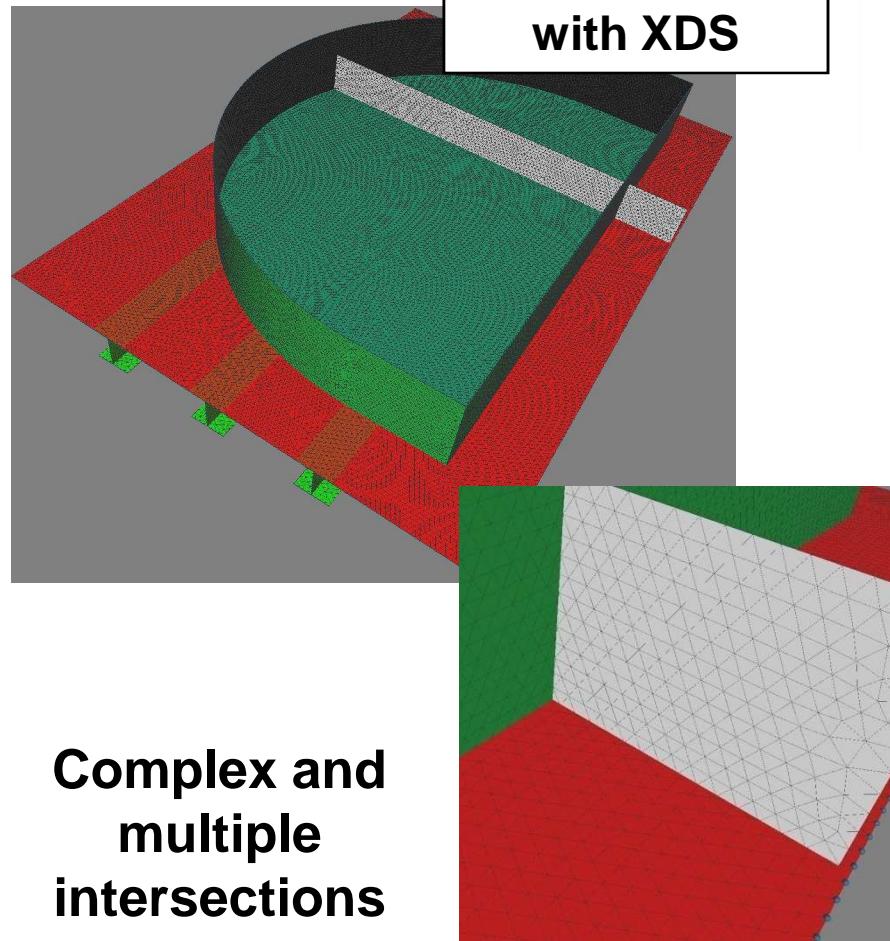
Add an edge



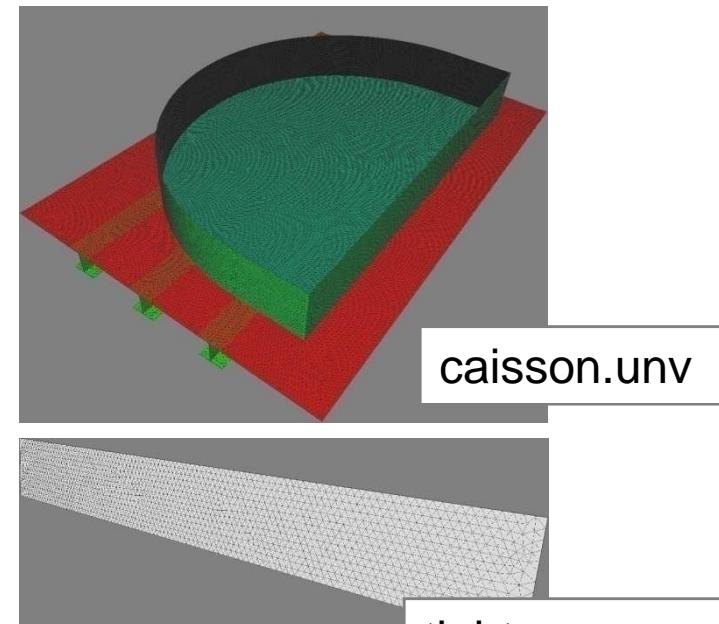
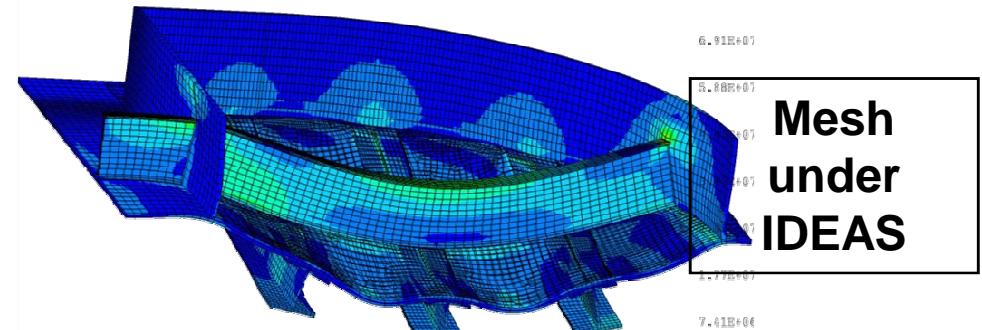
Merging of tightener and Caisson (1/2)



Face/Edge mode



**Complex and
multiple
intersections**

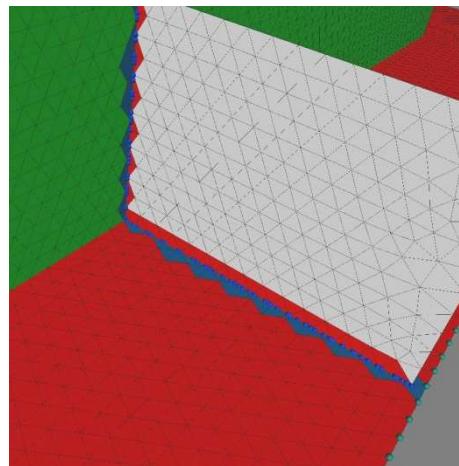


Tiangles NB : 76582 + 5724
Groupes NB : 9

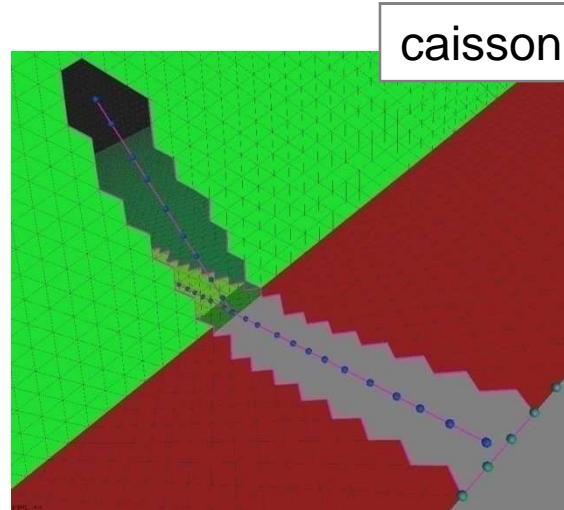
Merging of tightener and Caisson (2/2)



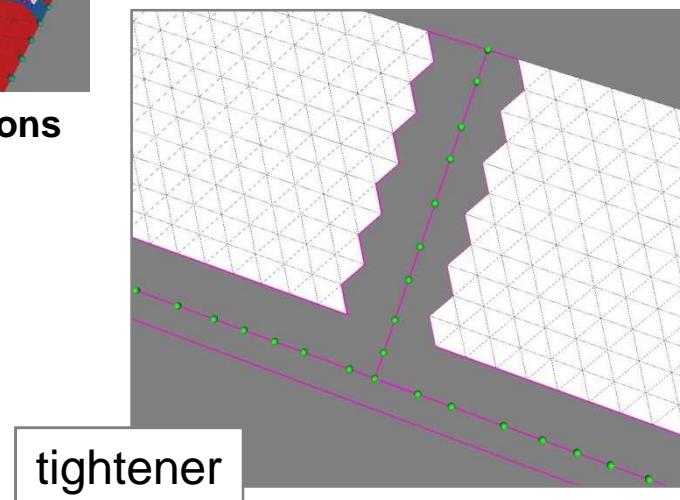
Face/Edge mode



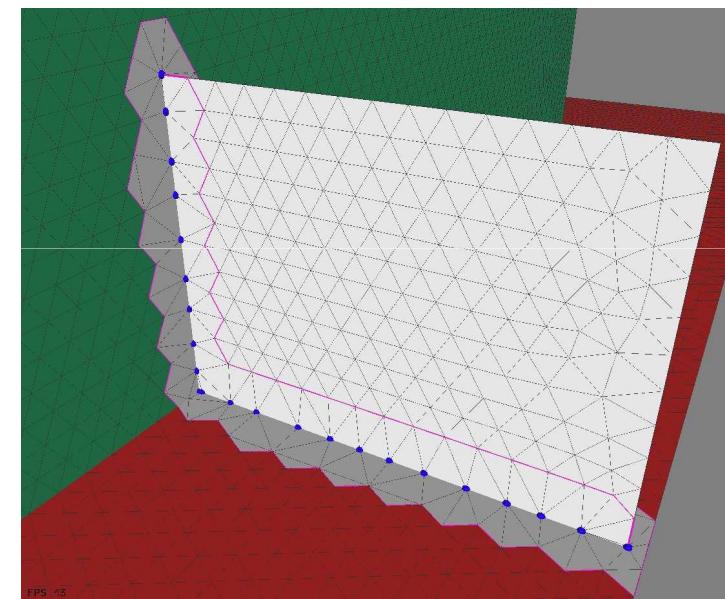
Compute intersections



Nodes décimation
+ Cleaning of 2 ranges



tightener

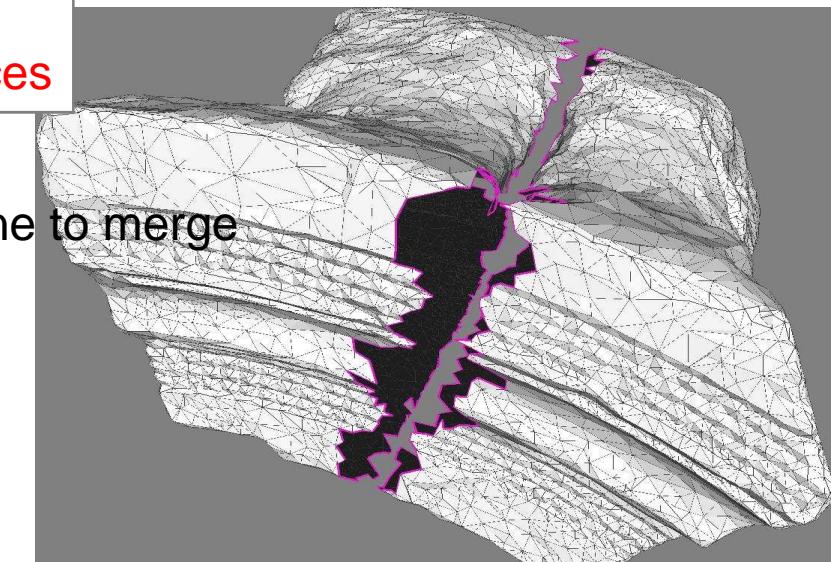
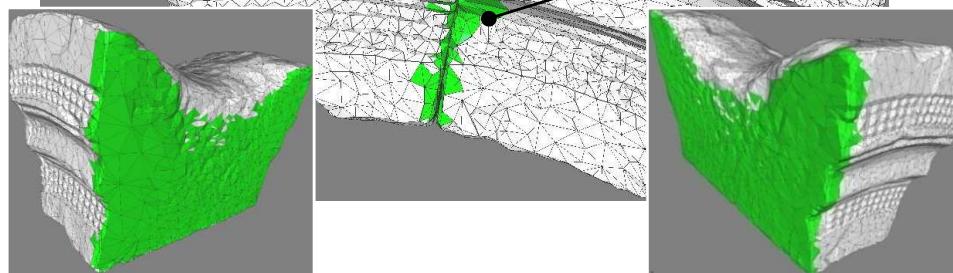
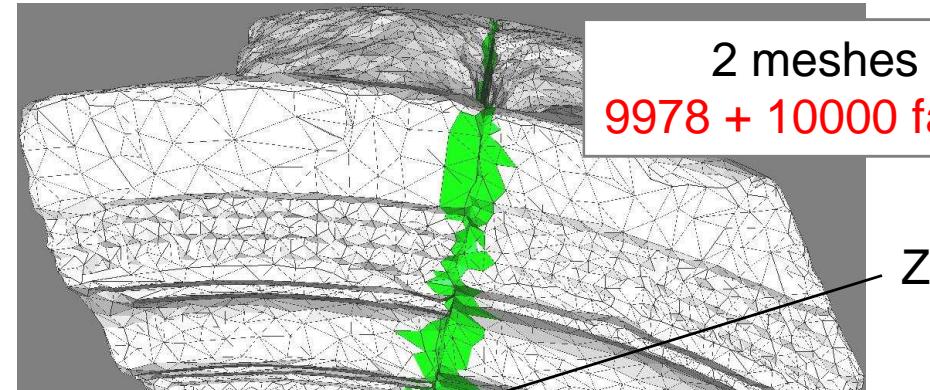
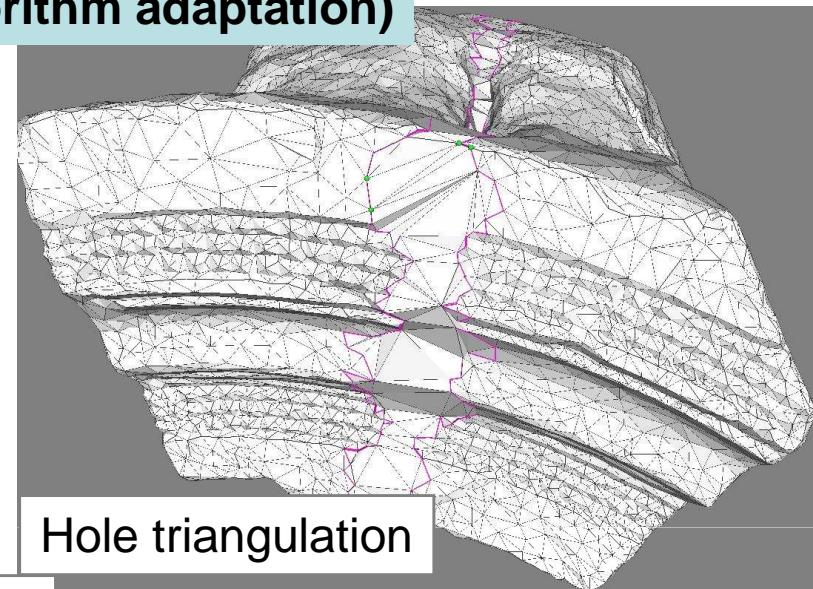
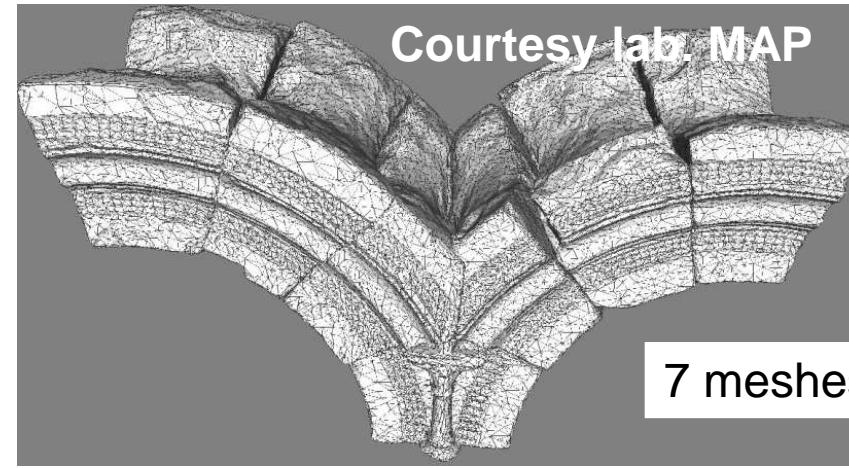


Constraint triangulation taking
account of intersection line

22 sub-meshes on caisson
7 sub-meshes on tightener

Merging of two stone blocks

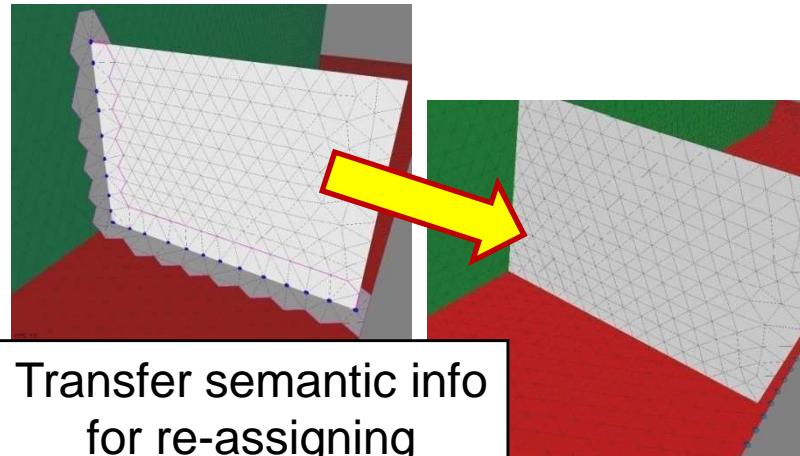
Face/Face mode (Face/Edge merging algorithm adaptation)



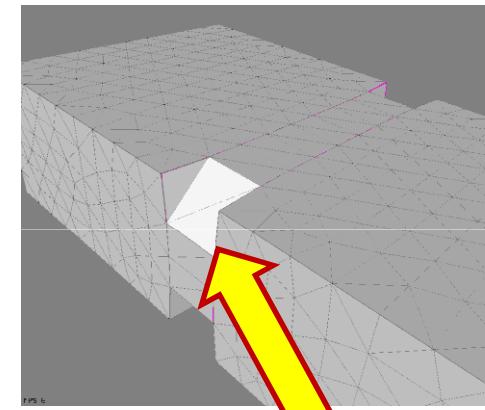
Conclusion

- Approache of modular steps proposition and development for triangular meshes merging
- Two merging modes : face/edge and face/face
- Conclusive testes with industrial models (EDF R&D, MAP)

Outlooks



Transfer semantic info
for re-assigning
entities groups...



Triangulation modul
amélioration in case
of vive edges...

- Refinement by nodes insertion [Liepa 2003]...
- Extensions to volume 3D meshes ...

