# AP203/AP214 to STEP-TAS

*A CAD to thermal analysis converter based on open source technologies*

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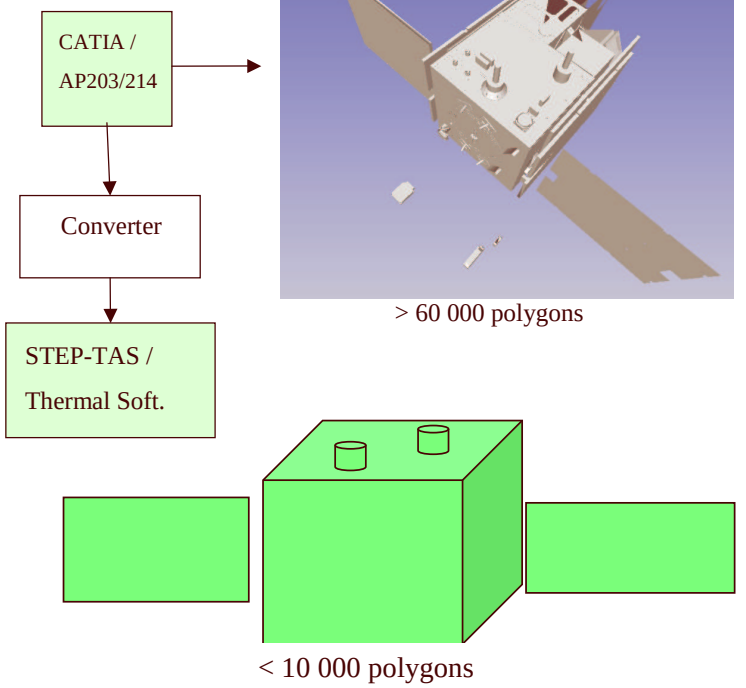
## The problem to solve

- From a detailed CAD definition of a spacecraft
  - Engineering, architectural, mechanical…
- …to a generated simplified geometry
  - Equivalent for thermal analysis purpose
  - But with only a few thousand polygons



## Project history (1 / 2) : Origin

- 2000 : AP203 to ESARAD converter :
  - C++,
  - Nurbs & O++ library
  - SDAI C & Steptools
- **->** Limited solution :
  - AP203 parsing : only working with CATIA V4.2
  - Dependency to providers (O++, Steptools)
- Works conceptually but no operational solution



## Project history (2 / 2) : Prototype

- 2004 : AP203/214 to STEP-TAS converter :
  - Hanop prototype
  - C++
  - Triangulation & OpenCascade 5.2
  - STEP-TAS & PyExpress
- Improvements :
  - AP203/214 parsing : CATIA V4 & V5, Pro*Engineer…
  - OpenSource technologies
  - Open to several thermal tools thanks to TASverter

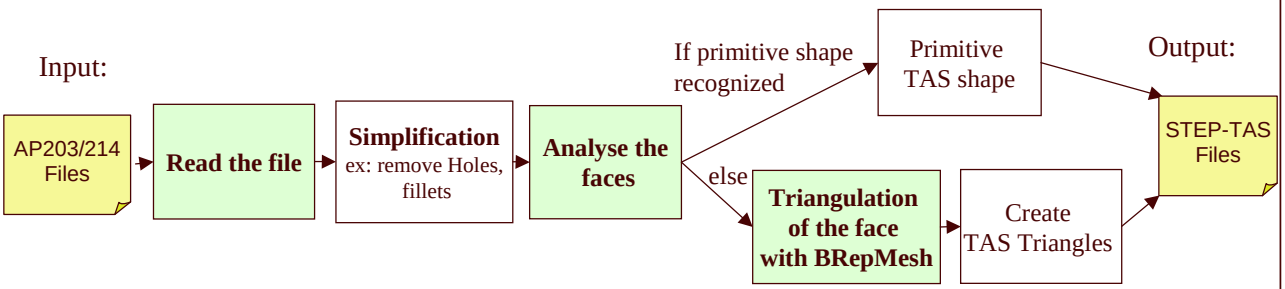
## Current project : Goals

- Start from the prototype
- Shape recognition :
  - Reduce the number of triangles
  - Transform into STEP-TAS primitive shapes (cone, cylinder, disc, paraboloid, quadrilateral, …)
- Model simplification :
  - Eliminate the non-relevant holes or fillets
  - Improve the transformation into STEP-TAS primitive shapes
- **->** Industrial product



## Extensions done or in development:

- Main goal:
  - Reduce the number of facets
- Approach:
  - Simplify the model



# Recognition of TAS primitive shapes (1)

- Definition of the thermal faces :

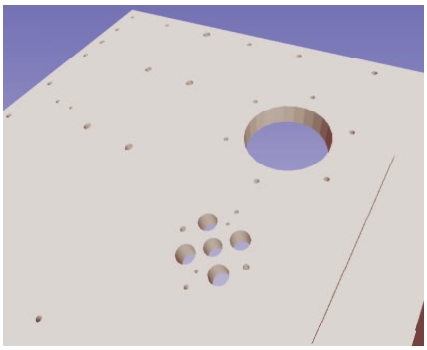
| |
|---|
| Tas_triangle |
| Tas_rectangle |
| Tas_quadrilateral |
| Tas_disc |
| Tas_cylinder |
| Tas_cone |
| Tas_sphere |
| Tas_paraboloid |

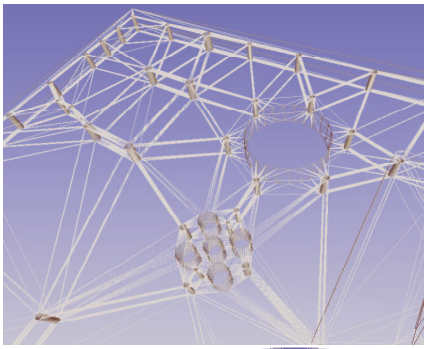
- Approach:
  - For each face, find the surface's type:
    (Planar, cylindrical, spherical, conical surface)
  - Analyse the edge loops if necessary
  - Find the corresponding TAS primitive shape if there is one
- Validation in progress with Baghera View
- Demonstration…



# Remove holes

- The holes:
  Remove holes which are irrelevant for thermal analysis
- In the application:
  The user can specify:
  - If we remove or not the holes
  - If we remove or not the cylinders of the holes
  - The characteristic length threshold of the holes to remove (ex: diameter for a circular hole).

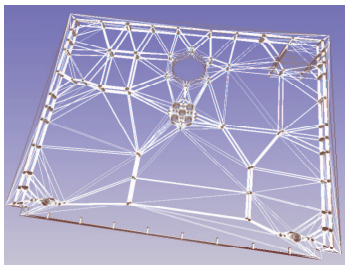


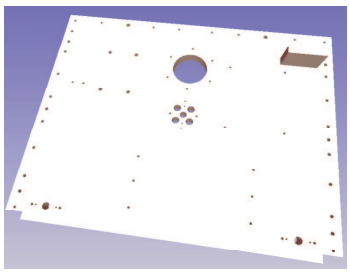


# Remove Holes

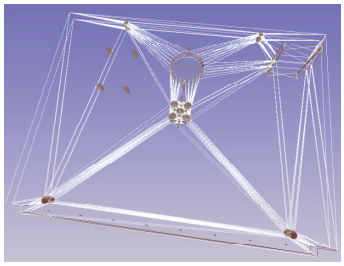
TAS Models

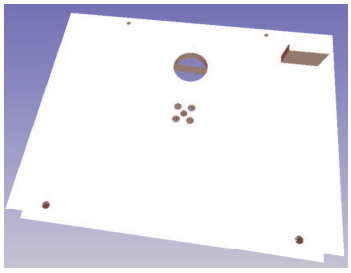
Without removing holes:
8646 elements





After removing small holes:
1046 elements







# Remove Fillets

- The fillets

  Often defined by a piece of cylinder.

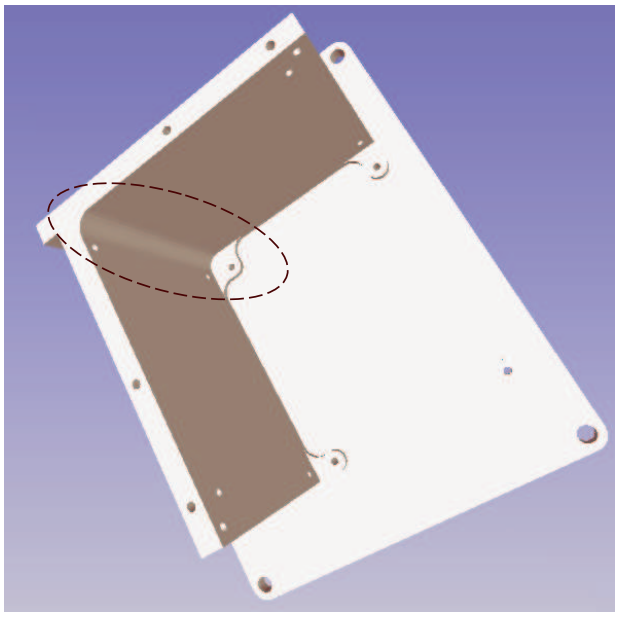
- Algorithm:

  1- Detect the cylinder and the adjacent faces

  2- If it's a fillet:

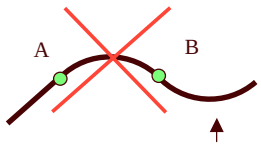
  - find the new points of intersection.
  - modify the model (remove the cylinder and join the faces composing the fillet).

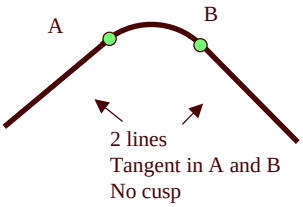
- Optional in the application.

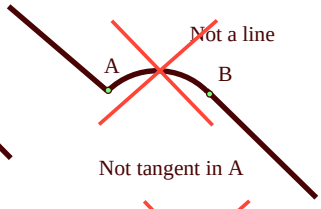


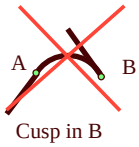
# Remove Fillets

- Detect a fillet
  (example in 2D):
  - Condition of detection:
    - Adjacent curves are lines
    - Adjacent lines tangent to the piece of circle (in A and B)
    - No cusp in A and B



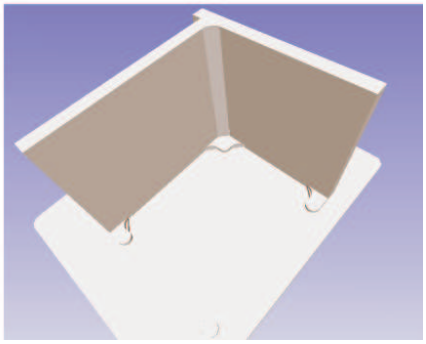



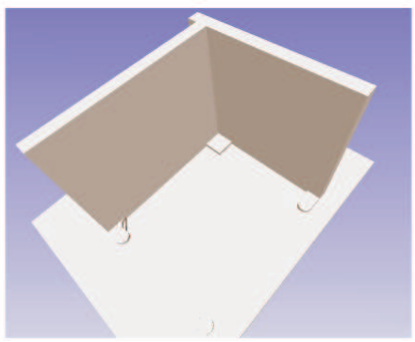


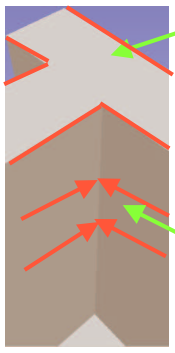

# Remove Fillets

Without removing fillets:
449 elements



After removing fillets:
263 elements





Top face
reconstruction

vertical faces
extension

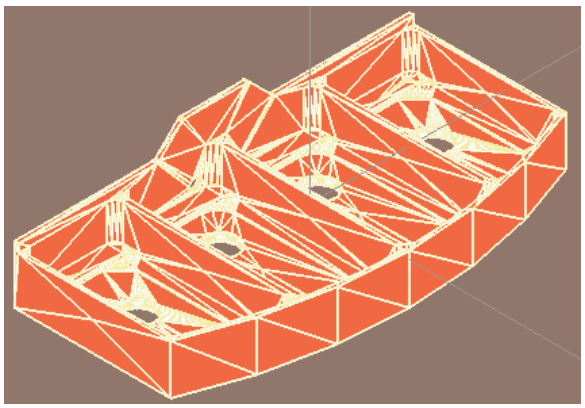
# Current project : current and future functionalities

- Current algorithms : number of polygons divided by ~8
- To be done:
  - Removing small objects (ex: bolts..)
  - Reducing a thin plate (box) to a shell with a notional thickness
  - Large scale models validation
  - STEP-TAS 5.3 / Expressik
  - GUI for launching the converter
  - Foreseen changes reporting (colored geometry)
  - Improved triangulation (specific ESARAD/Alstom extension)

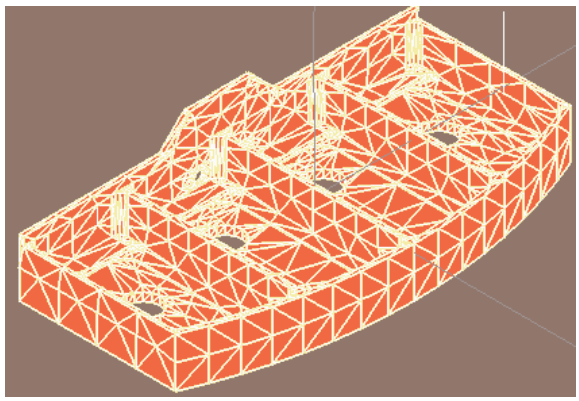


# Improved triangulation with ESARAD

Standard BrepMesh



Improved meshing for analysis



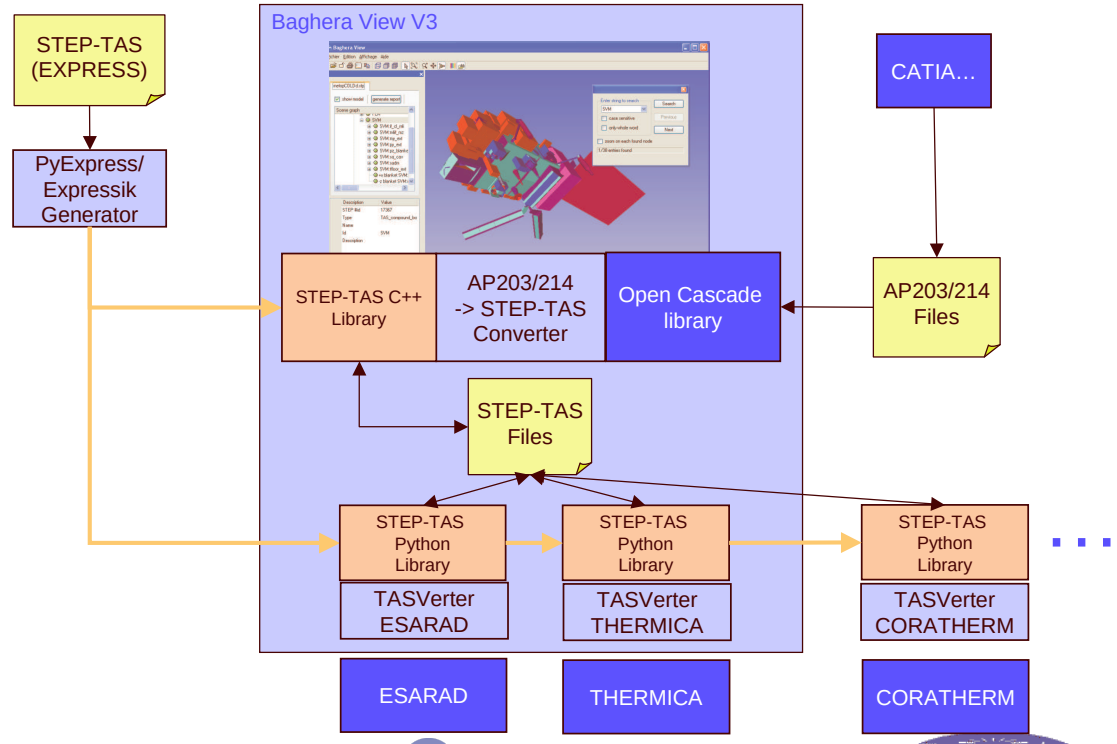
ALSTOM

## Current project : Configuration

- OS : Windows 2000 / XP, Sun Solaris 2.8, Linux RedHat Entreprise 2.1
- Compilers : Visual C++ 6.0 & 7.0, Sun Forte 6, gcc 3.4.1
- OpenCascade 5.2
- STEP-TAS release February 2004 / PyExpress



## Summary : A new architecture



# Thank you for your attention

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