### 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

Input:

AP203/214 Files → Read the file → Simplification ex: remove Holes, fillets → Analyse the faces

If primitive shape recognized

→ Primitive TAS shape

else

→ Triangulation of the face with BRepMesh
→ Create TAS Triangles

Output:

STEP-TAS Files
Recognition of TAS primitive shapes (1)

• Definition of the thermal faces:

• 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

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

Without removing fillets: 449 elements
After removing fillets: 263 elements
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
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

- STEP-TAS (EXPRESS)
- PyExpress/ExpressikGenerator
- AP203/214 Files
- ESARAD
- THERMICA
- CORATHERM
- STEP-TAS C++ Library
- STEP-TAS Converter
- Open Cascade Library
- Step-TAS Files
- STEP-TAS Python Library
- TASVerter ESARAD
- TASVerter THERMICA
- TASVerter CORATHERM
- Baghera View V3
- CATIA...
- AP203/214 Files
Thank you for your attention

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