

# Thermica and Thermal Desktop Geometric modeling: a user perspective

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## Foreword

Old italian proverb:

“Chi lascia la vecchia strada per la nuova  
sa quel che lascia ma non sa quel che trova”

[Better the devil you know than the devil you don't know ]

Just to say: at CGS we are moving from a well-known software environment to a brand new one (for us): we cannot avoid to be a little nostalgic... We knew almost all the tricks of Thermal Desktop, we are still learning the Thermica ones!

## Introduction (1 of 2)

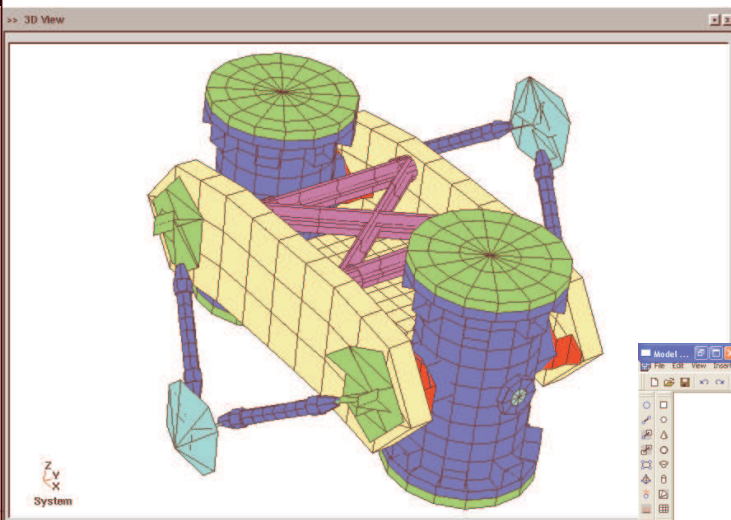
- For project choice (complying with harmonization guidelines), the LISA Core Assembly (LCA) thermal model had to be aligned to the ESA standards;
- we moved from a Thermal Desktop (TD) – SINDA/Fluint model to an ESATAN – Thermica one;
- the model has a medium/high complexity (about 3000 nodes).

## Introduction (2 of 2)

- The subject of the present comparison will comprise in particular the performance of the two geometrical **modellers**,
  - Thermal Desktop ver 4.7 (TD)
  - T3D ver3.2, the Thermica modeller
- Thermica (and, to a minor extent, TD) is much more than a geometric modeler!

# What we won't consider

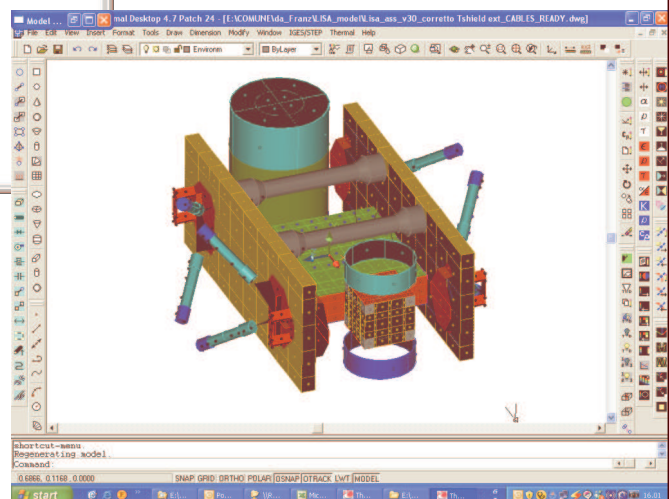
- A wide range of S/W functionalities are out of the scope of this presentation; among them we include:
  - Parameters and Speed of REF calculation
  - Mission parameters
    - Orbit
    - Pointing
    - Fluxes calculation
  - Internal solver
  - Network generation
- Some of them look in very good shape in Thermica, probably at a much better level than TD (e.g. mission parameters, orbits, pointing...)



T3D

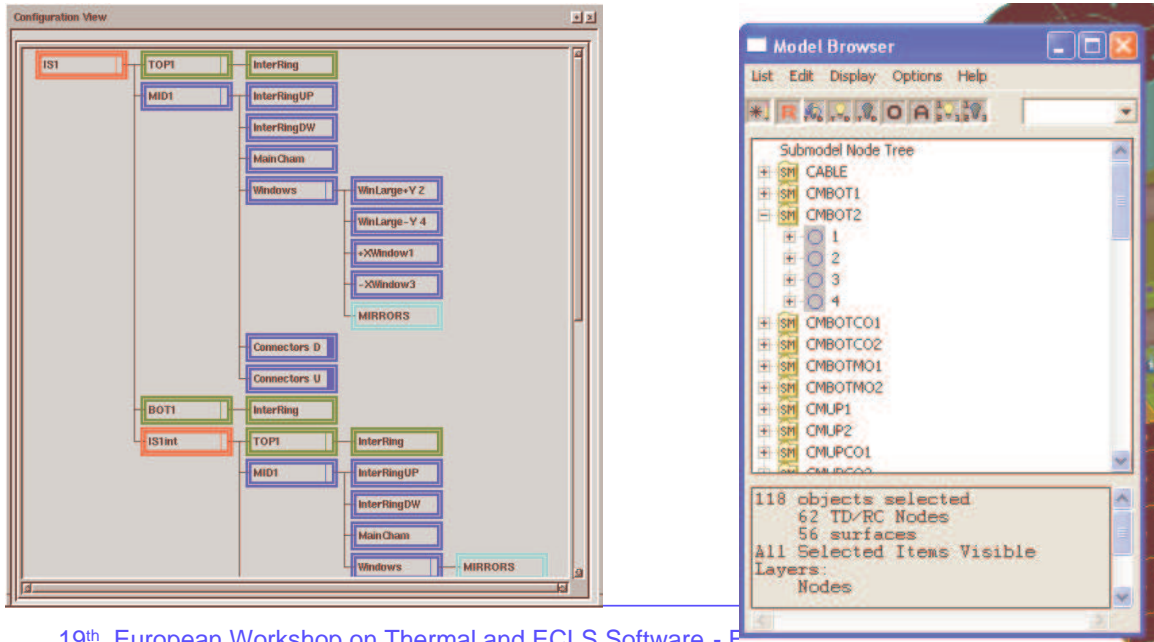
## LISA CORE ASSEMBLY GEOMETRICAL MODELS

TD



# Hierarchical structure

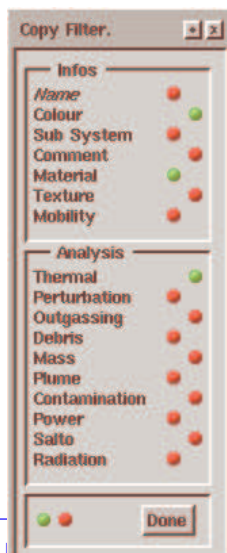
- T3D configuration Viewer vs. TD Model Browser



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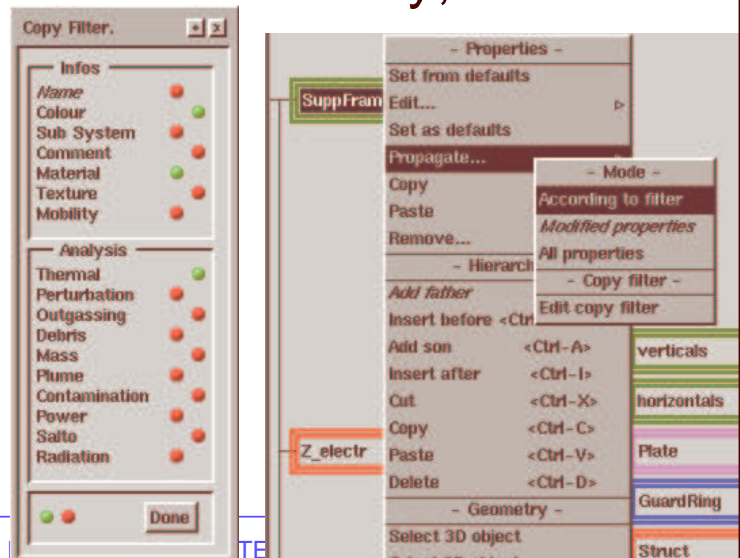
# Hierarchical structure

- TD has no hierarchy: all the submodels are put in parallel, 1 level only
- T3D has a well structured hierarchy, allowing:
  - Propagation of properties
  - Easy implementation of articulators

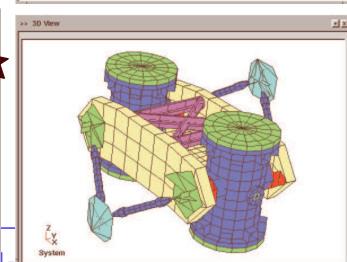
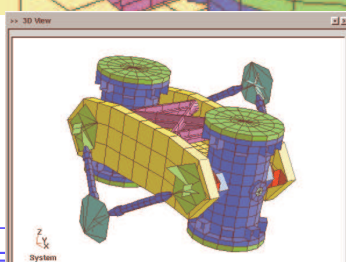
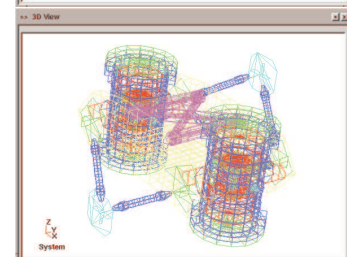
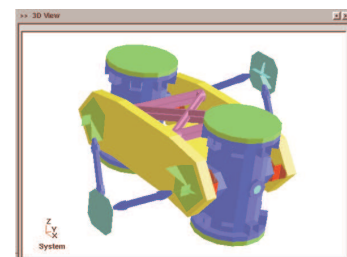
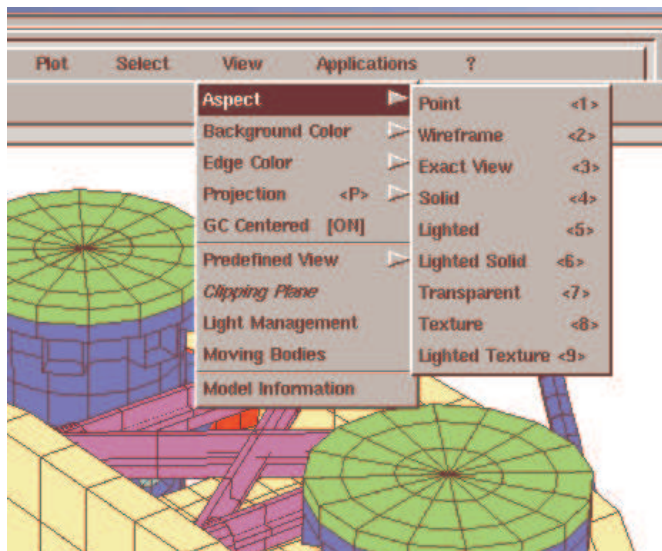


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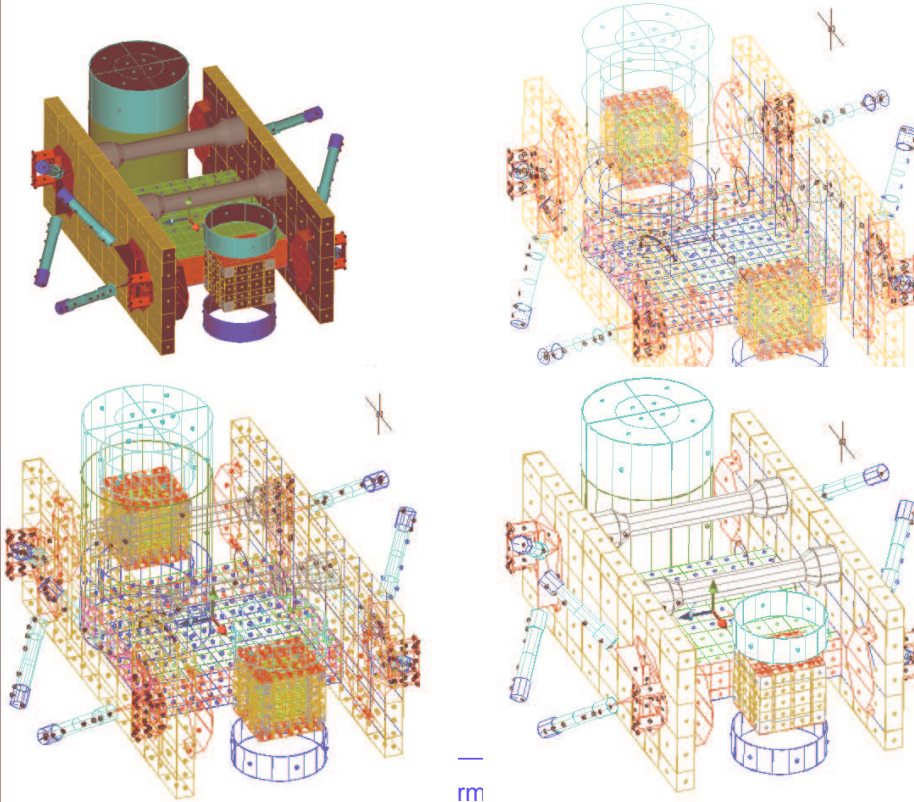
# Visualization modes: T3D



**At your own risk**



# Visualization modes: TD

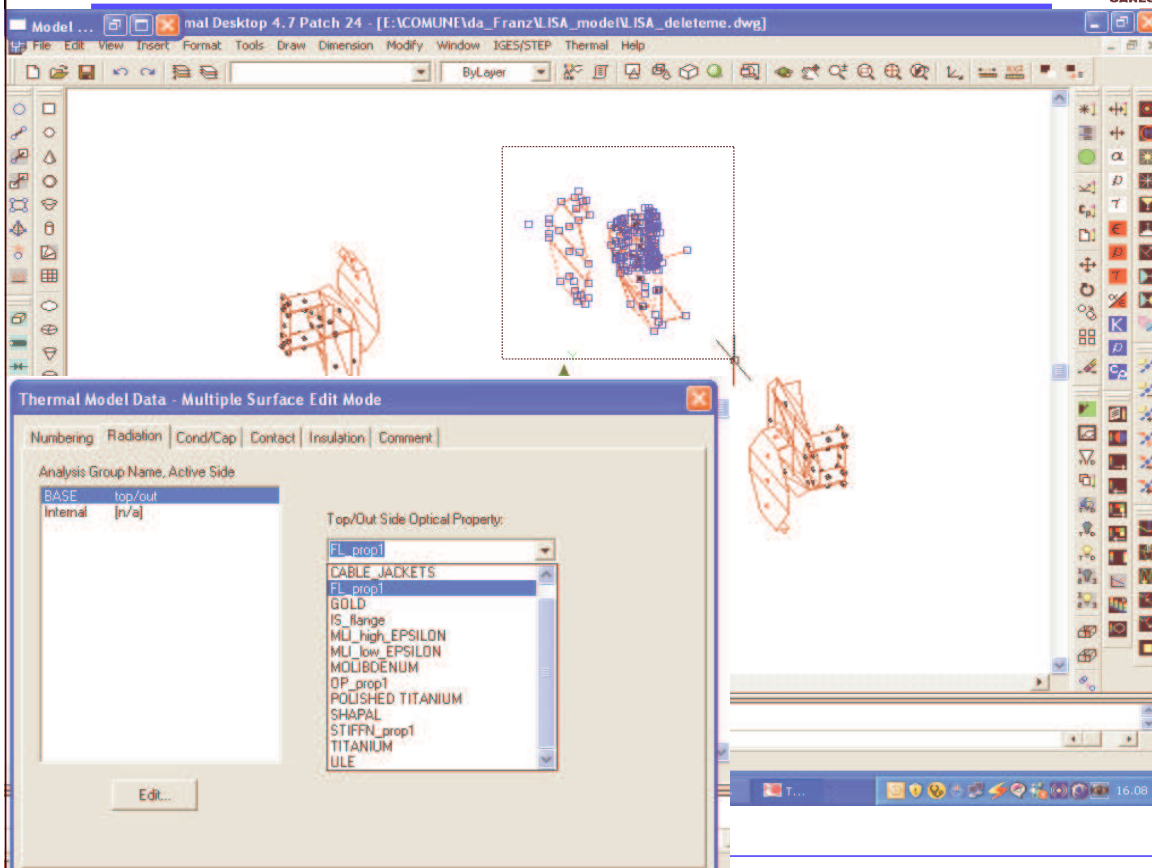
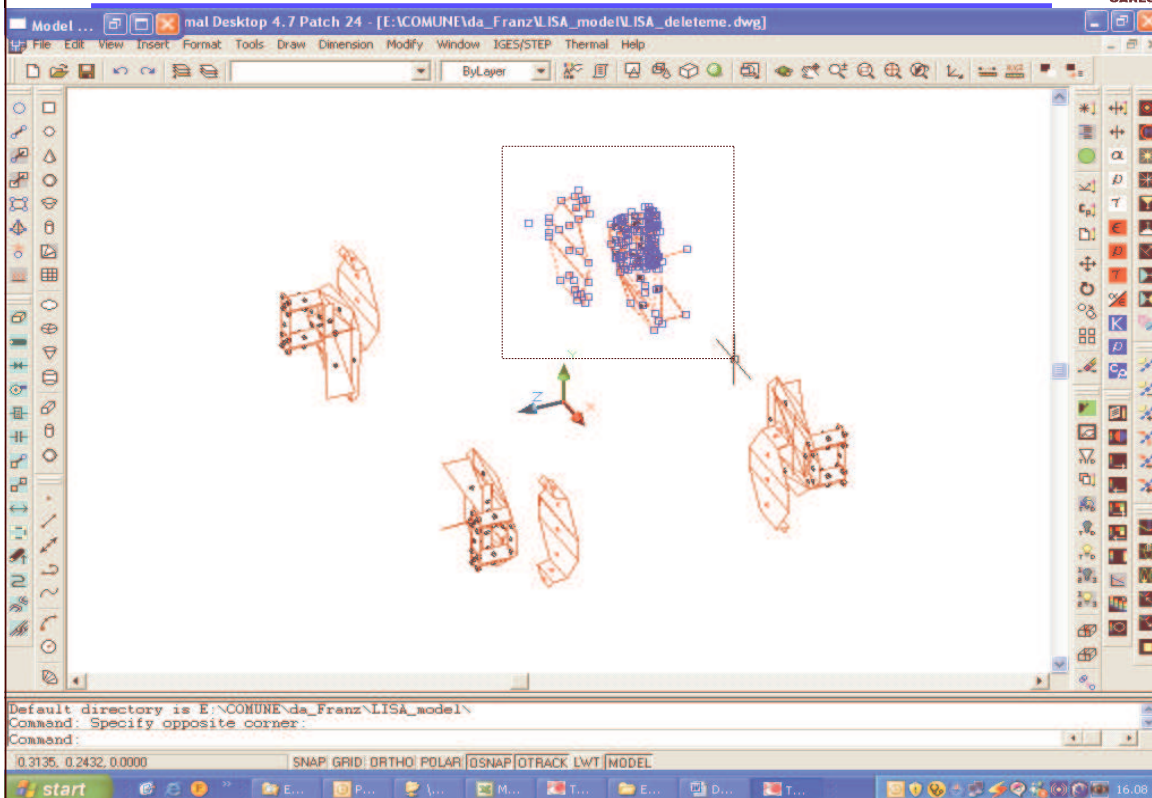


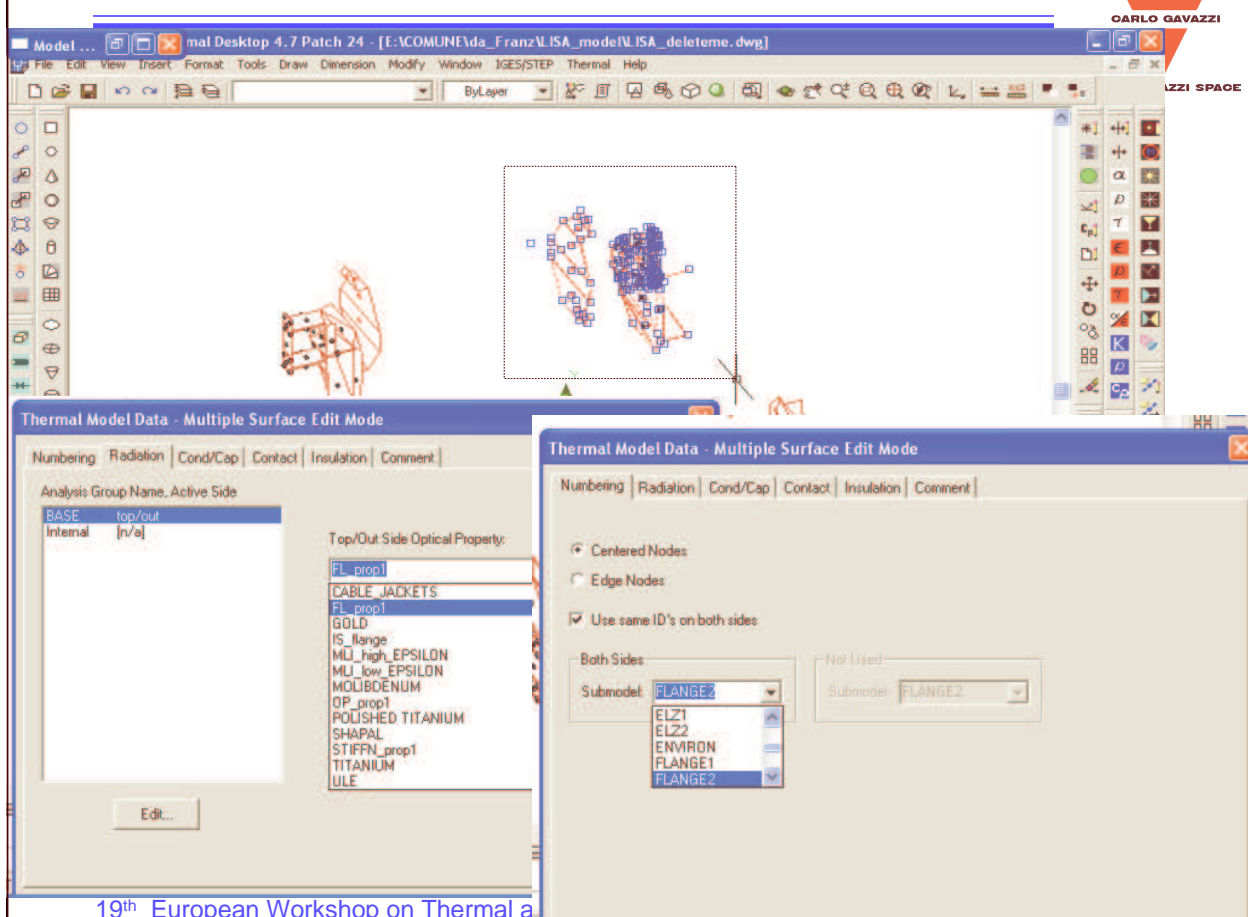
October, 2005

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## Global Editing

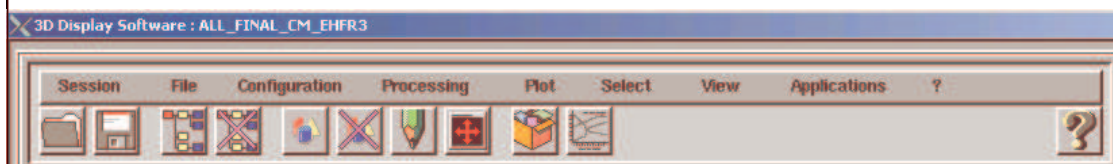
- T3D allows changes of properties (e.g. optical properties) only through
  - Single Object editing
  - Propagation
- TD has a more efficient selection features:
  1. Select shapes from screen with a click-and-drag command (as many as you like, from different submodels too)
  2. Edit globally a property on all the shapes at the same time
    - Submodel name
    - Optical properties





# Customization

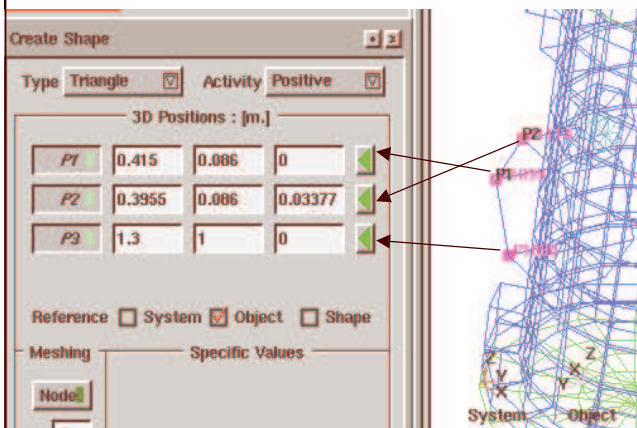
- TD has customizable menu and icon blocks
- The T3D user interface is fixed





# Point Snapping/graphical input

- Both s/w allow coordinate input by:
  - direct numerical coordinate
  - selection points from graphical window
- TD has however a higher variety of choices:

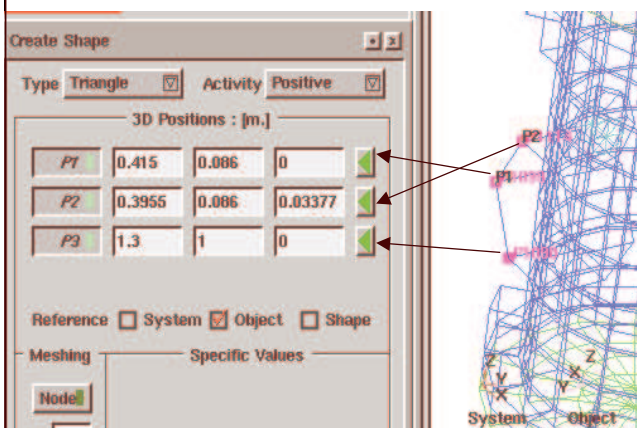


Software - ESTEC, 11-12 October, 2005

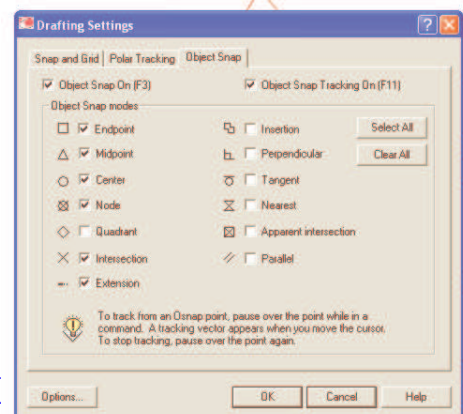
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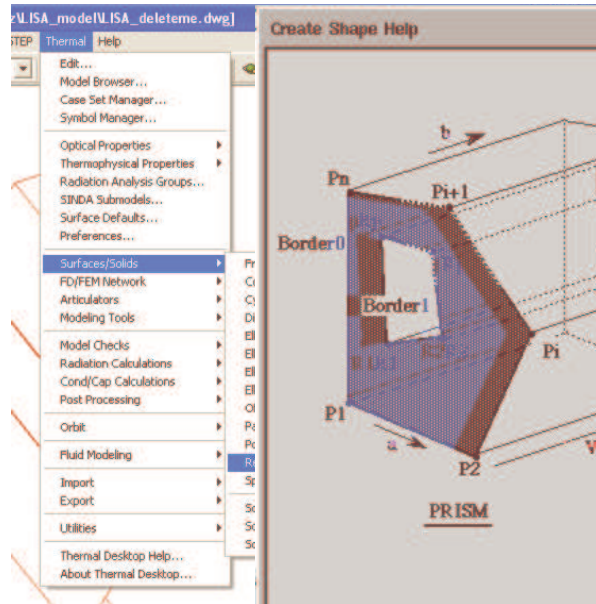


Software - ES



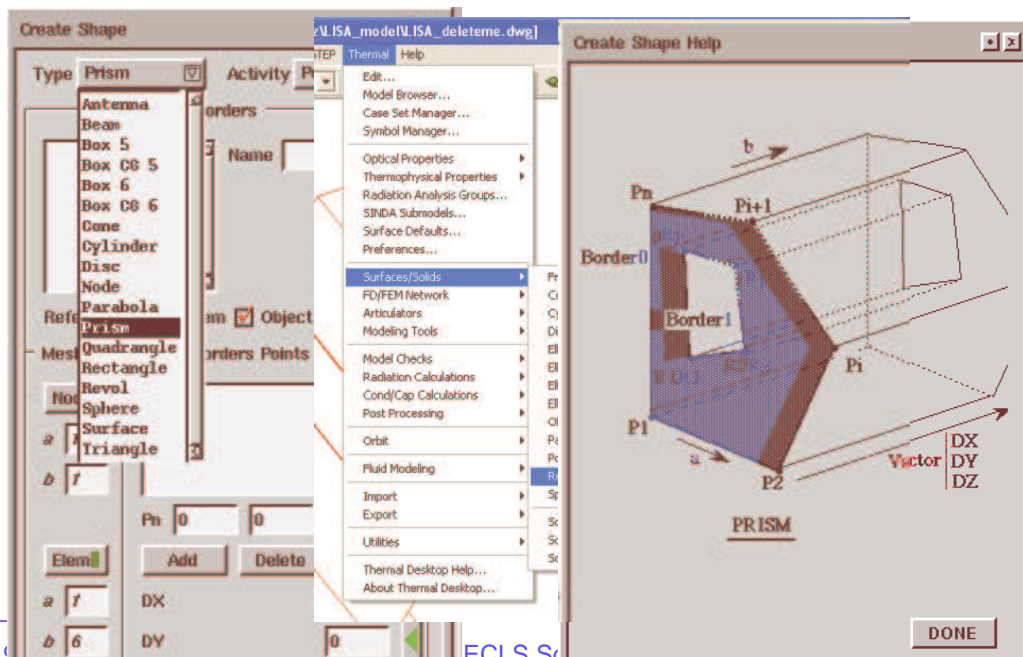
# Primitives

- T3D has a wide number of primitives, and a nice help utility



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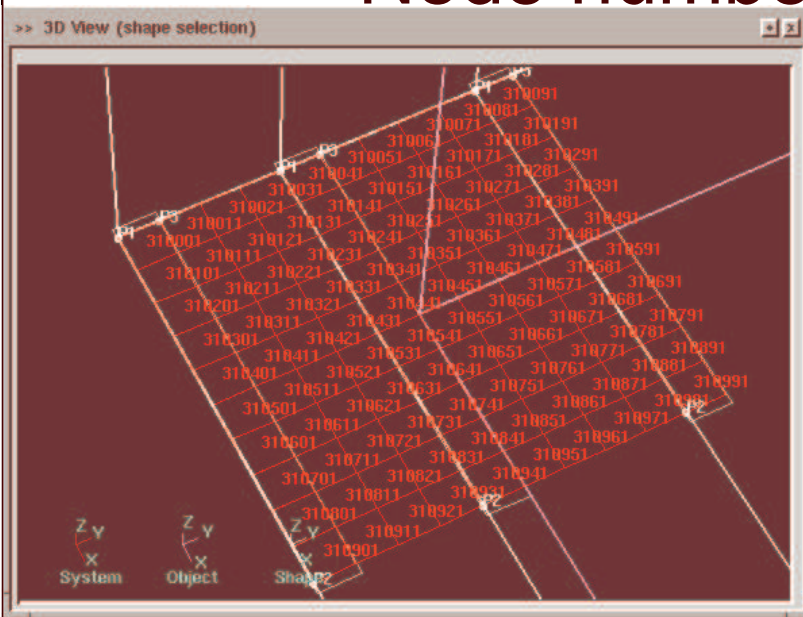
# Speed / Graphical acceleration

- T3D is rather slow as the model increases in complexity.
- TD, through AutoCAD, exploits the hw/sw acceleration in a better way

# Node numbering

- When a shape is subdivided in several nodes, nodal numbering can be assigned
- T3D allows only START+Increment
  - Annoying if the orientation of the shape (P1-P2-P3) is not the desired one => re-draw the shape
  - Shape subdivision in subelements is needed when one single increment is not sufficient (e.g., a  $m \times n$  rectangle to be numbered 10X0Y, and X, Y representing position along the axis)
- TD allows user defined input sequences

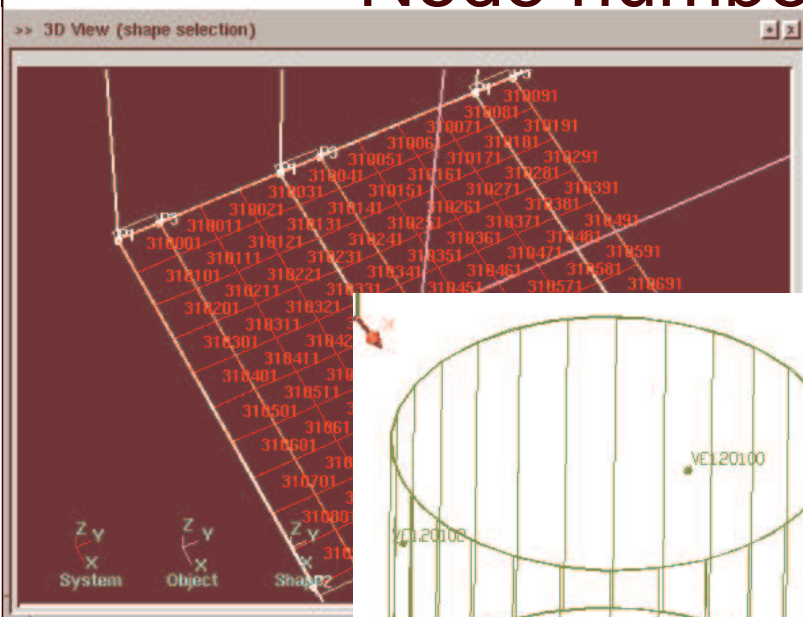
# Node numbering



This 10 x 10 rectangle had to be built as 10 small rectangles 1 x 10, in order to have a numbering in the format :310xyz, with  $x=0..9$ ,  $y=0..9$ ,  $z=1$

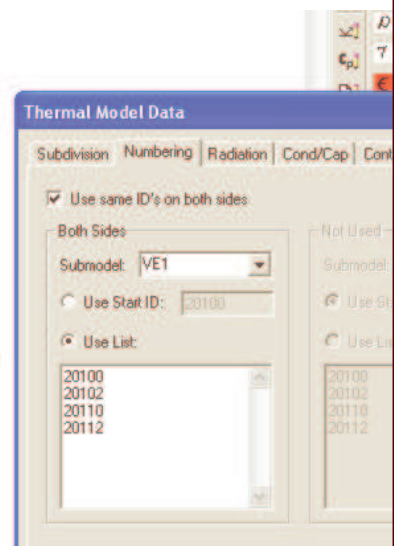
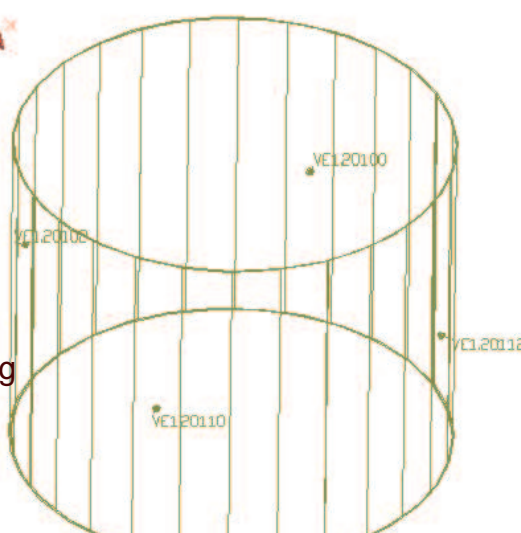
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# Submodels

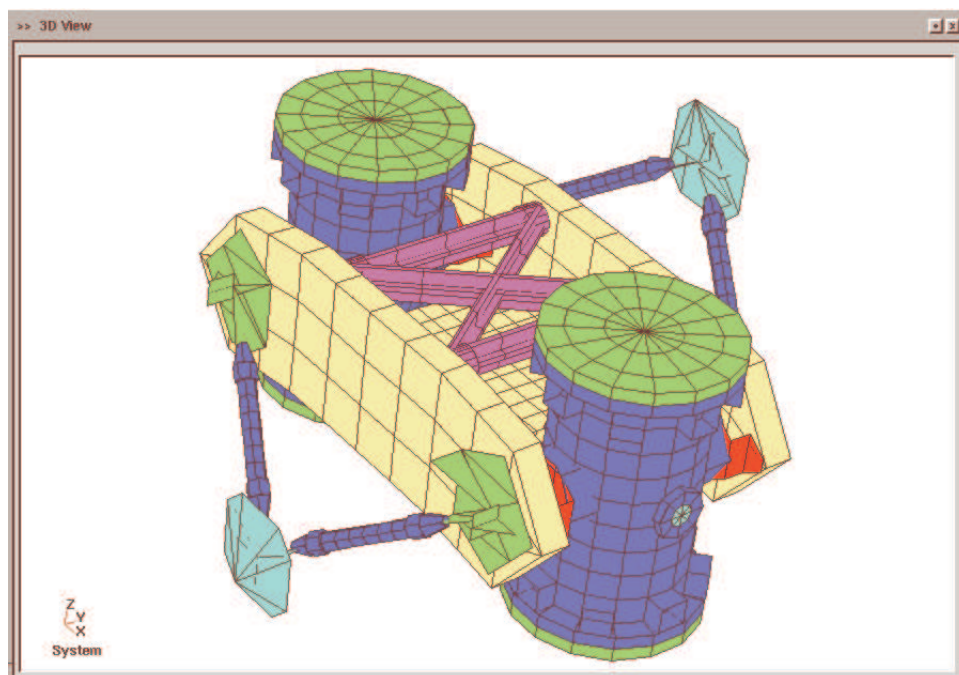
- Probably the strongest limitation of Thermica
- SINDA/FLUINT and TD make use of submodeling in an extensive way.
- ESATAN has even a more articulated submodel structure (hierarchical), which is not reflected in Thermica
- The submodel concept is somehow mimicked by the Object entities of Thermica, but pay attention to node numbering!

## Why Submodels? (1 of 3)

- The main difference between Submodels and Objects is in the numbering:
  - TD: One can have the same node numbers in different submodels, without any conflict: they remain separate entities
  - T3D: Different objects with the same node number are considered “a single node”.

## Why Submodels? (2 of 3)

- This is particularly troublesome when, as in the case of LCA, due to symmetry considerations 80% of the model is mirrored:
  - in T3D, the “parent object” was copied and rotated, BUT ALL THE SHAPES HAD TO BE RE-NUMBERED ONE BY ONE! (1 day work, for about 300 shapes)
  - in TD, the submodels were copied and rotated, and it was sufficient just to select the copied versions and assign them to different submodels (10 minutes work, for 5 submodels)

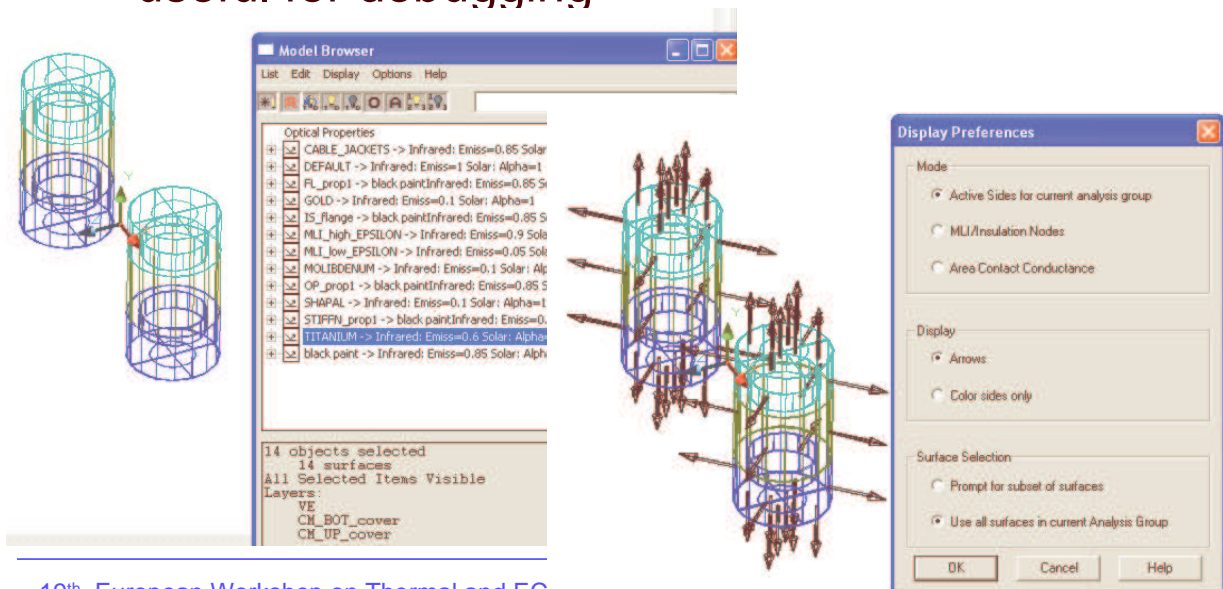


## Why Submodels? (3 of 3)

- System level analytical integration
  - the integration of externally provided thermal models in T3D is dangerous (node ID duplication), while in TD it is simple to assign them to a submodel
  - The importing in TD is sometimes tricky: cut&paste from other models do not always work
  - Cut&Paste in Thermica not directly allowed, but it is quite easy to edit the SYSEXP data file (ASCII file)

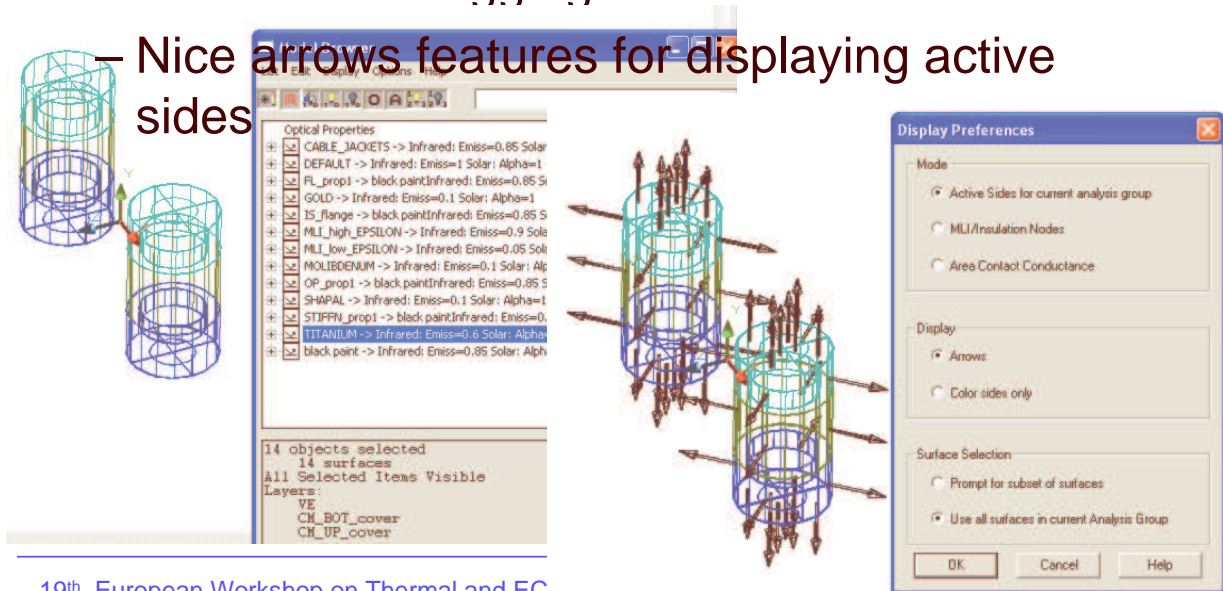
## Preprocessing

- TD has several utilities for pre-processing:
  - Selection by optical properties (show only), useful for debugging



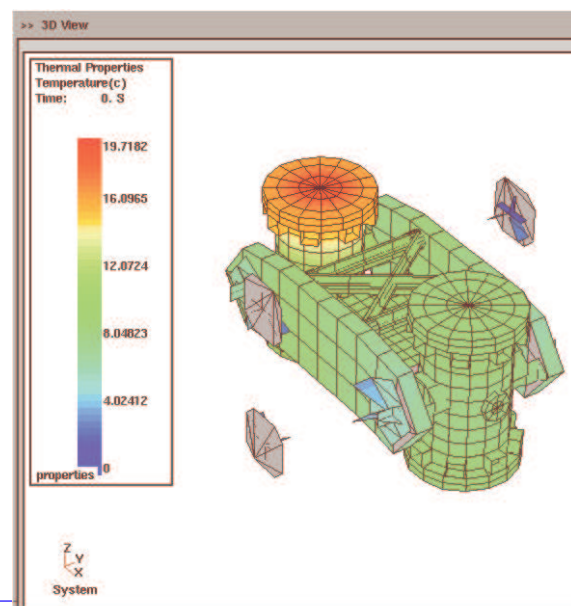
# Preprocessing

- TD has several utilities for pre-processing:
  - Selection by optical properties (show only), useful for debugging
  - Nice arrows features for displaying active sides

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# Post-processing

- T3D has a better postprocessing layout, with isocountour options, simple temperature range manipulation, nice visualization
  - Still to be fixed some (minor) bugs on the active surfaces
  - The input temperature file can be created only by the integrated internal solver (TBC), and is hard to edit manually (major)

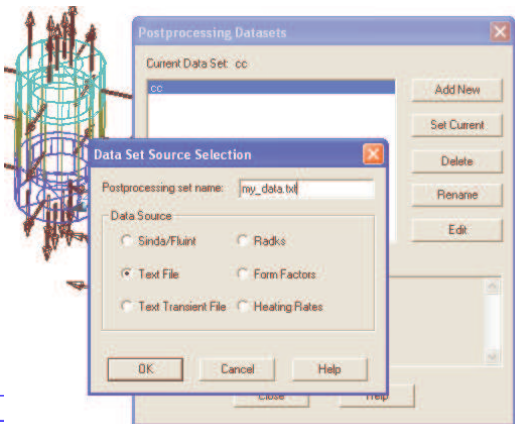




# Post-processing

- TD post-processing is less impressive from visualization point of view, and the layout is not always easy to control, but
  - It allows a wide range of input files format, including simple databases in the format

submodel.#node	temp
RADIATOR.1101	28.3
MLI.900110	62.8
...	...



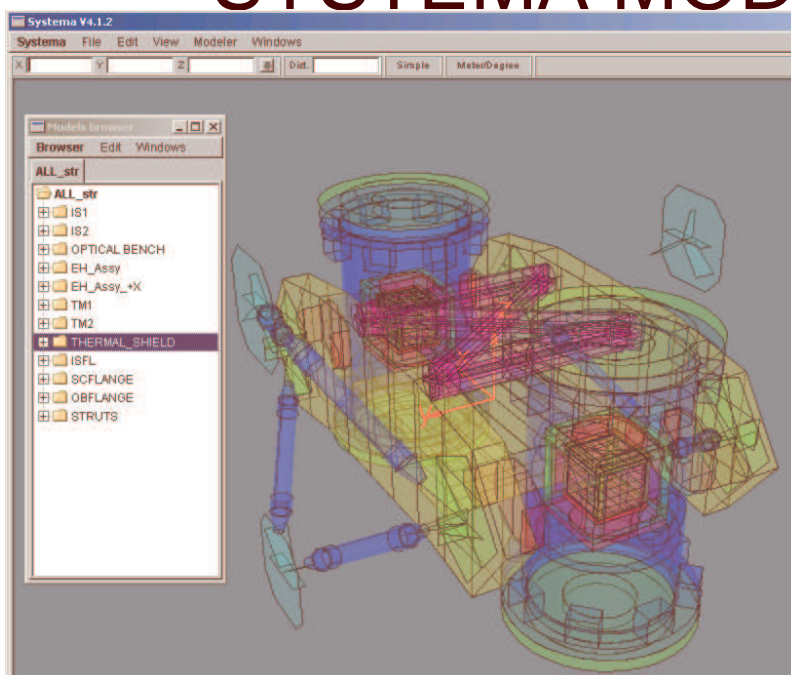
# User friendliness

- Being acquainted with Windows OS, TD results more friendly thanks to the “familiar” menu and icons approach
- Thermica has “nested” menu, and the path to set the parameters is sometimes not intuitive (requires going up and down through different levels)

## Other minor topics

- T3D
  - does not allow different node numbering on the two sides of a surface
  - has no “Undo” button
- TD
  - has no perspective view
  - has no transparency view
  - articulators are associated to single surfaces, rather than hierarchical object: more risky!
  - conductive block is much less flexible the Thermica new FEM approach
    - Edge conductance doesn't consider conduction contribution within the shape: not suitable for conduction among different shapes
    - Documentation not clear about the adopted method

## SYSTEMA MODELLER



- Impressive graphical acceleration
- Multiple models management
- Cut&Paste
- CAD import
- Point Snap improved
- Many more, but
  - still under development
  - no pre/post processing

# Conclusions

- Thermica S/W capabilities have been evaluated starting February/March 2005
- Key features missing when moving from TD to T3D:
  - Submodelling
  - Global editing by display selection
  - Nodal numbering within the shapes
- We remained impressed by the new Systema editor, which represents a great advance.
  - WHEN it will comprise all the T3D functionalities, and
  - IF some of the suggestions above will be implementedit will definitely become our preferred one!