Appendix C

Presentation of eTherm 1.2

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Abstract

In Thales Alenia Space - Cannes, we have a long experience and expertise, in the thermal software development. Concerning this point, we work with external companies like DOREA. The subject concerns the presentation, the demonstration of a new thermal software in TAS Cannes (= e-Therm). This tool is funded entirely by Thales Alenia Space - Cannes and it should not have to be commercialised but freely distributed.
This presentation is an overview of e-Therm. Today this release includes pre-processing tools (CIGAL2 for the building of geometrical models - radiative and 2D-3D conductive ...). It includes also post-processing tools like CIGAL2 for plotting graphs or cartographies.
Then, we will to talk about industrialization strategy especially based on using of our thermal software and on the integration of expert tools (2D-3D conductive module, Radiative module, Orbitography module, Solver module, Thermal model reduction tool, PTA is a tool dedicated for preliminary phases and very well adapted to the telecom program because it reuses automatically the recurrent part of spacecraft in the building of the model, friendly pre pro for telecom applications , CORAFILE , modelling / meshing) in order to improve and standardize the analysis process, in order to gain in cost and quality, for better also input/output traceability. In the soon future, we are going to integrate all the pre and post-processing modules developed initially for CORATHERM. These modules have been used on following programs : Apstar, Yamal, W6A, O3B, Irridium ...
In parallel of industrialization strategy, we develop a strategy of openness of e-Therm by distributing software free of charge to TAS-Toulouse for antenna applications and TAS-Turin for infrastructures and instruments and more generally to TAS-Group and a lot of companies.
Finally, e-Therm is well interfaced with the market tools thanks to STEP-TAS : it is an exchange standard developed by ESA more or less ready for exchanging geometrical models but not ready for exchanging thermal model. It is why a direct interface has been developed between our solver and ESATAN using TMRT without no reduction process.
Moreover, it is possibly used e-Therm for concurrent design facilities, for thermal simulator for operation and customers, and planned to extend e-Therm to other fields in physics : using in the electronic board calculation, using for simulating ESD on geostationary satellite, based on plasma / satellite interaction modelling ...

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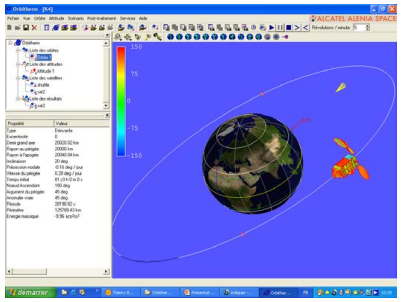
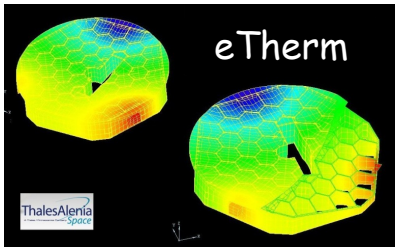
26th ESA workshop on Thermal Analysis

Presentation of eTherm1.2





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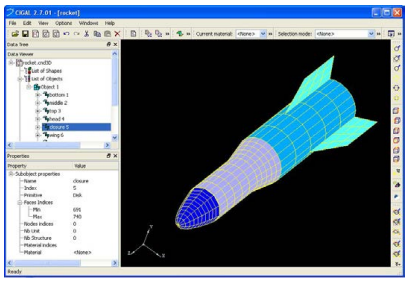
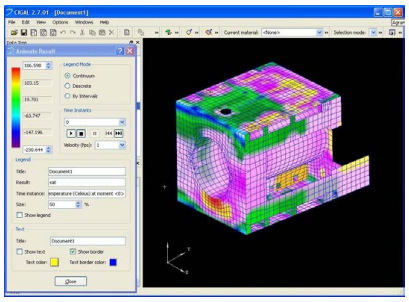
F. BRUNETTI (DOREA),
JP. DUDON





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ETHERM : HISTORY, STRATEGY AND CONVERGENCE

CORATHERM

CORATHERM
CIGAL

CORATHERM
CIGAL2

CORATHERM
CIGAL2
ORBITHERM
PTA2

CORATHERM
ORBITHERM
ETHERM V1.0

- CIGAL2
- 2D and 3D Conductive Session
- PTA2 model building
- Processing CORATHERM files

1970 ***1990*** ***2001*** ***2003*** ***2010***

07/2011

CORATHERM
ORBITHERM
ETHERM V1.1

- Thermal Model Reduction Tool
- 3D Mesh, Realistic View
- Radiative Module calculation
- Concurrent Design Facilities
- PTA2 : integrated heat pipes

- PTA2 Fortran
- Thermal Simulator for Operation
- Concurrent Design Facilities : New functionalities

ETHERM V2.0 ***06/2013*** ***12/2012*** ***04/2012***

Extension of others physical fields

Spacecraft charging ? Electronic boards, Electron tubes

ETHERM V1.3

- Moving SA
- Pre-Post Processing Tool
- Integrated Guideline

CORATHERM
ETHERM V1.2

- ORBITHERM
- Thermal Solver : RPT
- Management of historical CORATHERM files
- Thermal Model Reduction Tool Session
- Conductif : Variation of Conductivity into Nida
- View surface calculation : SV

eTherm new Release presentation – Oct 2012

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eTherm1.2 : Main Circle Dock

eTherm v1.2 : 3 tools in 1

- **Thermal for Space**
- **Dynamic Simulator for Space**
- **Concurrent design facilities**

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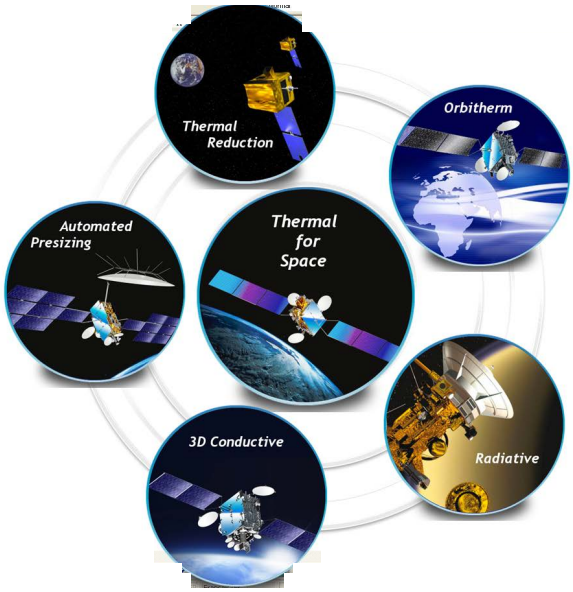
eTherm1.2 : Secondary Circle Dock

« Thermal for Space » tool is composed of 5 modules



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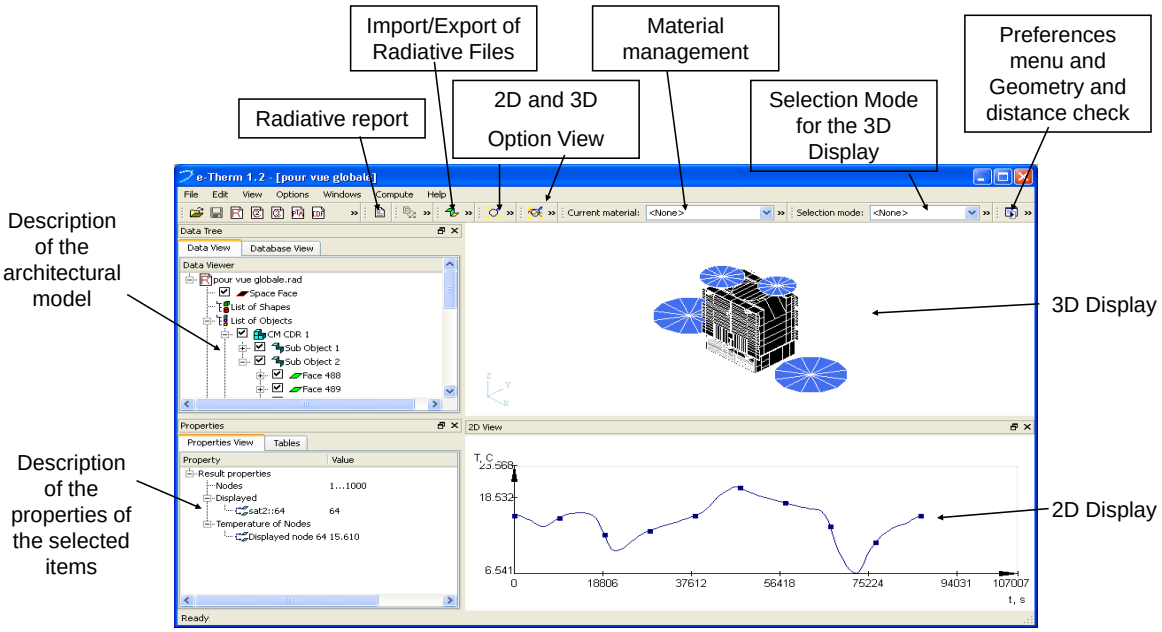
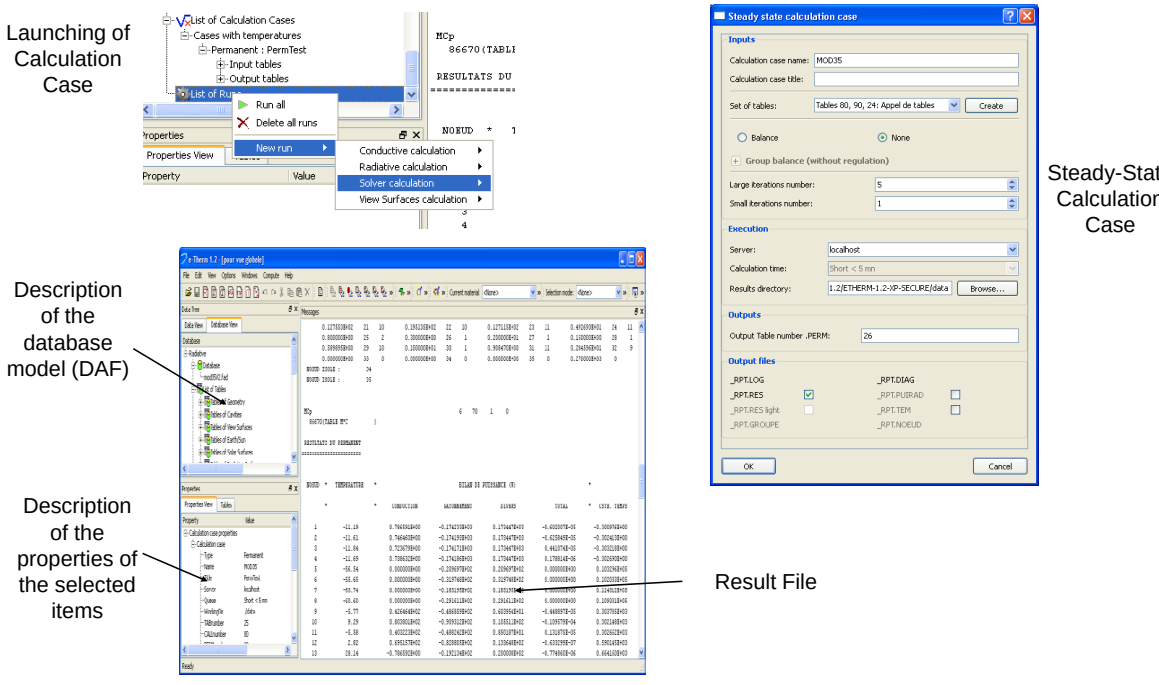
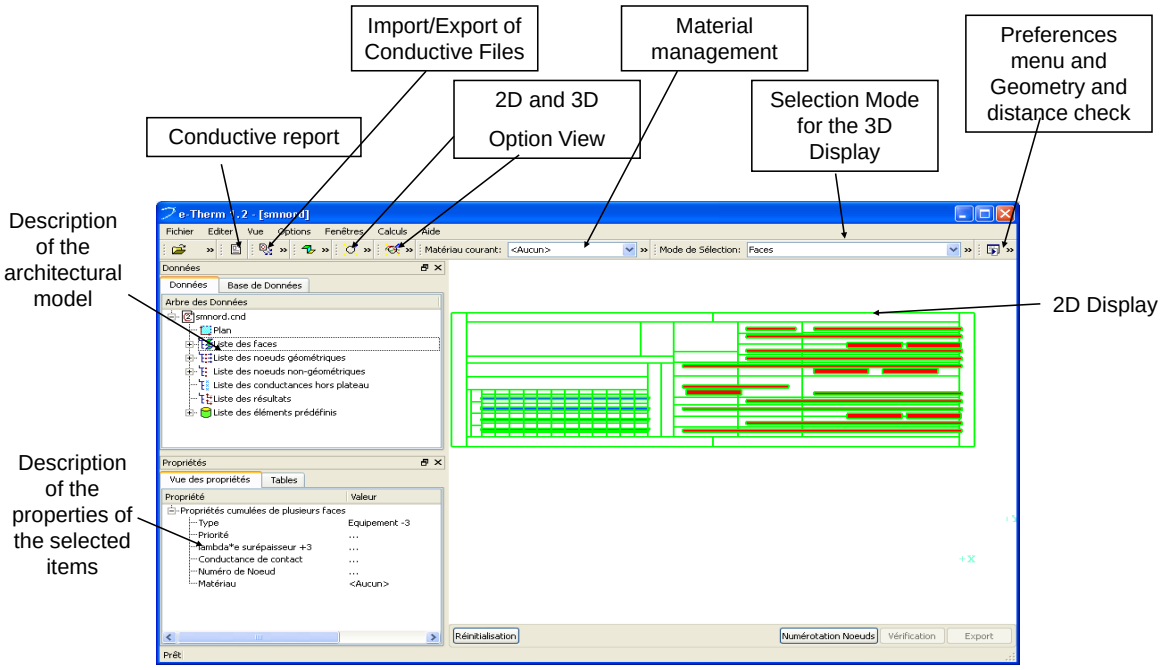
Radiative Session – GUI & Data Viewing



Radiative Session - Database access



2D Conductive Session – GUI & Data Viewing



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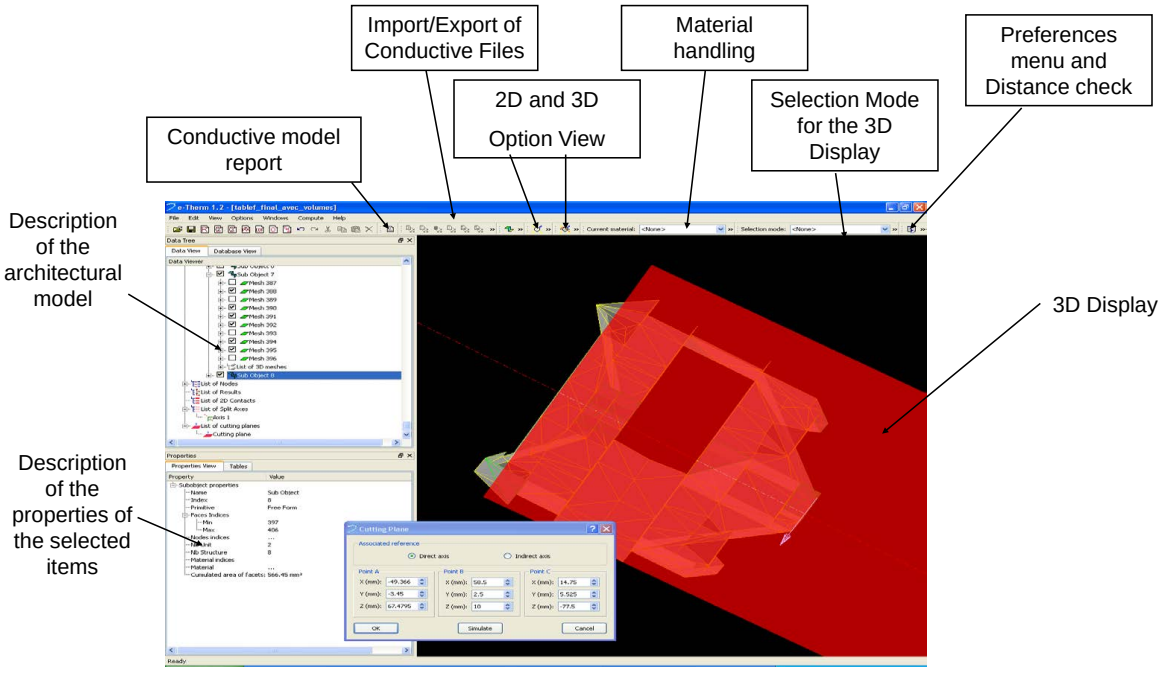
3D Conductive Session - Data Viewing



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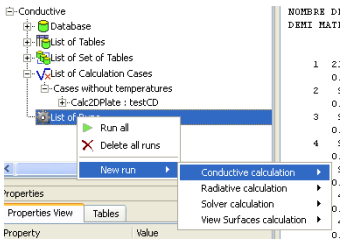
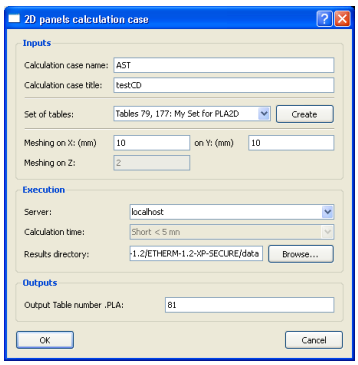
Conductive Session - Database access

Launching of Calculation Case

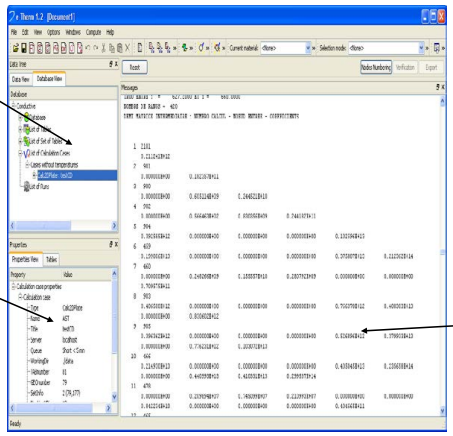




Conductive Calculation Case

Description of the database model (DAF)

Description of the properties of the selected items



Result File

Orbitography Session - Data View

Import Orbit, Attitude, satellite result Files

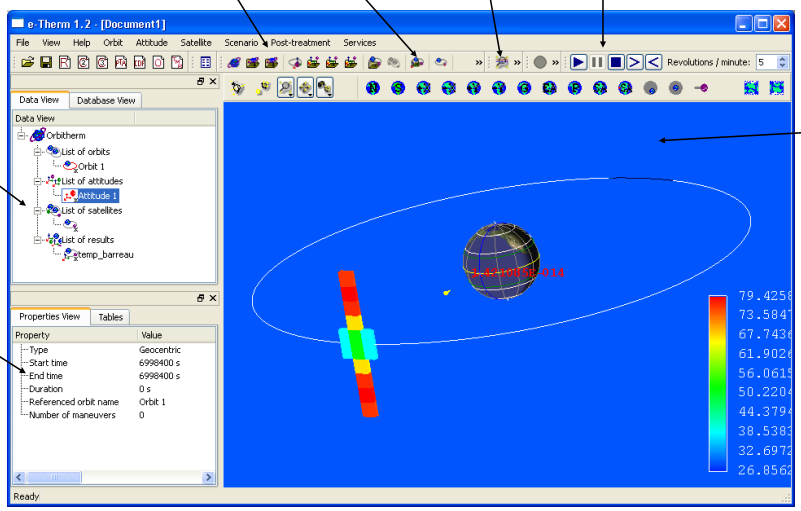
Graphical action for the 3D Display

Print and Snapshot view

Animation menu

Description of the architectural model

Description of the properties of the selected items

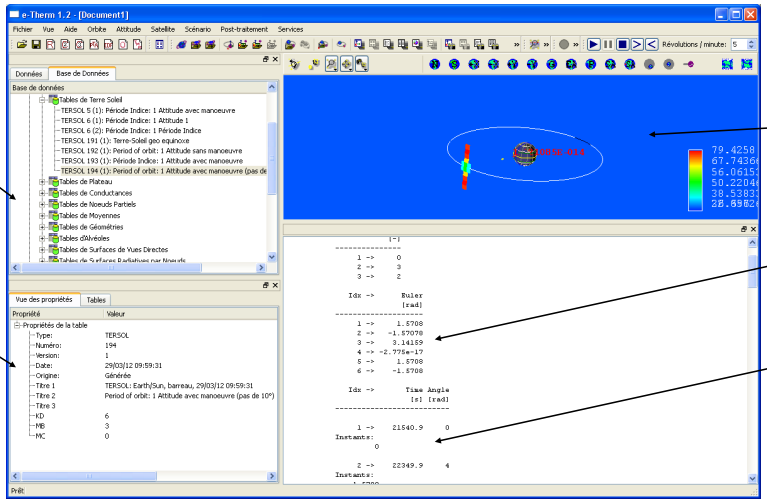


3D Display

Orbitography Session - Database View

Description of the DAF

Description of the TERSOL Table Structure



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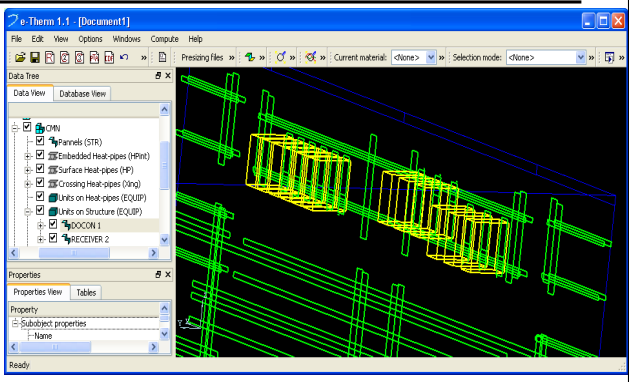
PTA Session and Application

- **Goals and Interests**
  - To Generate a complete SPACEBUS S/C Model including
    - Generic P/F Parts issued from Data Base
    - Specific P/L Part created from CAD Data direct processing (North/South Panels)
  - To Generate Preliminary conductive meshing of North/South Panels
  - To include quickly and automatically a great number of each Unit or Heat Pipe reference with their specific thermal modeling
    - Data Base Management
  - To Generate automatic numbering with complete consistency of
    - Radiative And Conductive Geometries and Associated Couplings
    - Inertia
    - Dissipation
  - To propose an ergonomic and visual Graphical User Interface
- **Outlooks**
  - TMM delivery to be reduced to 3-4 weeks
    - User Guide and Support
    - P/L Units/Heat Pipes DataBase Completion and Management
  - ATHENA-FIDUS
    - Generic P/F TMM update in progress
    - Specific P/L Units DataBase in progress



- **Applications to CDR Model Building**
  - AP7A (eTHERM V1.0)
    - 1st application on Telecom Program
    - Finalization/Validation of the Tool on full scale TMM
    - TMM delivered in 8 weeks
    - S/C TMM Correlation under nominal progress
  - YAMAL 402 (eTHERM V1.1)
    - 1st application on Telecom Program for Embedded Heat Pipes Panels
    - Finalization/Validation of the Tool on full scale TMM
    - TMM delivered in 10 weeks
  - EUT W6A (eTHERM V1.1)
    - TMM delivered in 6 weeks

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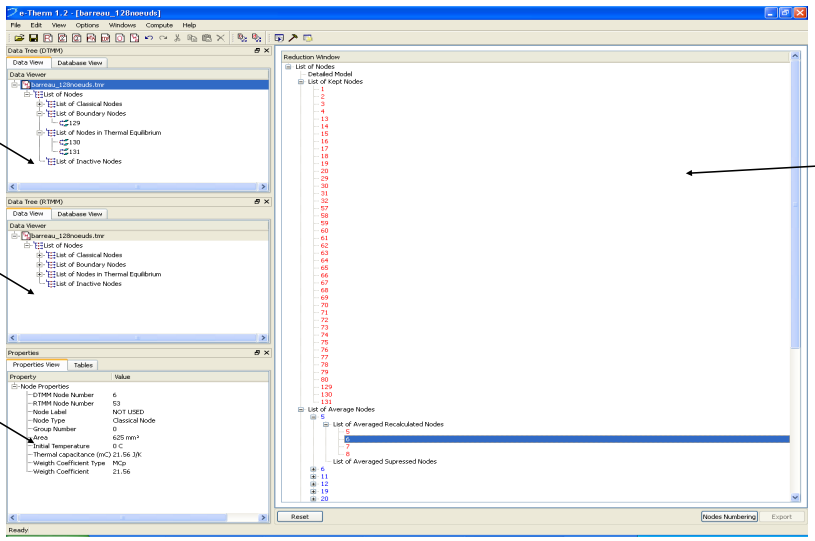
Reduction Model Session - Data View

Description of the nodal detailed model

Description of the nodal reduced model

Description of the properties of the selected items



Definition of the reduction process

TMRT

- **Goals and Interest**
  - To go from a Detailed TMM to a Reduced TMM
    - Automatic Management of all the Exchanges and Power
    - Keeping the consistency of the thermophysics behavior
  - To Enable iterative process to match to the Specified compromise
    - Decreasing number of nodes and Exchanges
    - Keeping acceptable precision
  - To work on both CORATHERM/ESATAN DTMM Formats
    - Enable to convert TMM ESATAN <-> CORATHERM
- **Process**
  - Principle :
    - Use of the PLATEAU-EQUIVALE Method for Conductive exchanges and Capacitances (TAS-F Heritage)
    - Arithmetic Sum of Radiative Exchanges and Power
  - Different Types of nodes
    - Kept nodes : RTMM nodes
    - Re-Computed nodes : taken into account in the reduction and enabling to have complete Temperature Cartography by post-Process (initial TMM Cartography)
    - Eliminated nodes : taken into account in the reduction, but no possibility to retrieve Temperature after RTMM Process
  - The gathering of the nodes are given in a Reduction Matrix
    - Experience and Know-how to reach good compromise
- **Applications to S/C Model for Launcher Interface (from CDR Model)**
  - AP7A : RTMM delivered in 9 weeks
  - YAMAL 402 : RTMM delivered in 10 weeks
  - EUT W6A: RTMM delivered in 6 weeks, Reduction from 3000 to 375 nodes, Precision : less than 2°C on Units, near 0°C mean discrepancy on the whole TMM
  - ATHENA-FIDUS : S/C Model for Launcher Interface : RTMM delivered in 4 weeks
  - O3B : Thermal Model for Operation Simulator : RTMM delivered in 3 weeks

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Applications - TMRT

❑ Applications to S/C Model for Launcher Interface (from CDR Model) : W6A

node	descro	groupe	groupe name	mcp	nœuds calcules K/GR/GNR num. max: 400
286	SM/PCU_CONNECTOR	8	SMN Units	3.32E+03	246
287	SM/PCU_SUNLIGHT	8	SMN Units	9.69E+03	246
288	SM/PCU_CAPA	8	SMN Units	3.32E+03	246
289	SM/PCU_TMTC	8	SMN Units	3.70E+03	246
290	SM/PCU_BCR1_1	8	SMN Units	1.94E+03	246
291	SM/PCU_BDR1	8	SMN Units	4.27E+03	246
292	SM/PCU_BDR2	8	SMN Units	4.18E+03	246
293	SM/PCU_BDR3	8	SMN Units	4.18E+03	246
294	SM/PCU_BDR4	8	SMN Units	4.27E+03	246
295	SM/PCU_BCR1_2	8	SMN Units	1.94E+03	246
296	SM/GYRO+Z	9	SMS Units	3.38E+03	250
297	SM/GYRO-Z	9	SMS Units	3.38E+03	251
298	SM/SMU_2	9	SMS Units	2.00E+00	82
299	SM/PFDIU	9	SMS Units	1.73E+04	247
300	SM/SMU_1	9	SMS Units	2.00E+03	248
301	SM/RW -X-Z	10	RW	7.60E+03	249
302	SM/RW -X+Z	10	RW	7.60E+03	249
303	SM/RW +X-Z	10	RW	7.60E+03	249
304	SM/RW +X+Z	10	RW	7.60E+03	249

Group	Designation	Node	Localisation		N RTMM	T RTMM	T DTMM	DT
SM UNITS	PCU	246	INTERNAL		246	16.0	14.7	-1.3
	PFDIU	247	INTERNAL		247	23.4	24.9	1.5
	SMU	248	INTERNAL		248	22.9	23.1	0.2
	RW	249	INTERNAL		249	17.5	19.7	2.2
	GYRO+Z	250	INTERNAL		250	21.1	22.1	1.0
	GYRO-Z	251	INTERNAL		251	21.6	23.8	2.2

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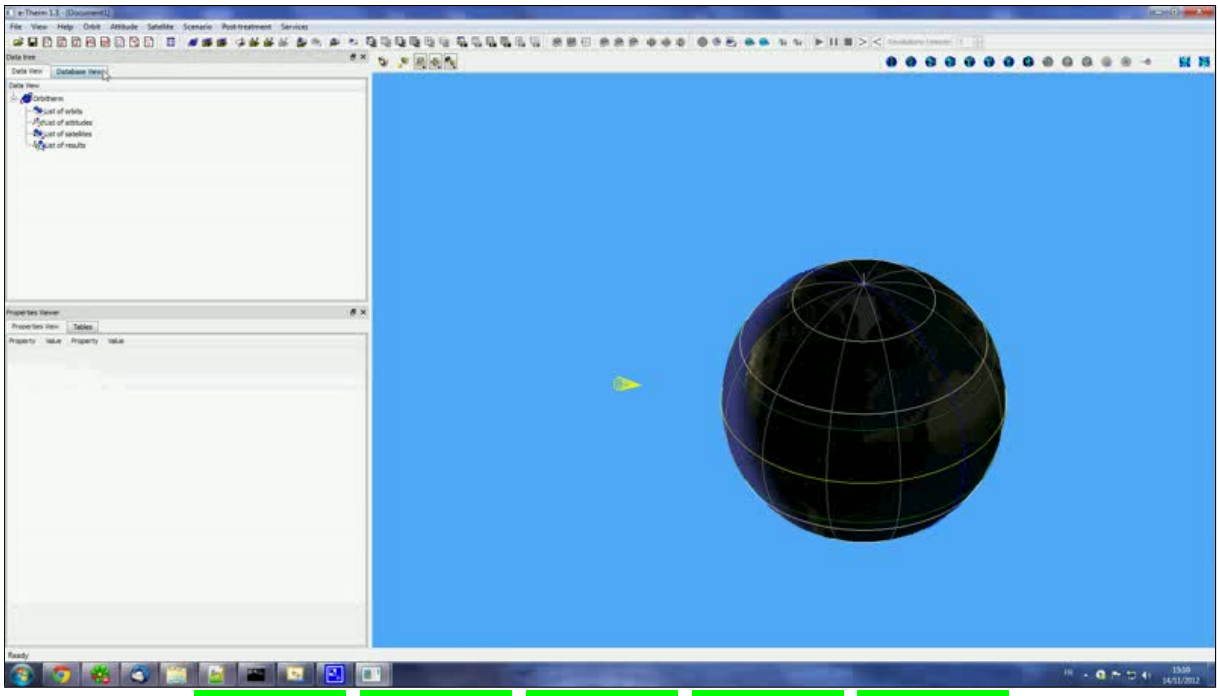
eTherm1.2 : Conclusion and Support

- eTherm 1.2 :
  - ❑ Release available until September and it is a FREE software
  - ❑ Availability :
    - ➔ Download from the website of DOREA
    - ➔ Supply install DVDROM
  - ❑ Operative mode :
    - ➔ Launch the Setup (Windows XP with 3D graphical card – GeForce6600GT)
    - ➔ Supply the ethernet card number to Thierry.basset@thalesaleniaspace.com
    - ➔ Rename the file license in “license” and put this file in \\eTherm-1.2-XP\AlcatelResources directory
- Documentations
  - ❑ User Manual
  - ❑ EID : External Interface Document
  - ❑ Guideline : training module, SVVP, Technical note



Slow | Normal | Fast | Play/Pause | Stop