

SYSTEMA

An Open Framework for Engineering

Christophe THEROUDE, Mehdi HANNA

ASTRIUM Satellites

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All the space you need



Agenda

- SYSTEMA overview
- SYSTEMA: An open and evolutionary framework
 - Geometry
 - Trajectory
 - Kinematics
 - Mission
 - Processing
- SYSTEMA: An interdisciplinary model description
- SYSTEMA applications
 - Thermics
 - Radiation
- SYSTEMA roadmap

SYSTEMA Overview

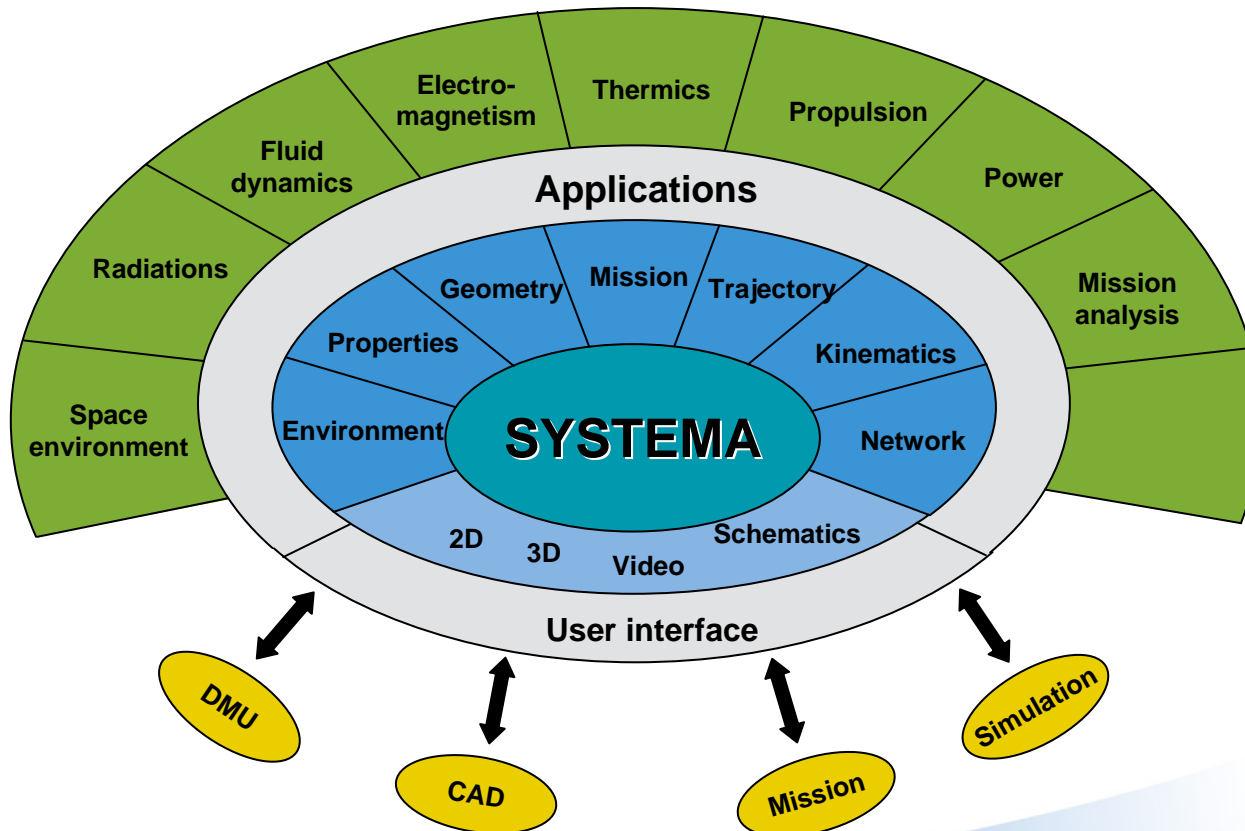
■ Description

- SYSTEMA is a software product line for space engineering to support the needs for the early design to the detailed design phases
- The objective of SYSTEMA is to gather in the **same environment** and using the **same model representation** a large set of applications (AOCS, thermal, power...)
- SYSTEMA integrates:
 - An open framework consisting of interactive toolboxes to build the spacecraft geometry, define its orbit, its kinematics, specify a mission scenario
 - A set of dedicated application in various technical fields (thermics, radiation, power...)

■ History

- System analysis software development with ESA and CNES for more 20 years
- SYSTEMA development company funding for more than 10 years
- Software distribution (THERMICA, DOSRAD...) for 10 years
- Experience on observation and scientific spacecraft, telecommunication spacecraft, launchers

SYSTEMA: an interdisciplinary tool suite



SYSTEMA: The key features

- Clear separation between framework and applications
 - Easy to develop new applications for specific use
 - Easy to maintain and make evolutions
- Software standards based
 - Helps exchanges between tools (XML for all input/output files, HDF5 for large computation results)
- Modularity
- Rich platform support
 - PC, Linux, SUN, HP
- Modern and intuitive ergonomics

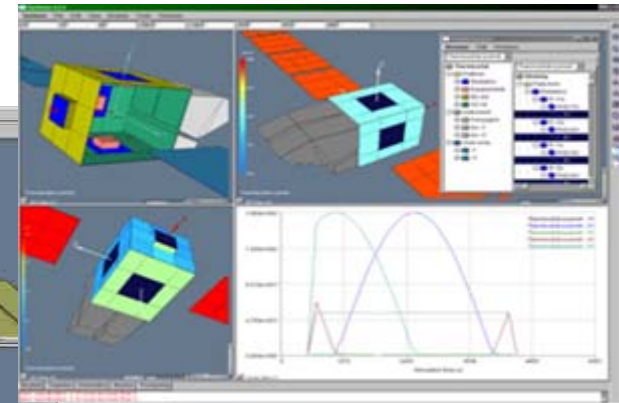
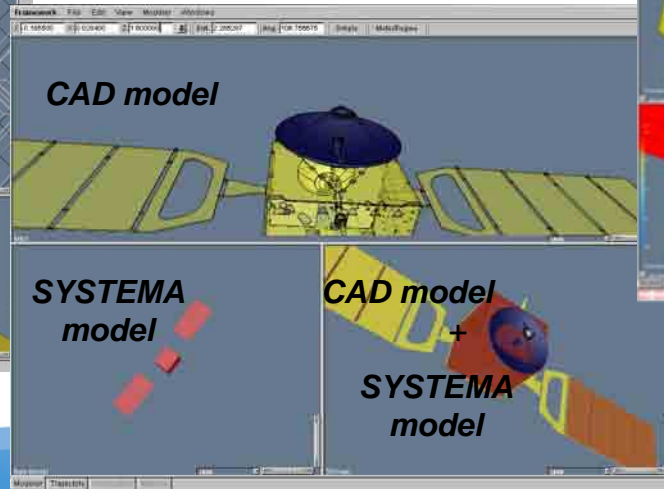
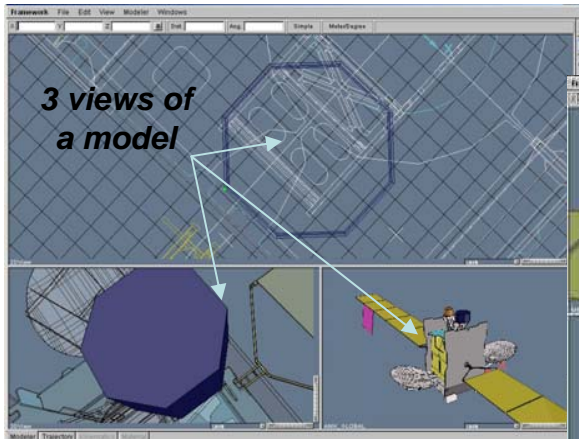


SYSTEMA: An open and evolutionary framework

- It provides a set of functionalities required to make an analysis:
 - CAD import / model generation / meshing / properties / results display
 - Trajectory definition (Keplerian or general)
 - Kinematics description (pointing laws or general)
 - Mission scenario description / results display / animation
 - Processing: defining the computation case and the run parameter
- Applications are plug-in package described by XML files
- SYSTEMA framework is also a powerful stand-alone application to perform mission and kinematics analysis.

SYSTEMA Modeler – Model manipulation / generation

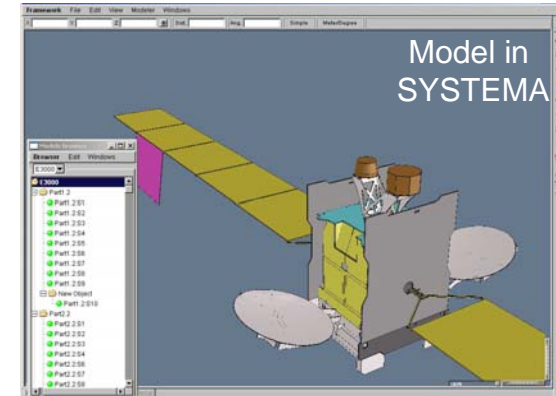
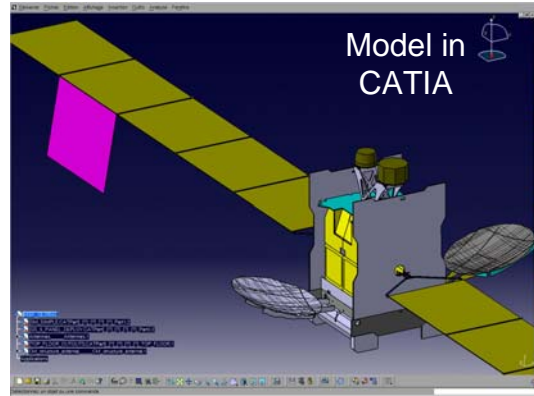
- Easy model creation
 - Hierarchical description
 - Interactive shapes creation
 - Interface with CAD and mechanical tools
 - Rich help for CAD models simplification
 - Management of complex shapes (boolean cut)
- Easy 3D manipulation
 - Standard mouse zoom, pan, rotate
- Multi-viewers / multi-models management
 - Simultaneous points of view of a model
 - Several models can be loaded
- Display of the results on the 3D model



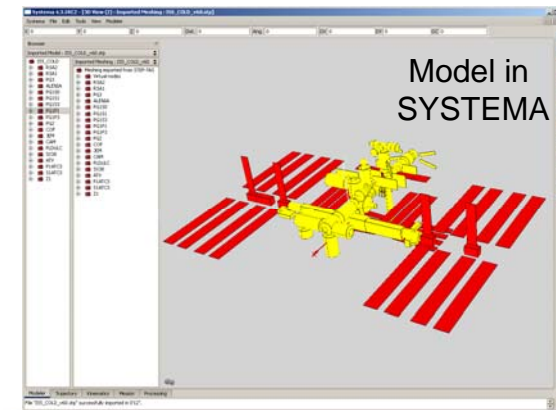
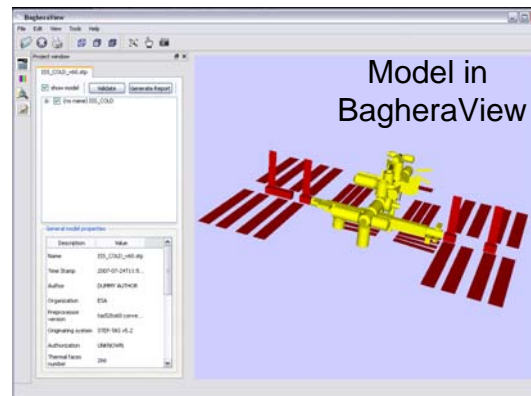
THERMICA results

SYSTEMA Modeler - Interfaces

- **STEP AP203 interface:**
 - Import models from CAD

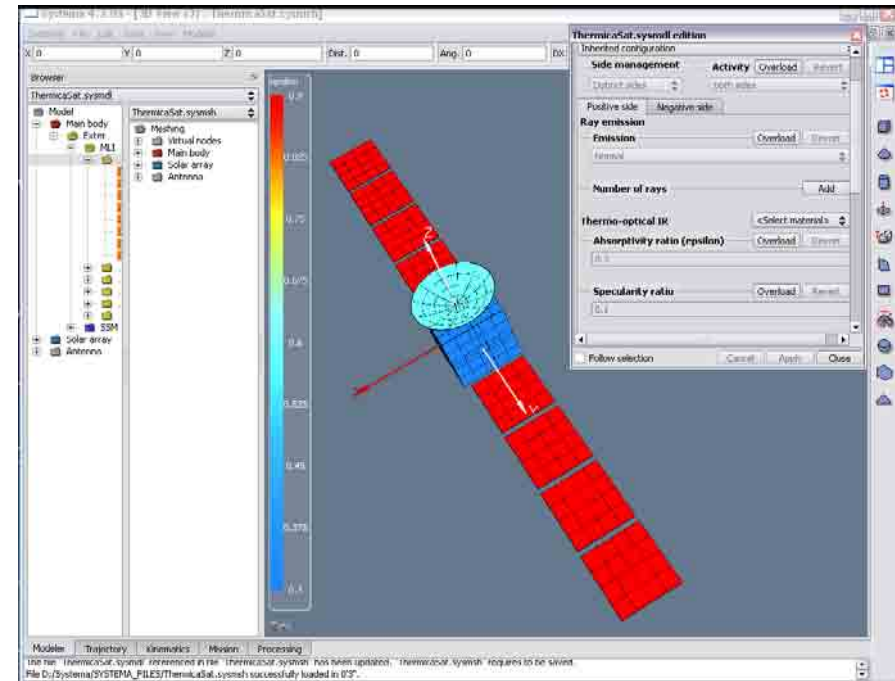


- **STEP-TAS interface:**
 - Import thermal models from other thermal analyse tools



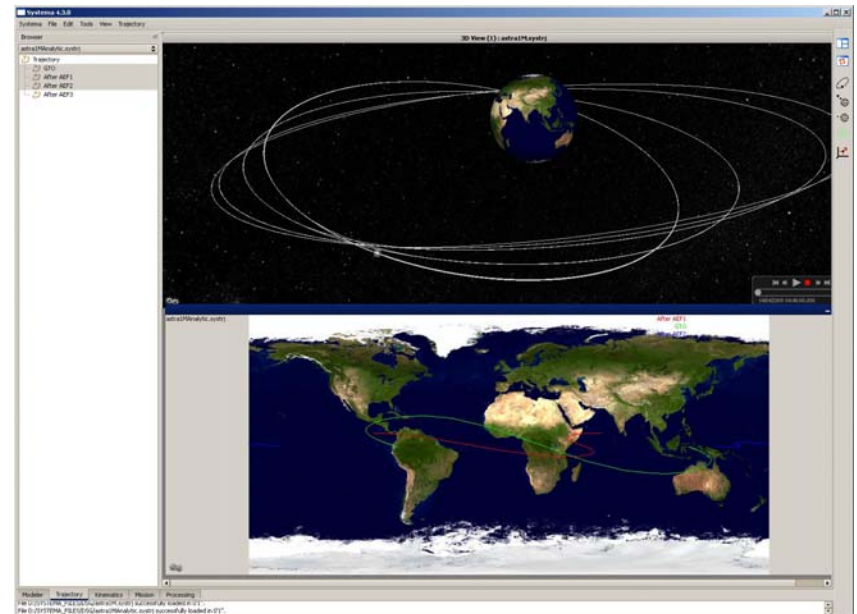
SYSTEMA Modeler – Application properties

- Application properties (physical properties, computation parameters...)
 - At object level
 - From a material libraries
- Several meshing associated to a same geometrical model
 - Multi-representation of the same model
- Non-geometrical entities to support the specific needs of the application
 - Computation points, bounding box, space node, source...

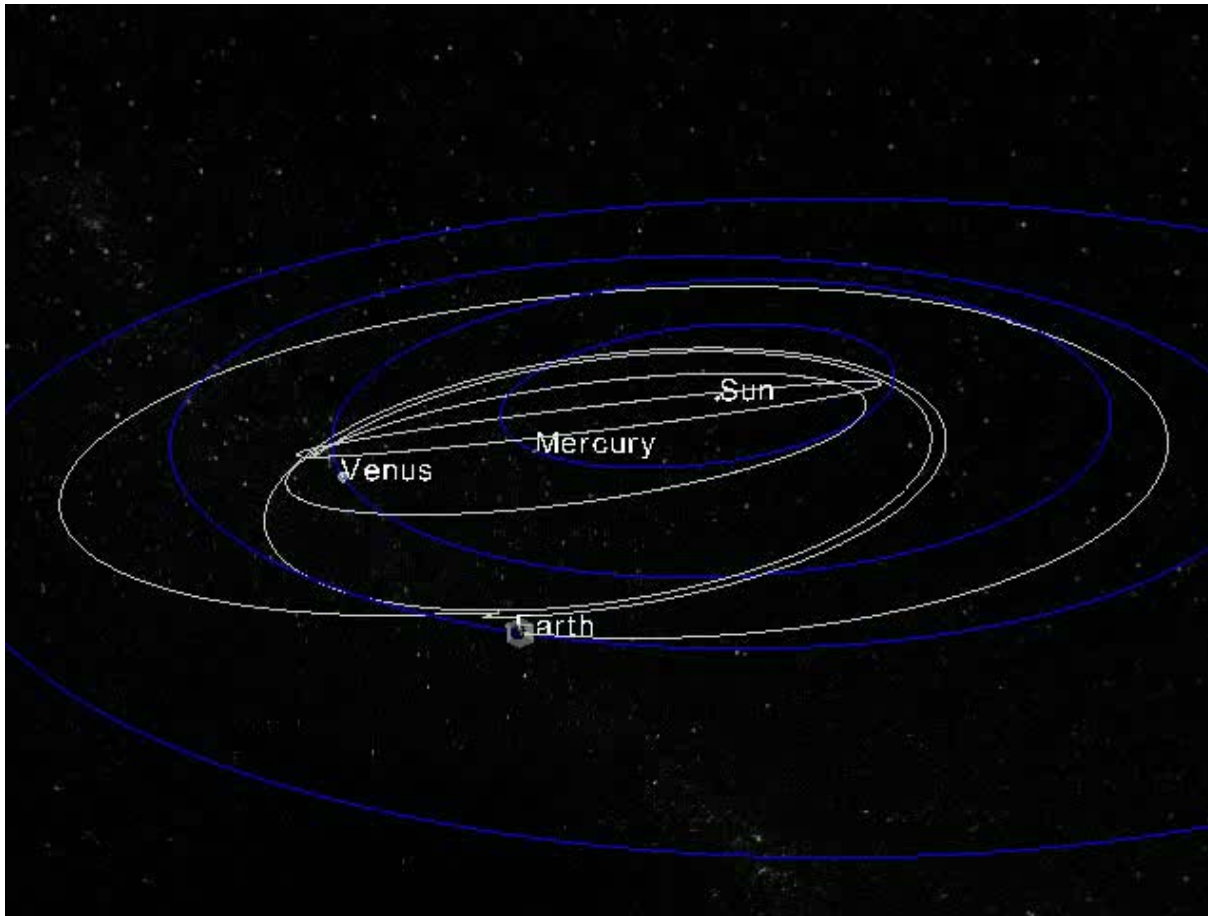


SYSTEMA Trajectory (1)

- Management of every planets of the solar system, Sun and moon with the real ephemerid
- Complex trajectories as a structured assembly of orbital arcs
- Arc defined either as a Keplerian arc or as a general trajectory (position, velocity)
- Functionalities in each viewport: zoom, pan, rotate, fit
- 2D cartography and 3D display
- Animation of the spacecraft trajectory including the planets

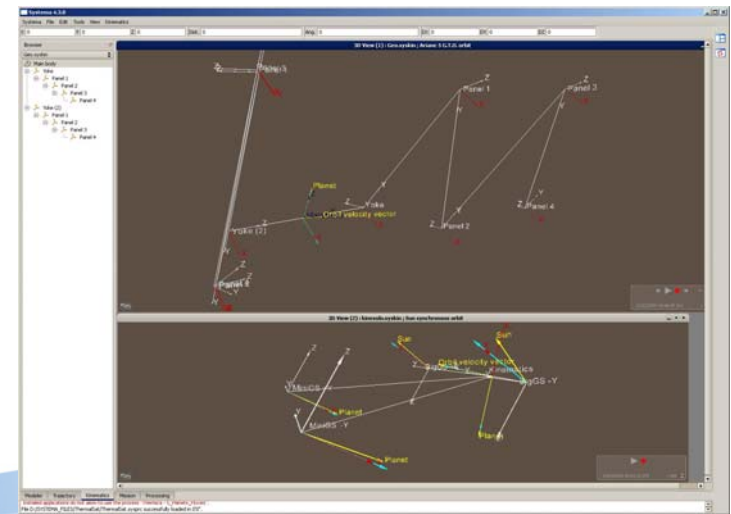


SYSTEMA Trajectory (2)



SYSTEMA Kinematics

- Generic definition of the kinematics (reuse between satellites)
- General description of kinematics without the support of a geometry
- Tree of rigid moving bodies linked by degrees of freedom (and constraints)
- Support of several kinematics phases (SA deployment, SA sun pointing...) to handle the different sequences of the mission
- Definition of standard pointing laws of moving bodies (Earth pointing, Sun pointing...)
- Definition of general kinematics laws
- Animation of the kinematics

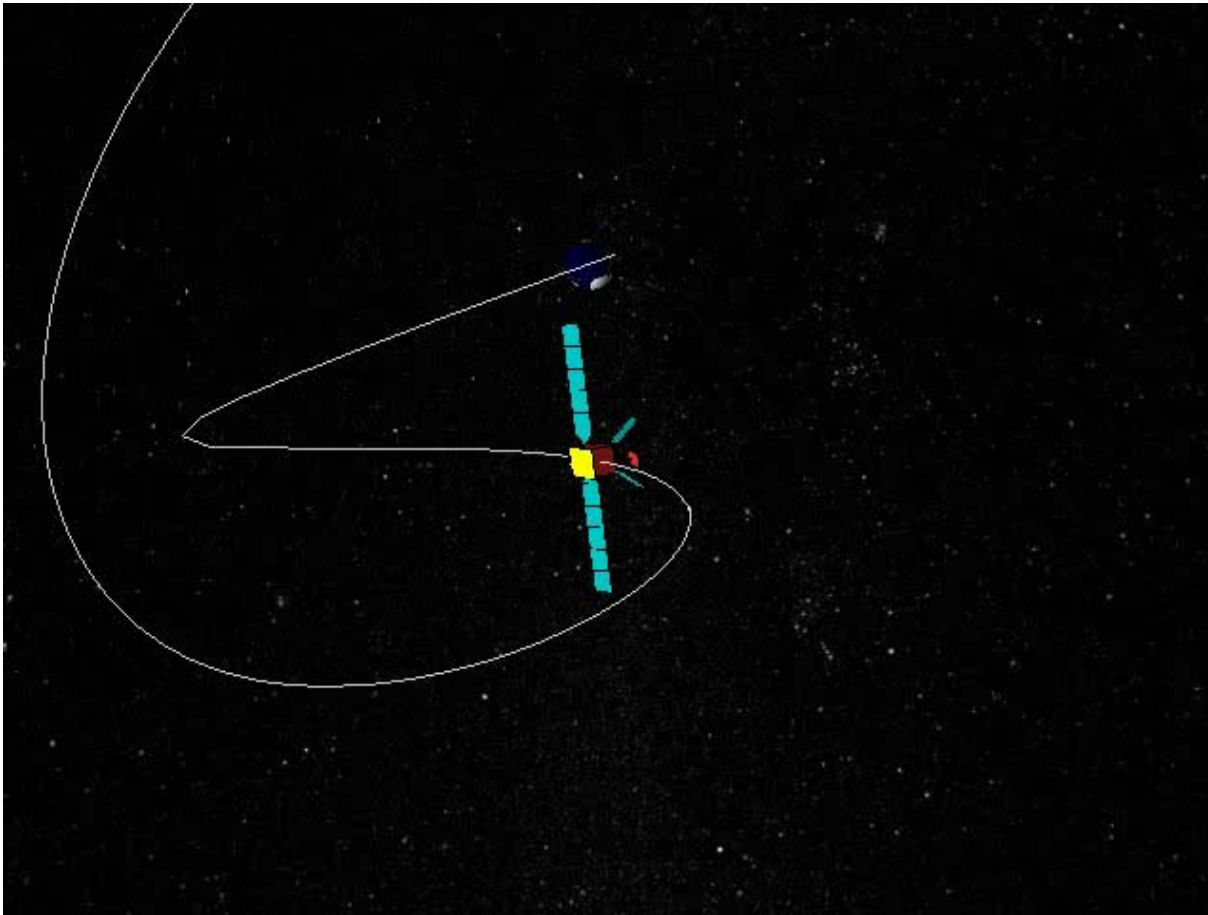


SYSTEMA Mission scenario (1)

- To define the whole system and the connection between the different aspects:
 - Geometrical model
 - Trajectory
 - Sequences of kinematics and pointing
- Management of a timeline, of events (eclipse...), of kinematics phase
- Animation of the whole system
- In the future management of spacecraft modes (platform / payload usage...)



SYSTEMA Mission scenario (2)



SYSTEMA Processing

- Interactive processing
 - Sets the applications and their properties, their input/output files...
 - A processing schematics created
 - Any mission can be chosen from this module
 - Results management

Process management

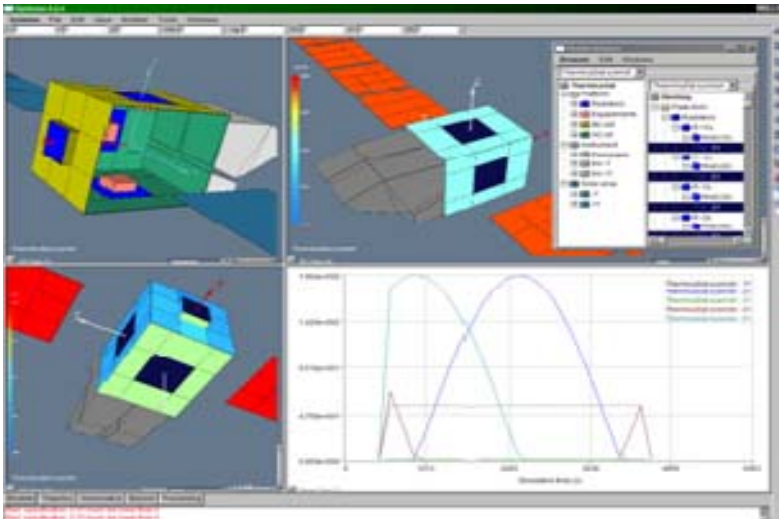
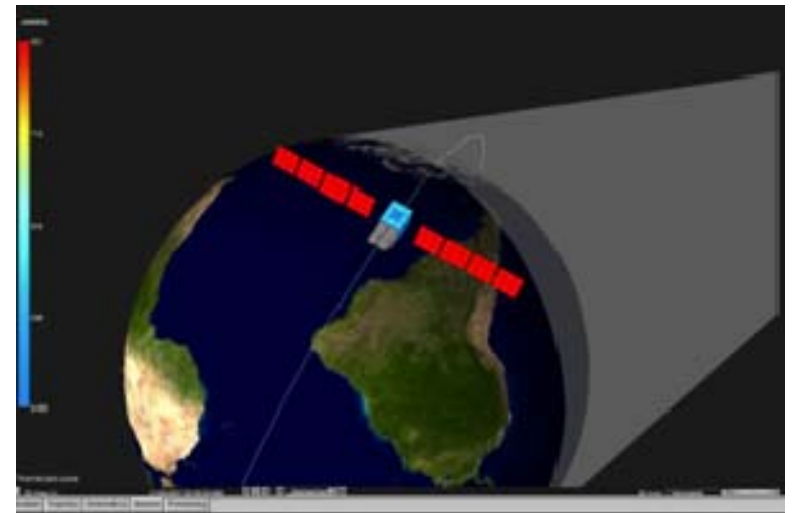
Result management

Process parameters

The screenshot displays the SYSTEMA software interface. At the top, a window titled 'Systema 4.1.0a [3D View (1) | ThermicaGet_system]' shows a process flow diagram with nodes like 'Current Mission', 'Heat_Direction', 'Conduction', 'Radiation', and 'Heat_Flux'. On the right, a list of 'Available applications' includes 'Thermica', 'Node_Description', 'Conduction', 'Radiation', 'Heat_Flux', and 'Panel_Fluxes'. A 'New Processing edition' dialog box is open, showing 'RUN PARAMETERS' for a simulation named 'Deco'. The dialog has tabs for 'Conduction', 'Radiation', 'Dissipation', 'Mapping', and 'Temperature'. The 'Conduction' tab is active, showing parameters like 'Approach' (Previous), 'Reduction of edge nodes' (No), '2D parameterisation' (No), 'Edges in submodel' (No), 'Edge first number' (0), 'Edge last number' (100000), and 'Edges detail' (No). A 'Run' button is circled in the dialog box, with a red arrow pointing to it from the word 'Run'. Another red arrow points from the text 'Available applications' to the application list on the right.

SYSTEMA Processing Results

- Analysis results can be displayed:
 - Text file
 - 2D table
 - 3D on animated model



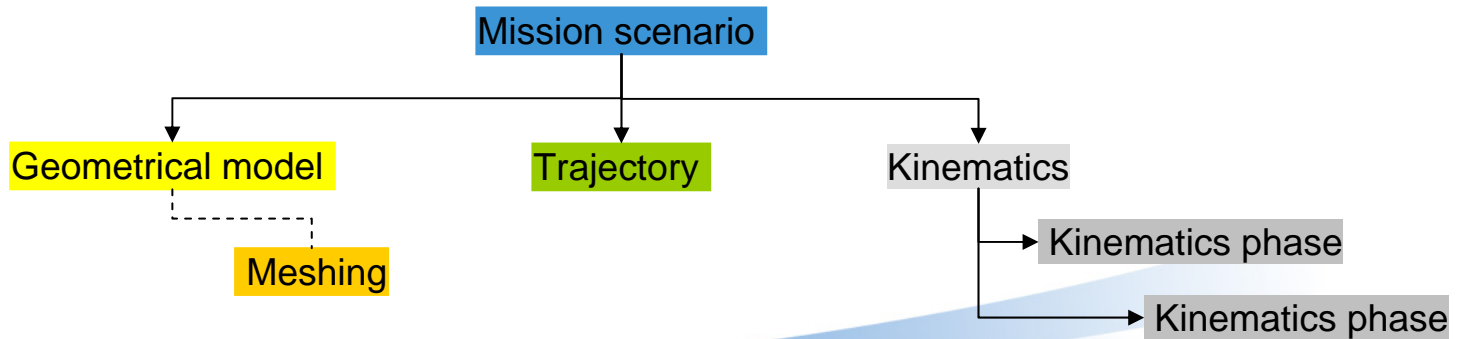
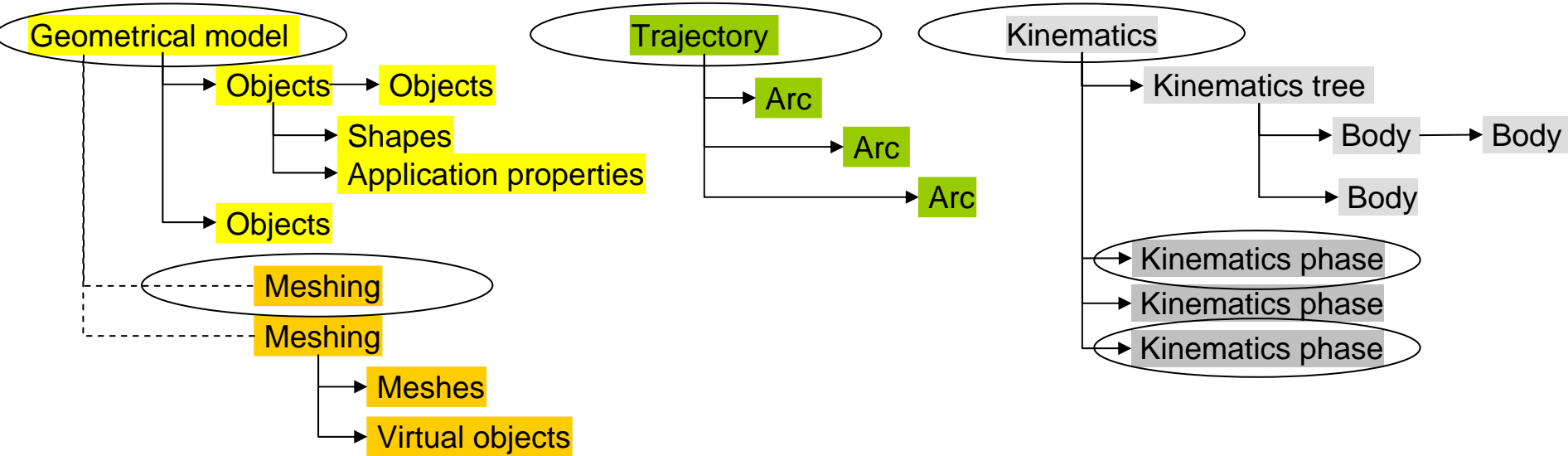
Applications Interfacing

- **Application specificities**
 - Properties handled by geometrical shapes
 - Meshing algorithms
 - Computation points generations
 - Computation processes
- **Solutions**
 - XML description for all properties and parameters
 - Dynamic libraries for framework related work (meshing, points generation)
 - Stand alone processes for computation code with low-level socket communication link with framework for processing real-time information
- **Package**
 - Auto detected by SYSTEMA

SYSTEMA : an interdisciplinary model description

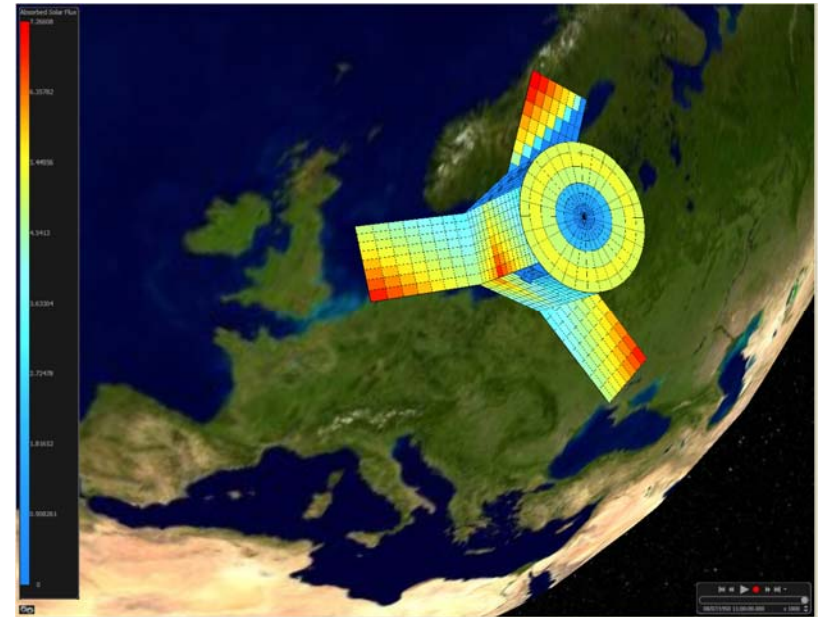
- Adapted to the needs of the different engineering applications
 - The model (and in particular the meshing and configuration) has to be adapted to needs of the application
- Allowing easy sharing of model entities between applications
 - Easy transfer of geometry, trajectory, kinematics... between different applications
- Allowing maximum reuse between different models
 - Generic description of the entities
- Offering a maximum of flexibility
 - To allow easy comparisons between configuration, parametric analysis, worst case identification...

SYSTEMA entities



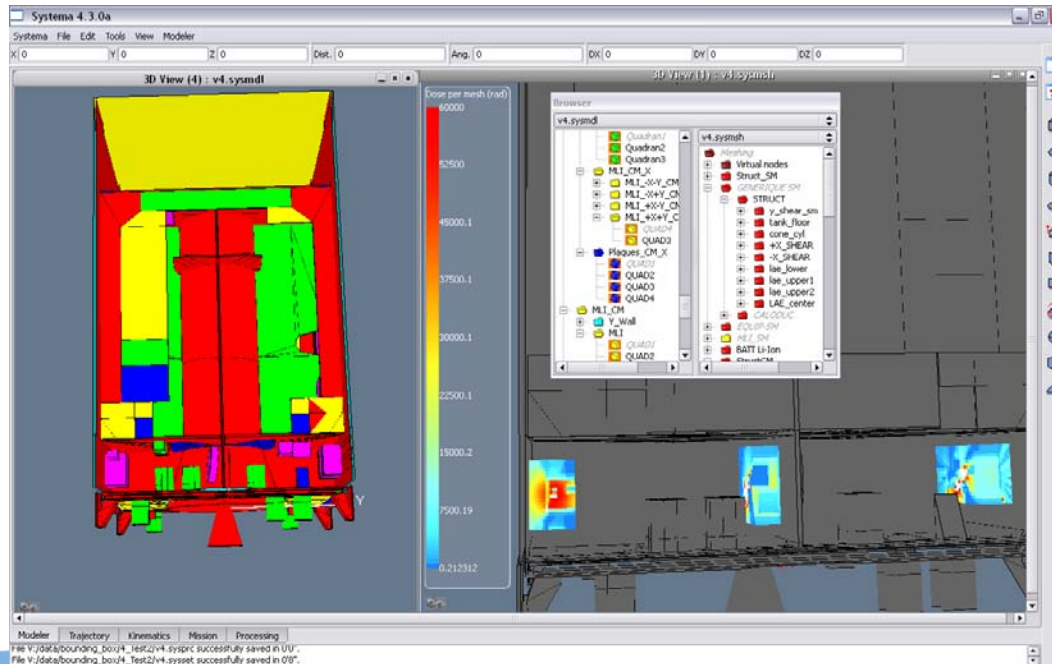
SYSTEMA application THERMICA

- Computation of computation of radiative, conductive exchange and external fluxes
- Computation of temperature
- Management of representative geometry, trajectory and planets
- Environment models (planet properties)
- Management of complex processes to chain the different modules

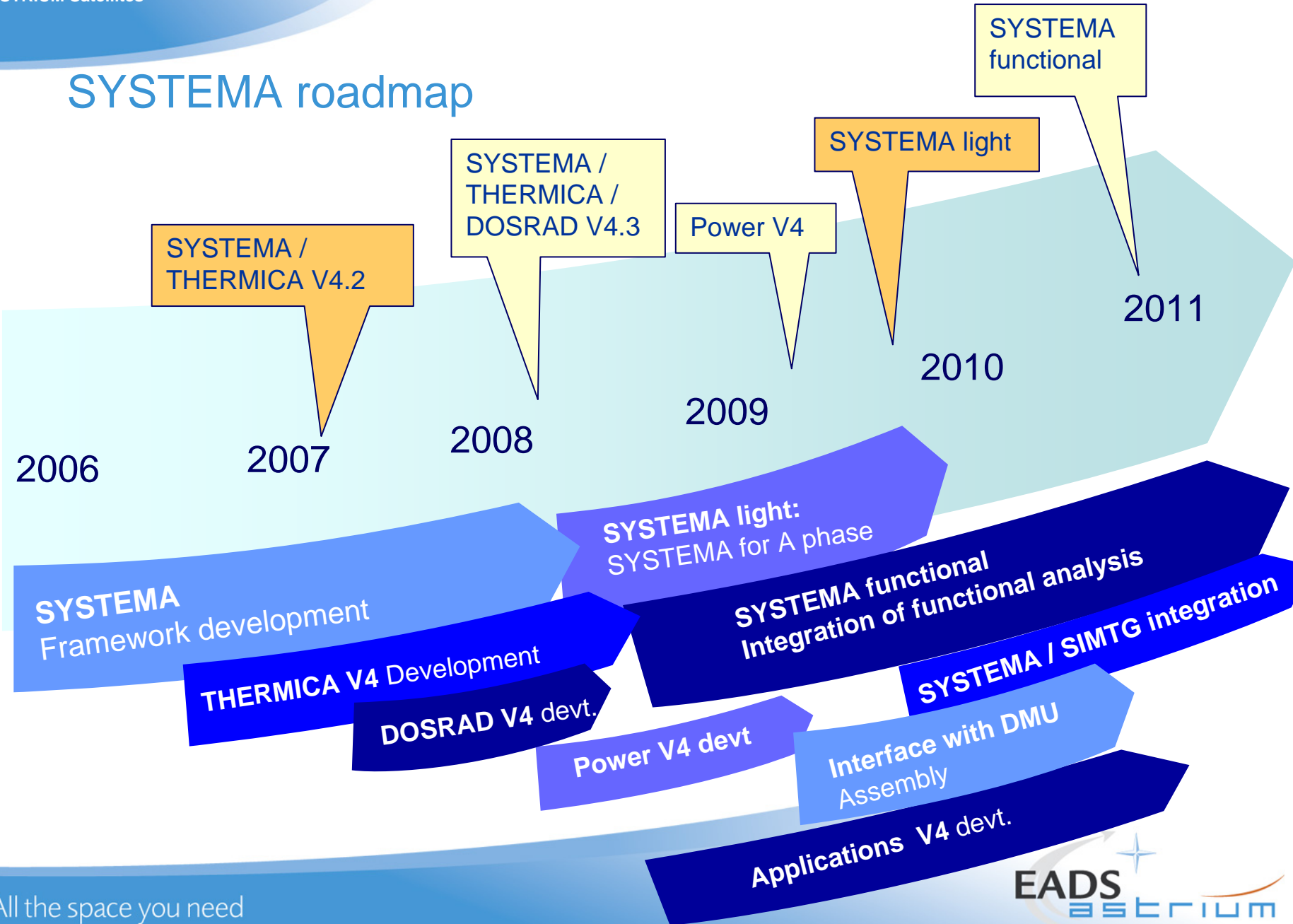


SYSTEMA application DOSRAD

- Computation of dose induced by environment and protection brought by the spacecraft
- Use of concept of target box (enveloping box attached to a set of objects) and computation points



SYSTEMA roadmap



More information in our booth
or on:
<http://www.systema.astrium.eads.net/>

SYSTEMA

A satellite is shown in orbit above the Earth's surface. A large, rectangular solar panel array extends from the satellite, displaying a color-coded map of radiation or temperature, transitioning from blue on the left to red on the right. The satellite itself is white and gold, with two large white parabolic antennas. The Earth's blue oceans and white clouds are visible below, and the grey, cratered surface of the Moon is in the upper left corner of the frame.