Appendix H

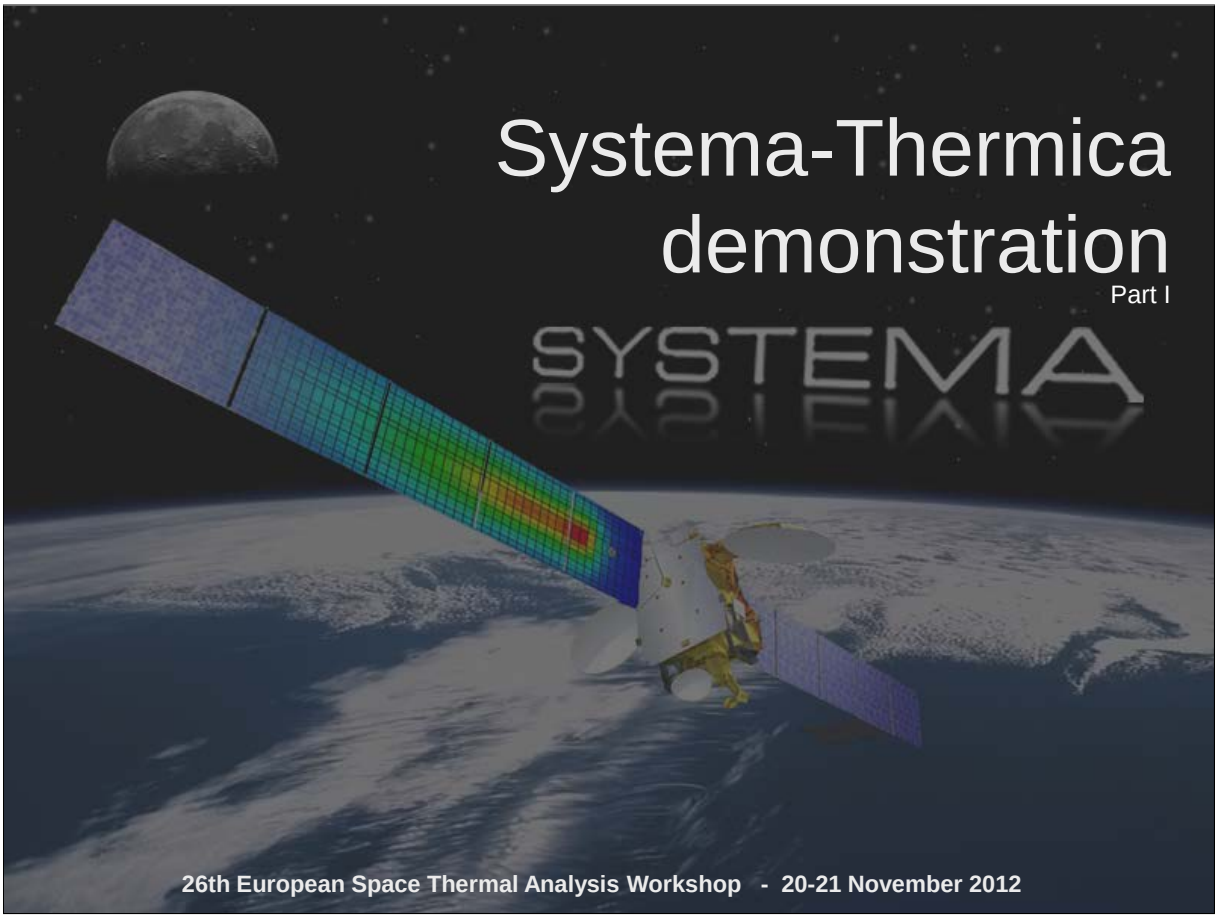
SYSTEMA-THERMICA Demonstration
Part 1

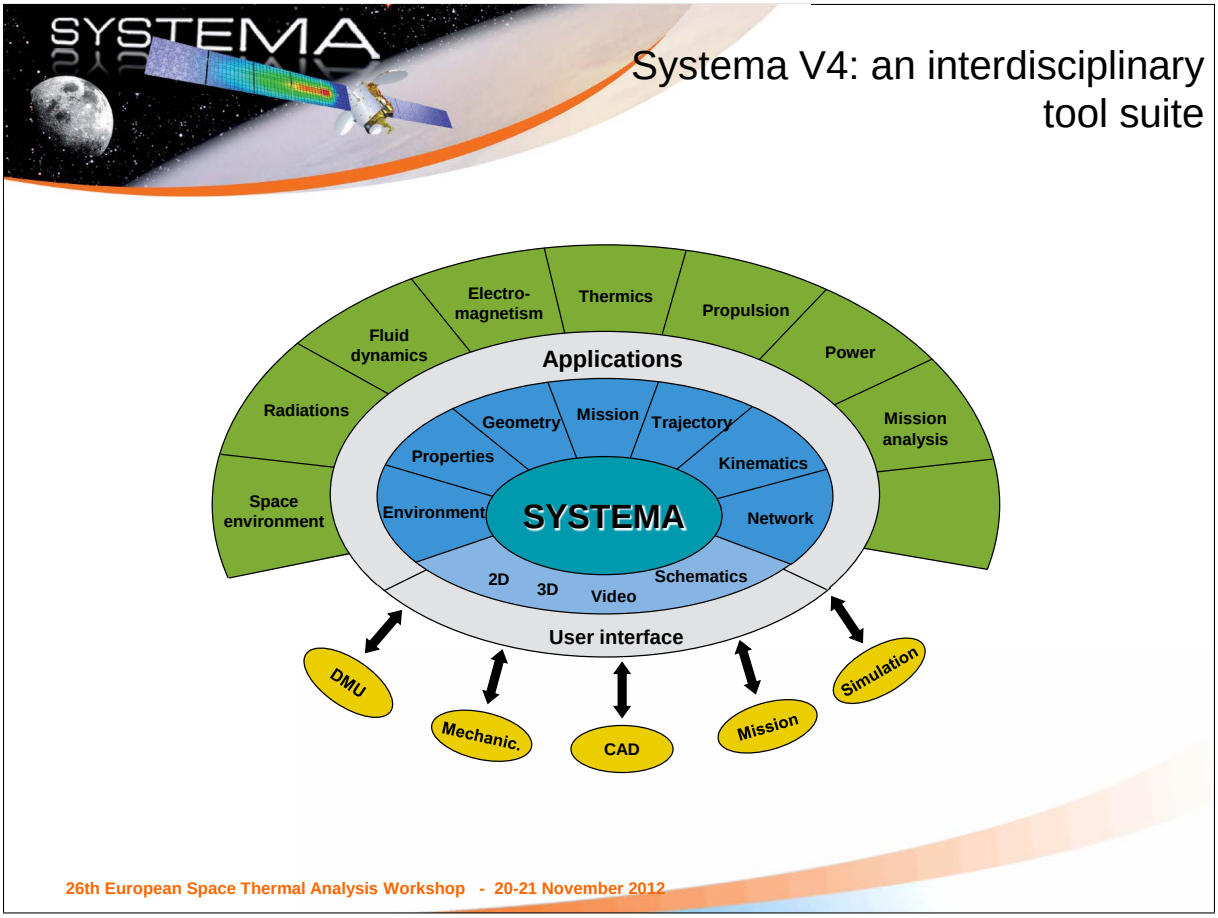
Maxime Jolliet Timothée Soriano
(Astrium, France)

Abstract

The SYSTEMA v4 project started in the mid 2000's and has successfully achieved its first goal: propose a new multi-physics software suite beyond on the v3 capabilities, in which new developments and evolutions becomes possible. Since the 2010's many new features and optimizations have been added and others are currently in development so to ease the process of thermal simulations from early phases to CDR, chamber test and in-orbit correlations.
Each year, the newly developed functionalities have been presented. This year's presentation is dedicated to an end-to-end use case covering the entire process from geometrical pre-processing to results post-processing, showing how the new SYSTEMA functionalities can ease thermal engineers work.
In particular, this first part covers:

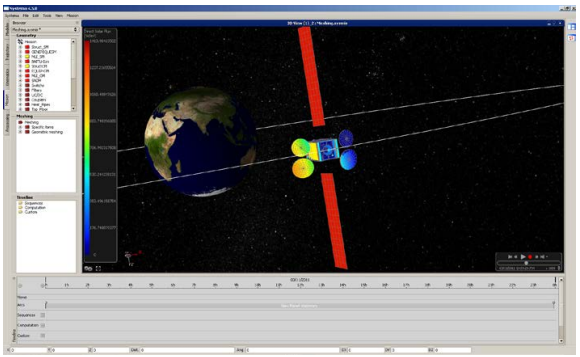
- Geometry Management and Pre-processing
  - CAD geometry insertion and management
  - Import of Nastran model
  - Execution of Python script
  - Reverse orientation of multi-selection
  - Interactive geometry transformations
- Mission Settings and Management
  - Real Solar system management
  - Import of custom trajectories
  - Kinematics tree creation
  - Import of custom transformations
  - Mission's time-line and events management

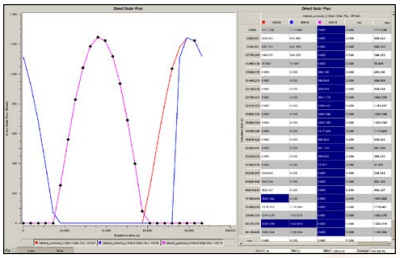

Systema-Thermica
demonstration
Part I
SYSTEMA
26th European Space Thermal Analysis Workshop - 20-21 November 2012

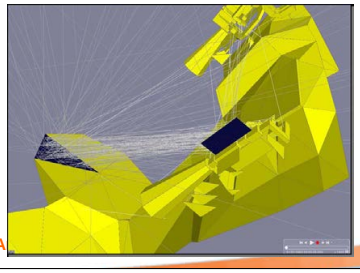

SYSTEMA
Systema V4: an interdisciplinary
tool suite
Electro-
magnetism
Thermics
Propulsion
Fluid
dynamics
Power
Applications
Radiations
Mission
analysis
Geometry
Mission
Trajectory
Properties
Kinematics
Space
environment
Environment
SYSTEMA
Network
2D
3D
Video
Schematics
User interface
DMU
Mechanic.
CAD
Mission
Simulation
26th European Space Thermal Analysis Workshop - 20-21 November 2012

Systema v4.5.1 – current status

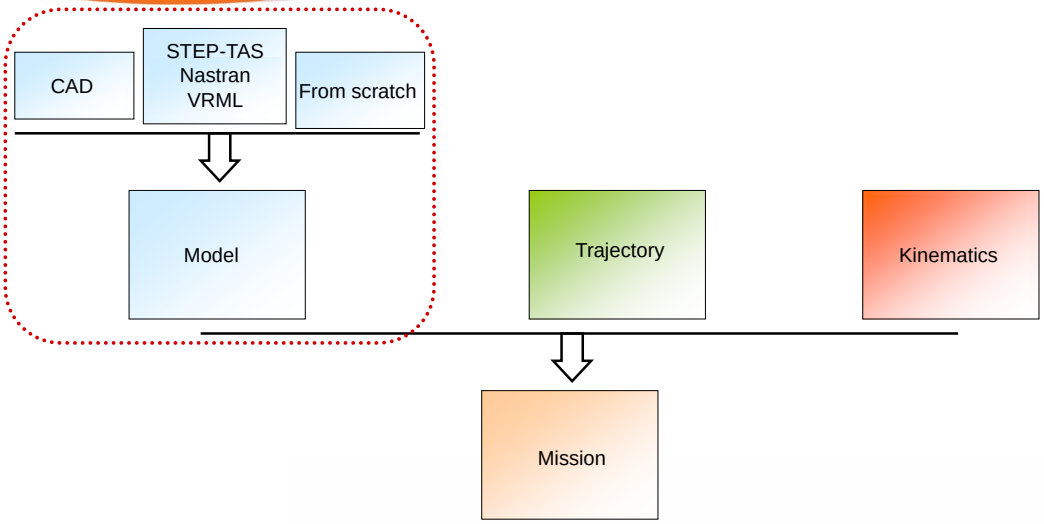
- Python scripting
- Timeline is available in both the Trajectory & Mission module
- Curve & table view for post-processing
- Ray display

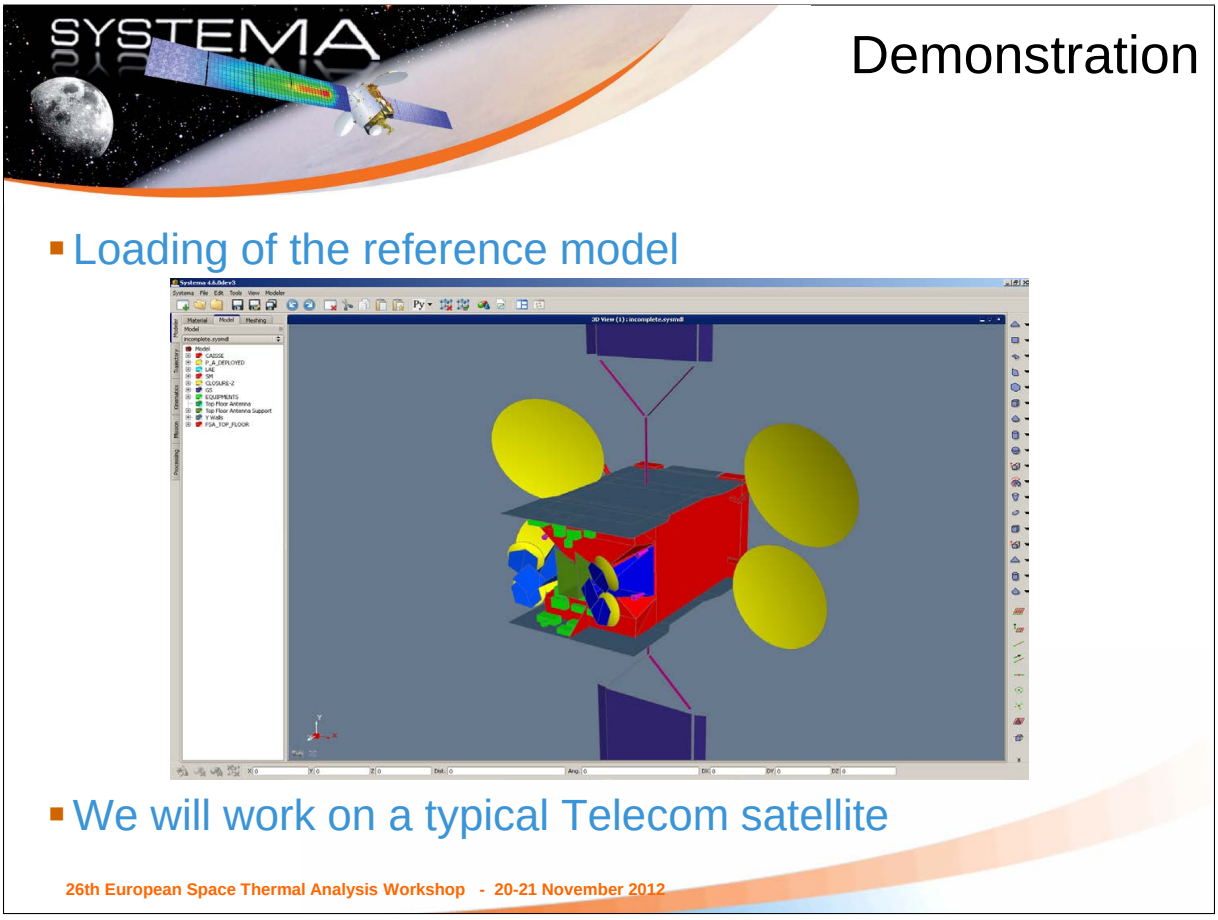


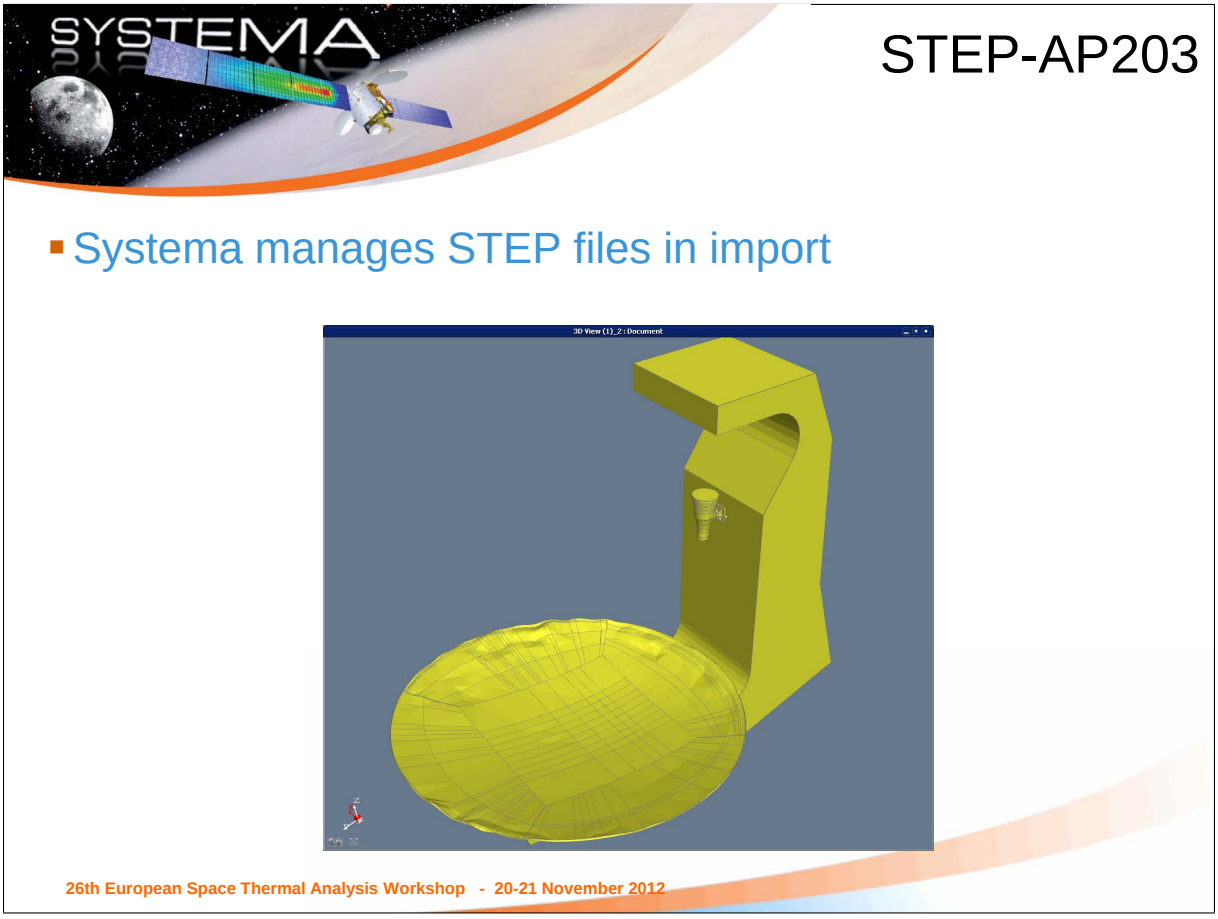




Systema Workflow

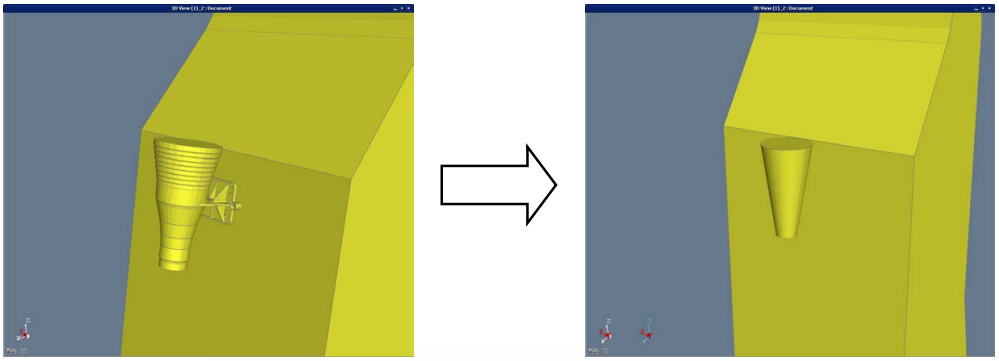



SYSTEMA
Demonstration
Loading of the reference model
We will work on a typical Telecom satellite
26th European Space Thermal Analysis Workshop - 20-21 November 2012


SYSTEMA
STEP-AP203
Systema manages STEP files in import
26th European Space Thermal Analysis Workshop - 20-21 November 2012

STEP-AP203

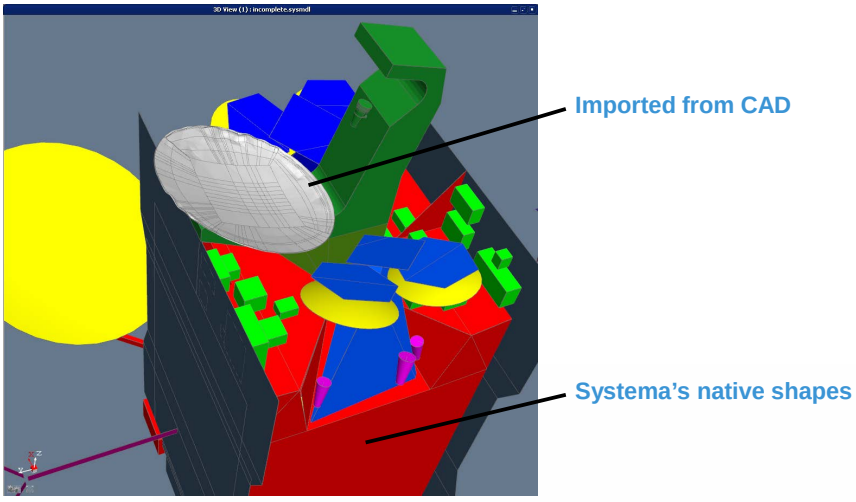
- Simplifications can be done directly in the framework



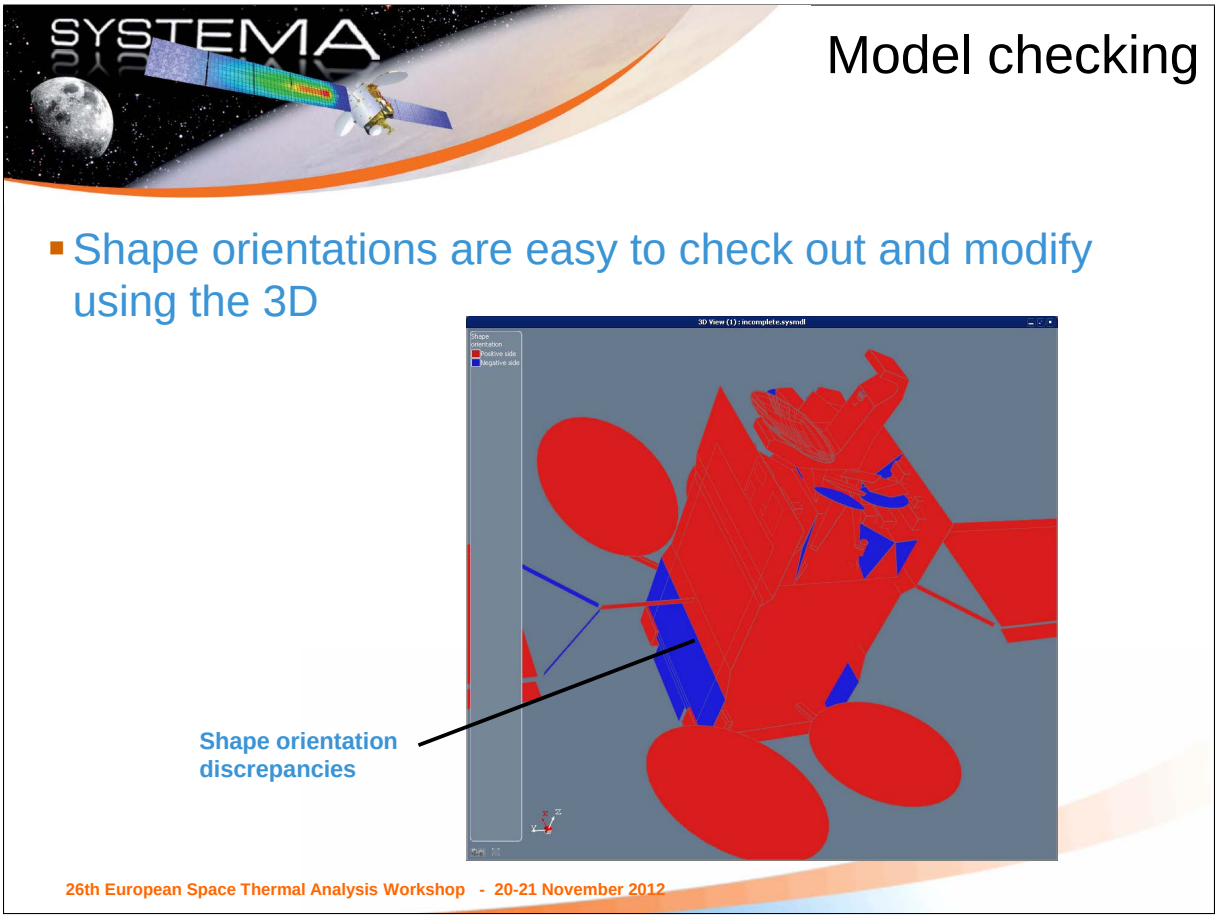
- Computation can be made directly on the STEP
- Or the STEP can be converted into Systema's model

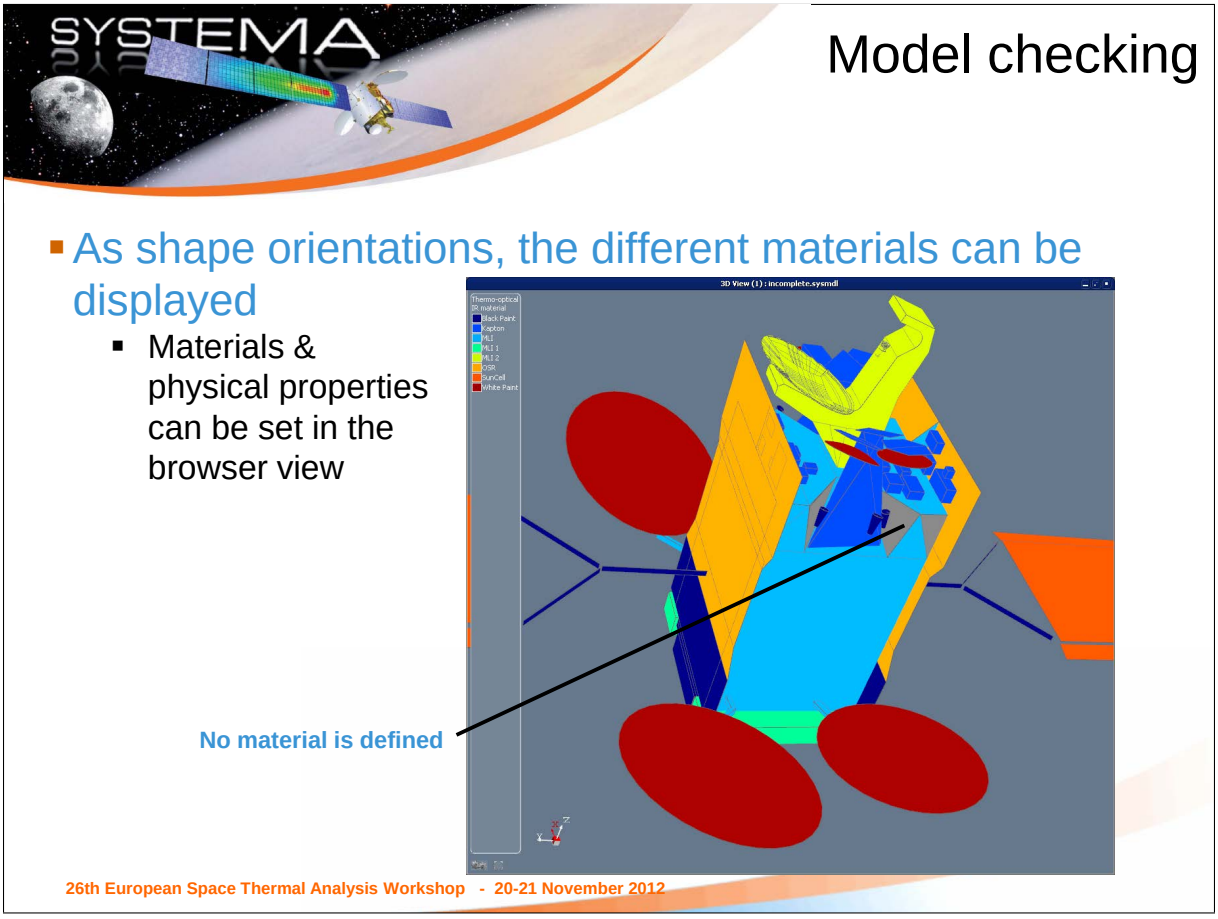
STEP-AP203

- Mixing of models from different sources



- Adaptation using transformations


SYSTEMA
Model checking
Shape orientations are easy to check out and modify using the 3D
Shape orientation discrepancies
26th European Space Thermal Analysis Workshop - 20-21 November 2012

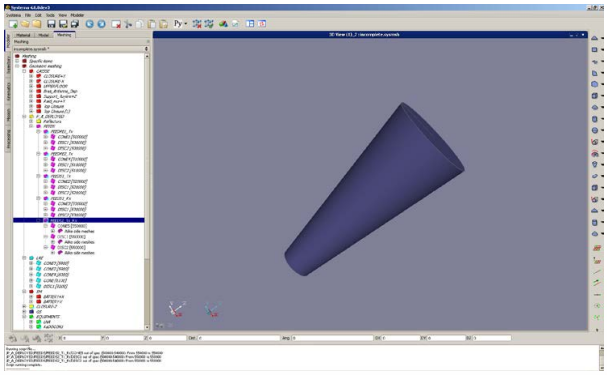

SYSTEMA
Model checking
As shape orientations, the different materials can be displayed
Materials & physical properties can be set in the browser view
No material is defined
26th European Space Thermal Analysis Workshop - 20-21 November 2012

Model checking

- Complex checking using Python
- I want to verify that my node numbering is within my specifications

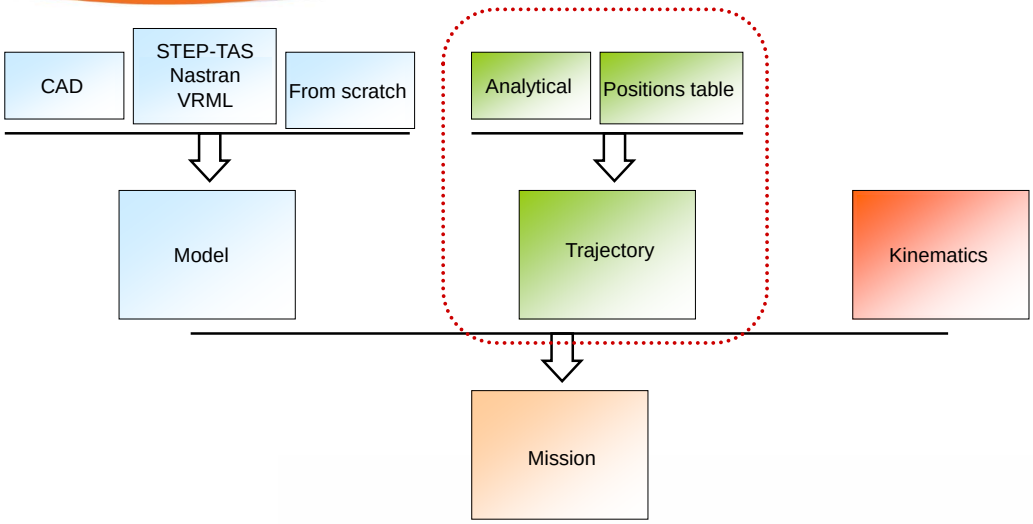
Text file

GS: [7500-8800]
Reflectors: [5000-5700]
Feeds: [500000-540000]



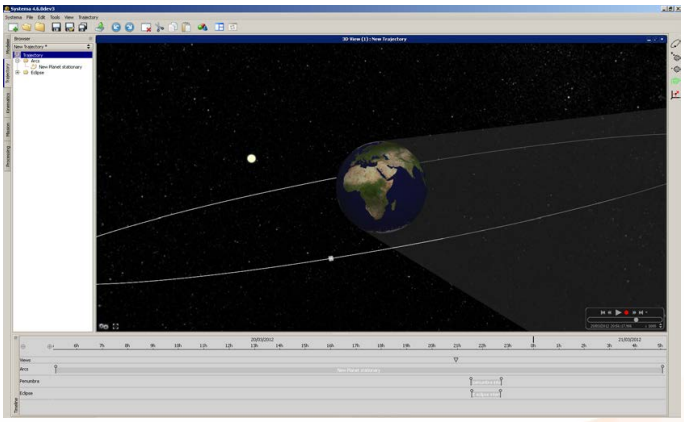
Returns and displays the out-of-spec meshes

Systema Workflow



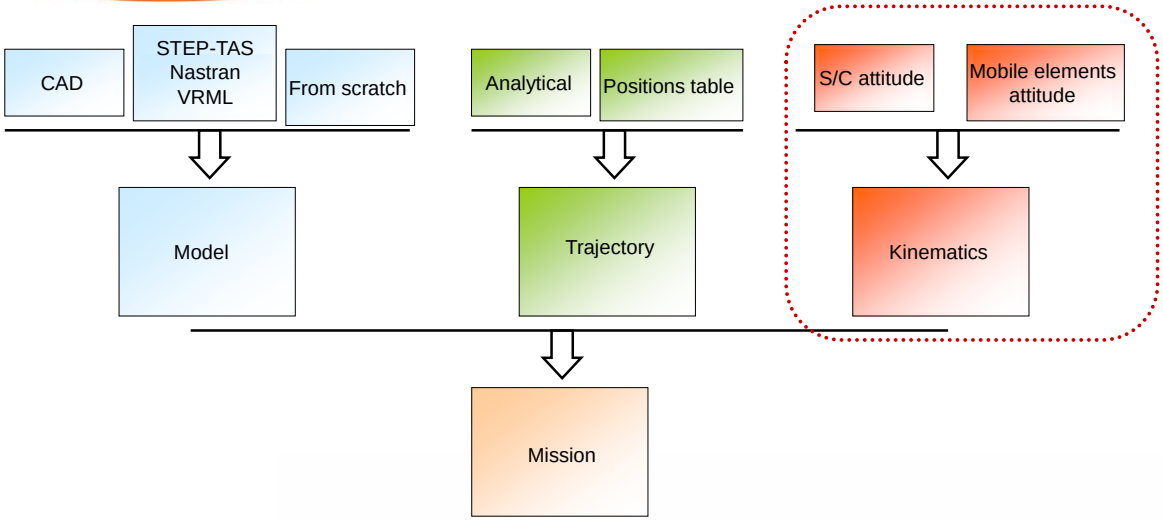
Trajectory

- Systema allows the user to easily define its trajectory
- Sun-synchronous, geo-stationary & general keplerians orbits are available



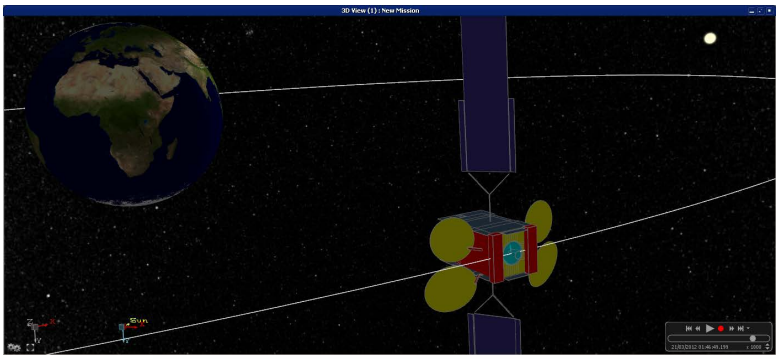
- Display of eclipses

Systema Workflow



Kinematics

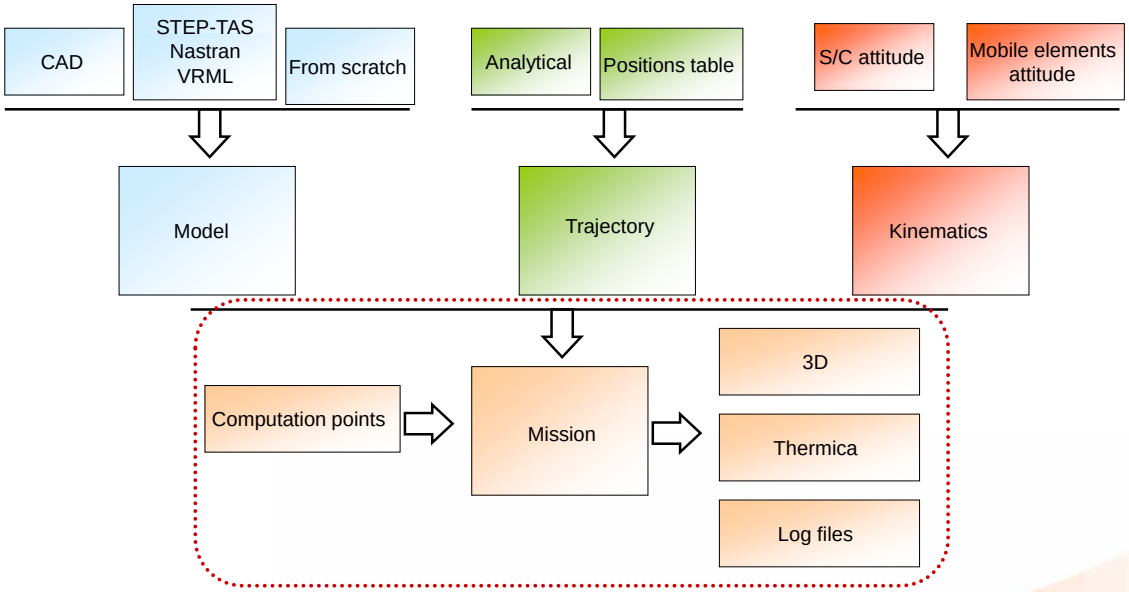
- Definition of the S/C attitude
- Definition of the orientation of the GS



Correct orientation of the S/C and its solar arrays

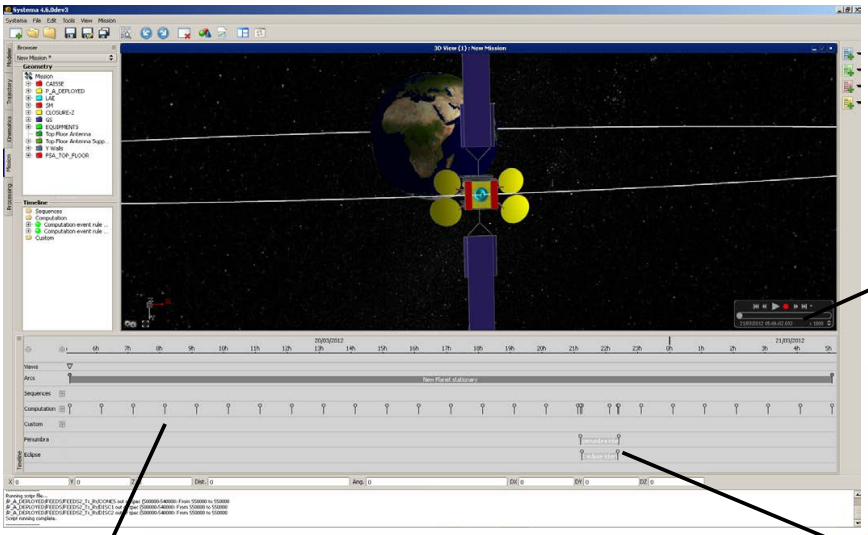
- Pointing laws to planets, sun, velocity vector ; linear rotations ; attitudes defined by tabulated data are available

Systema Workflow



Mission

- The mission scenario can be set up within seconds

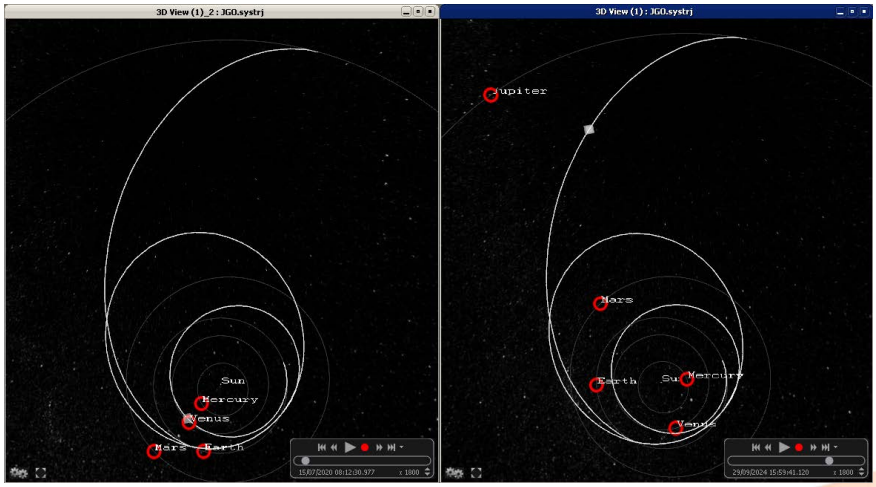


Systema Framework... In a nutshell

- Easy interfacing
  - With CAD
  - With NASTRAN
  - With AOCS tools
  - Using Python
- Gives integral access to the data
  - In 3D
  - With the time line
  - Using Python
  - As textual information
- A powerful mission creation
  - Can be created with a snap of the fingers
  - Complete trajectory & kinematics management

Additional slide Trajectory

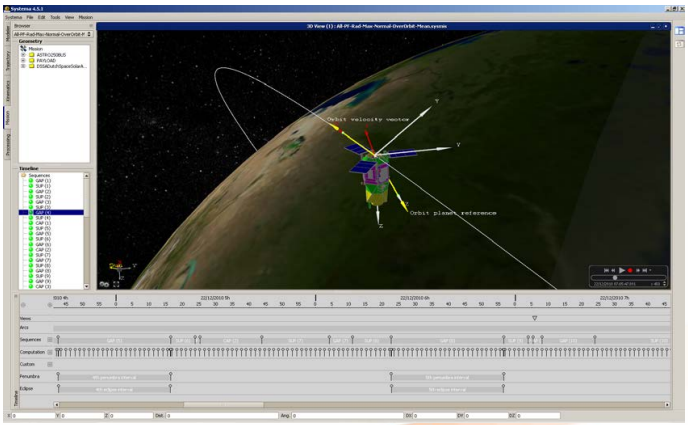
- For complex trajectories, possibility to use tabulated data
- Full & real-size solar system



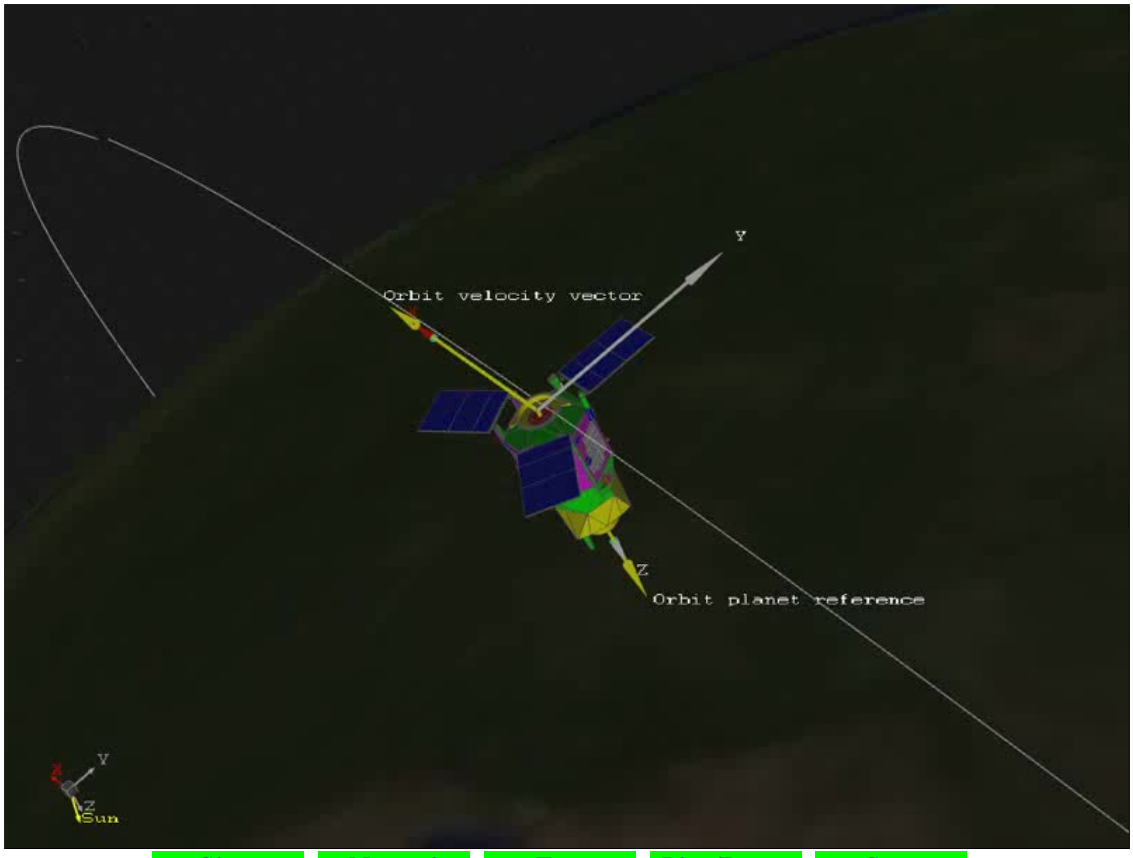
Jupiter Ganymede Orbiter example trajectory – Venus flyby (left) – Jupiter approach (right)

Additional slide Sequences

- To create complex mission plan
- Typically, for an EO satellite
  - Acquisition period
  - Charging (Solar arrays pointing the Sun)
  - Waiting (Earth pointing)



Cf video



Slow | Normal | Fast | Play/Pause | Stop