Appendix Q

Modelling of complex satellite manoeuvres with ESATAN-TMS

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Abstract

Requirements from the Space industry demand performing radiative and thermal analysis combined with more complex spacecraft manoeuvres and attitudes; for example the MetOp-SG project has multiple rotating and spinning components which can prove challenging to model.
This presentation focuses on how ESATAN-TMS eases the process of defining and visualising complex kinematics as well as performing radiative simulation.

ESATAN-TMS
thermal modelling suite

Modelling of complex Satellite manoeuvres with ESATAN-TMS

Nicolas Bures

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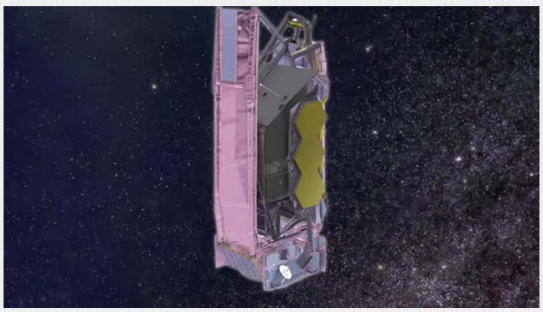
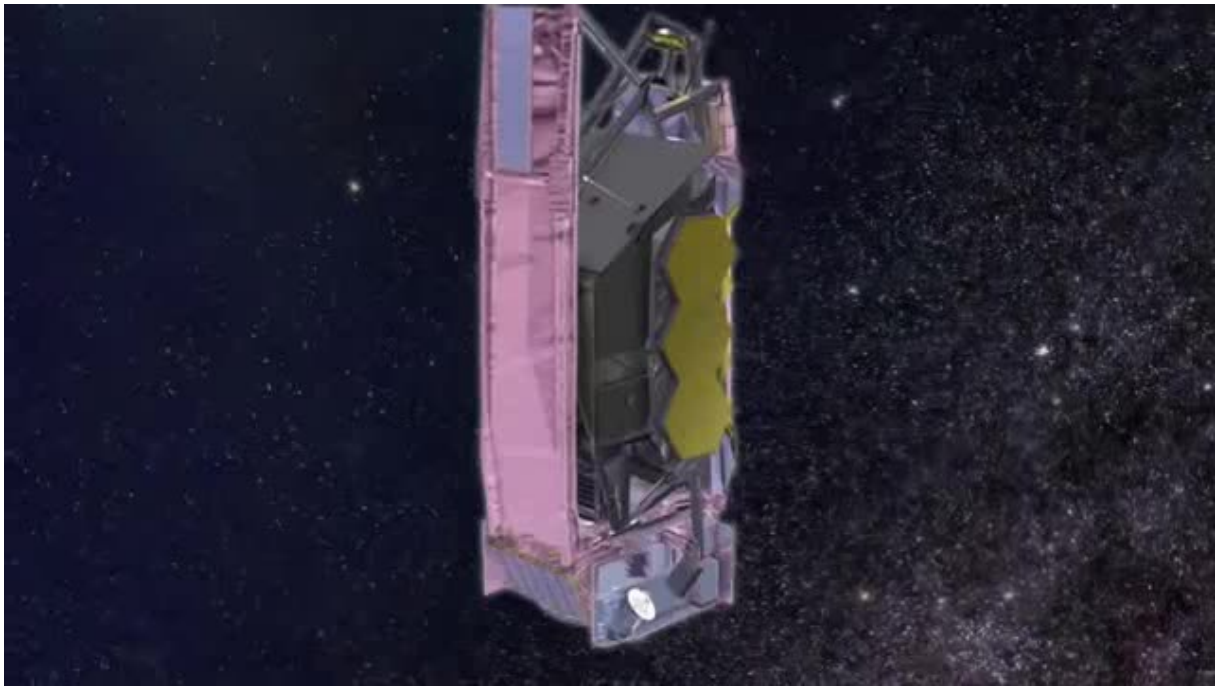
Presentation background

Background → Requirements → Demo → Questions

- Recent missions demand radiative analysis involving complex spacecraft manoeuvres, attitudes and kinematics (MetOp-SG, JWST,…)
- Movement can be:
  - Constant, i.e. including a rotation rate (MHS MetOp instrument, one rotation per 2.667 second)
  - Fast, i.e. to quick to calculate position at a time for the rotating component (MWI MetOp instrument, up to 45 rpm)
  - According to time, i.e. Antenna, solar panel, Mirror deployment (JWST, most of the S/C nowadays)



JWST Courtesy of NASA



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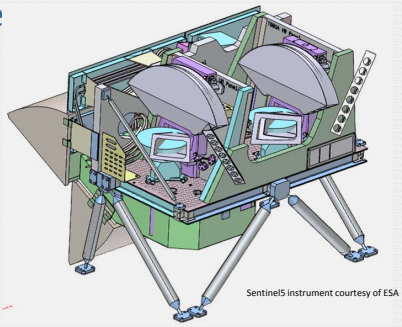
User requirements

Background → Requirements → Demo → Questions

- Creating a constant rotation at a component level and provide a rotation rate
- Including functionality to model a complex mission, include fast spin and rotation at a component level
- Be able to easily define a solar panel deployment or any other complex movement
- Requirement must be implemented as a user friendly way to reduce thermal engineer time



Sentinel5 instrument courtesy of ESA

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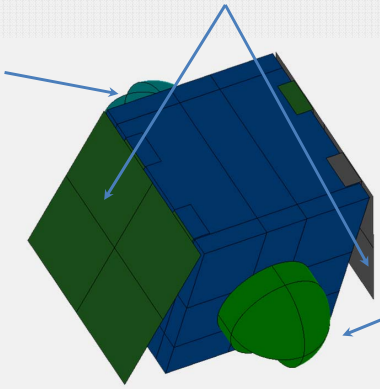
Example use-case

Background → Requirements → Demo → Questions

- Demonstrate a use-case showing complex kinematics
- Radiative calculations needs to be calculated during the deployment
  - 4s, 8s, 12s, 16s, 20s
- Validation of kinematics
- Post-process radiative results

2 Solar panels deployable from 0 to 90° in 20 sec

Rotating camera at 10°/s
Camera's position will be set according to the chosen time calculation



Fast spin camera (want to see the power distribution for each spin position, quickly verify the results)

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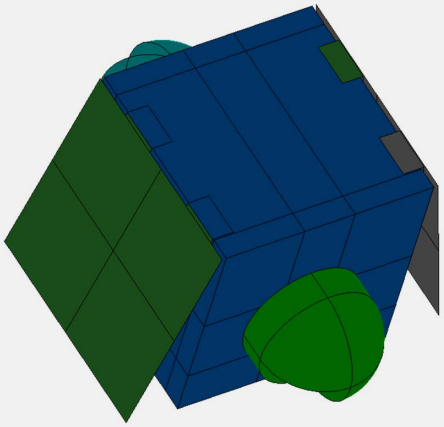
Demo

Background → Requirements → Demo → Questions



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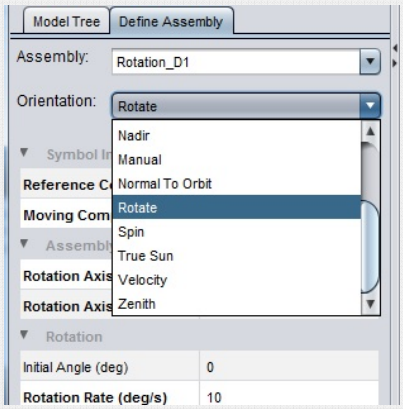
Modelling Kinematics

Background → Requirements → Demo → Questions

- Modelling Rotation and Spinning components
  - Any Assembly can be defined to Spin or Rotate



  - Rotate at a given rate, with an initial offset
  - Fast spin, analysis at spin positions, with average REFs and heat fluxes

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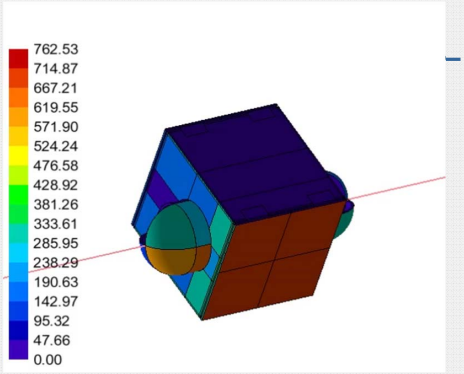
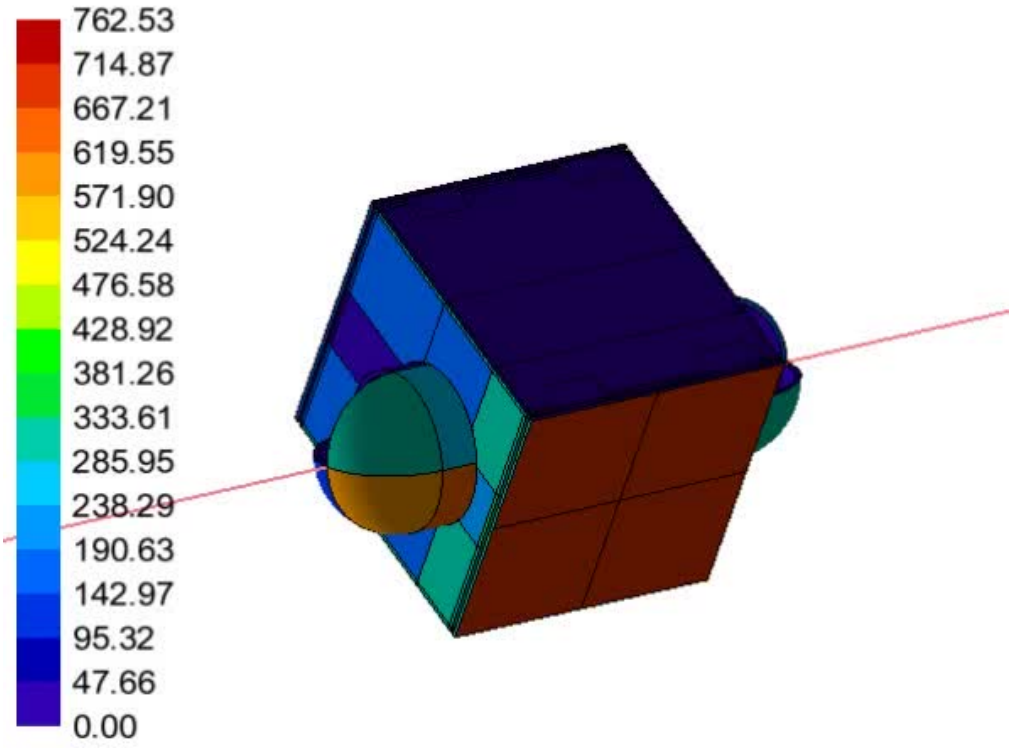
Modelling Kinematics

Geometry Definition → Radiative Analysis → Thermal Analysis → Post-Process

- Validation of Assemblies
  - Validate definition
    - Visualise Assembly movement
    - Rotation around an axis or user-defined translations and rotations



  - Validate radiative results
    - Display results on geometry
    - Animate results
    - Average or results at spin positions
    - Visualise solar rays at spin positions



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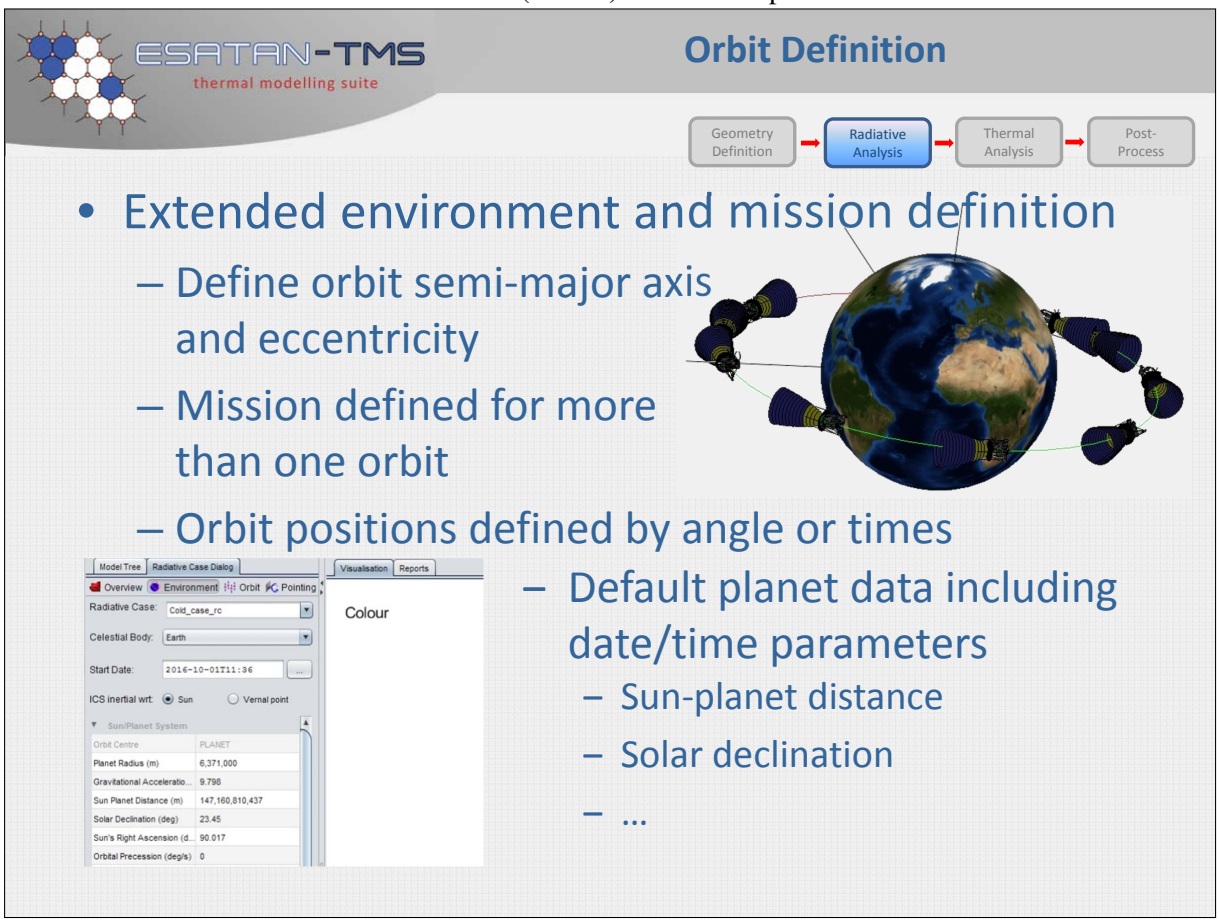

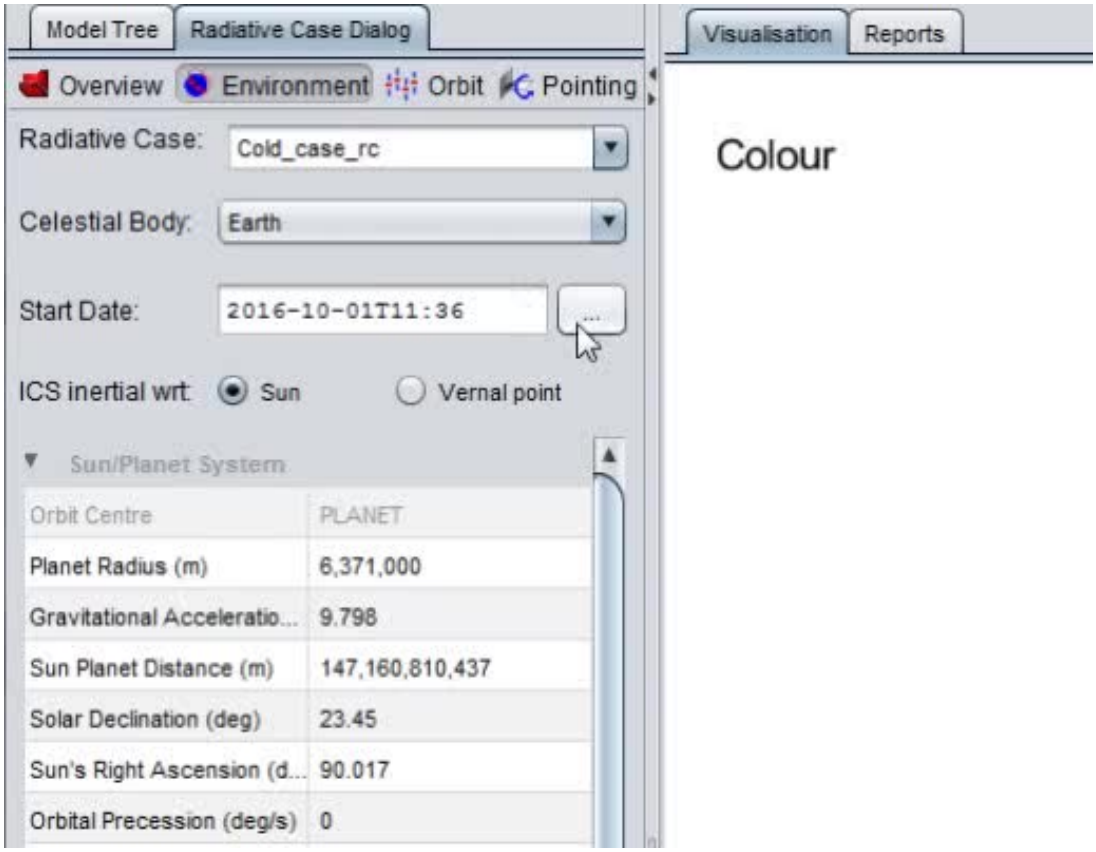

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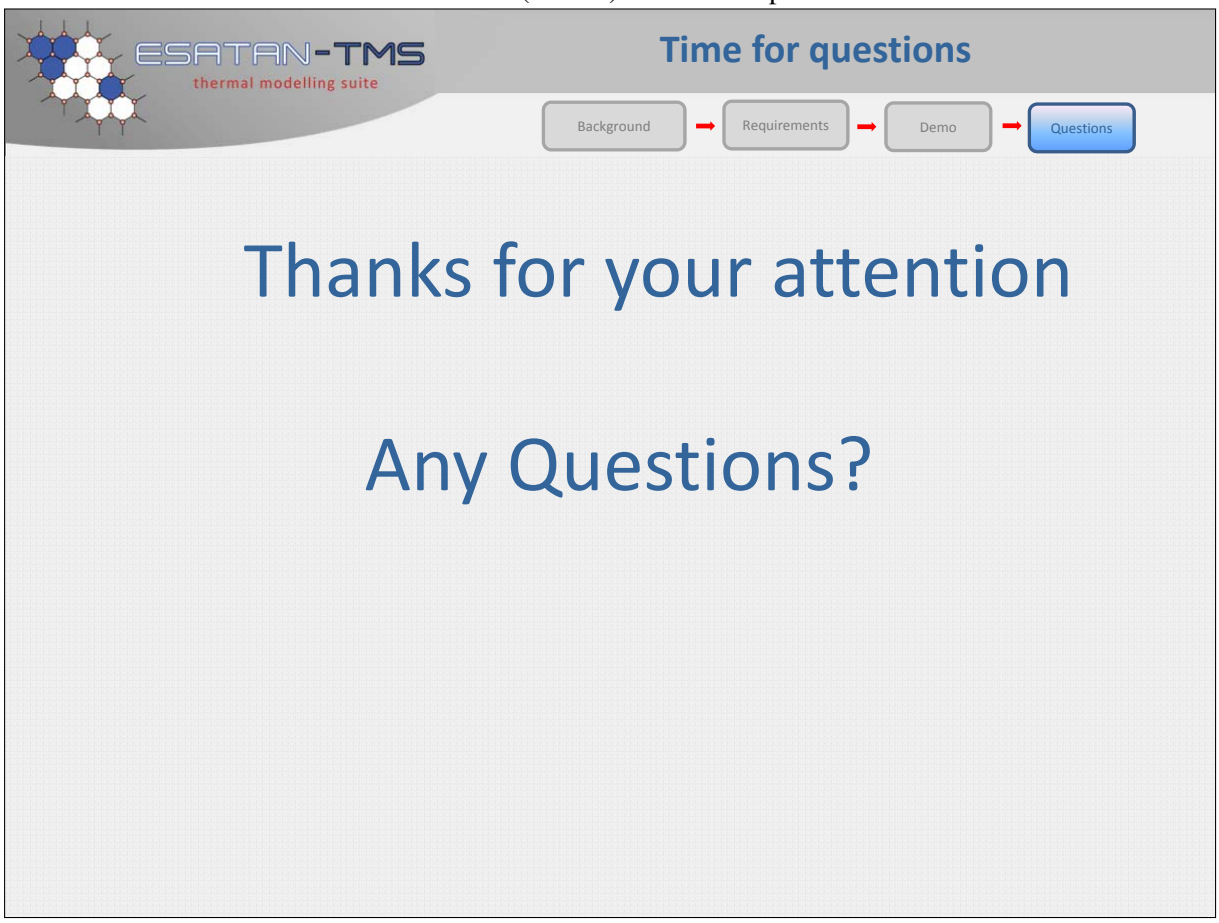

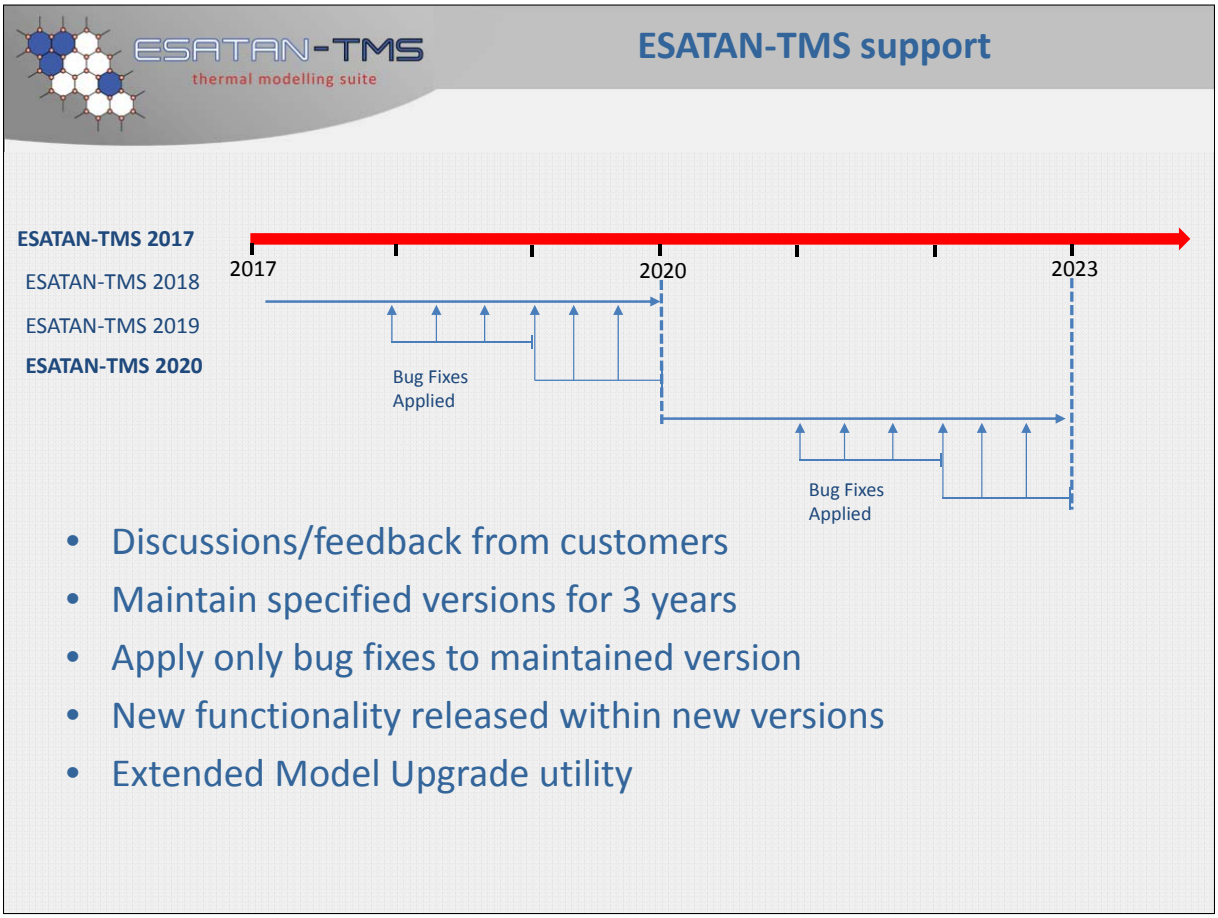
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ESATAN-TMS support
ESATAN-TMS 2017
ESATAN-TMS 2018
ESATAN-TMS 2019
ESATAN-TMS 2020
2017
2020
2023
Bug Fixes Applied
Bug Fixes Applied
• Discussions/feedback from customers
• Maintain specified versions for 3 years
• Apply only bug fixes to maintained version
• New functionality released within new versions
• Extended Model Upgrade utility


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