Thermal Analysis Using Assembly FEMs in Teamcenter, NX and Space Systems Thermal

by
Robert Krylo
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Jet Propulsion Laboratory,
California Institute of Technology

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Thermal Analysis within Teamcenter

- You can work within Teamcenter to perform an orbital thermal analysis of a spacecraft.
- Use existing NX parts and assemblies.
- Create FEMs and Sims directly off of the parts in Teamcenter.
- Create assembly FEMs to match the assembly parts.
- Map part FEMs onto the assembly FEMs.
- Import thermal couplings and loads from the lower level Sims.
- Define and display orbits.
- Solve in Space Systems Thermal.
Start with a spacecraft, available as an NX assembly in Teamcenter. You can build your thermal model directly on the NX parts so the model will be associative, modular, accessible to other thermal engineers, and under the configuration control of Teamcenter.

To begin:
Open Teamcenter and create a directory for your files.
Open NX and the Assembly

Open NX from the Teamcenter window, and load the assembly.
Select a Part

Pick a part for analysis. Then right-click and make it the displayed part.
Create a FEM and SIM

Switch to Advanced Simulation and go to the Simulation Navigator. Then create a new FEM and Sim. For an orbital thermal model, choose NX Space Systems Thermal as the solver.

Tip: Be careful with your file names. You will have an easier time finding things if you start with the part name and add the CAE terms “ideal”, “fem”, “assyfem”, “sim”, or “assysim”. Using the existing part name helps later when you map part FEMs to assembly FEMs. CAE terms in the name help in the Simulation File View where you won’t see file extensions. Also note that names in Teamcenter cannot be reused.
Idealize and mesh the part.
Open the Sim

Switch to the Sim.
Tip: If you already have a Sim, you can quickly open it by going to the Simulation file View, right-clicking the FEM, and clicking Find CAE Items. This switches you to the Search Results mode where you can double-click the Sim. You can switch back to the Session View with a right-click on the Search Results.
Add Simulation Objects

Add your Simulation Objects such as thermal couplings and heat loads. You will later import these into the higher level Sim.
Create a New Assembly FEM

Make the assembly part active. Then right-click and create a New Assembly FEM.
Map the Part FEM

Map the part FEM onto the assembly FEM by right-clicking on the part and selecting Map Existing.
Map All Part FEMs

Keep mapping until your assembly FEM is complete. You can replace a part FEM by right-clicking the part, selecting Ignore, and mapping another FEM to the part.

Tip:
Right-click the FEM, go to the Label Manager, and resolve the label conflicts. The orbit plotter and thermal couplings will not work with label conflicts.
Create an Assembly Sim

Create a new Sim (I call it an assembly Sim) with a right-click on the assembly FEM.
Import Simulation Entities

Import the thermal couplings from the part Sims by right-clicking the part FEM and choosing Import Simulation Entities.
Choose Names and Entities

Browse to the Sim that corresponds to the FEM. Prepend any descriptive text you want (the default part name is usually too long). Choose which entities to import.
Map Remaining Assembly and Part FEMs

Work your way up to the top-level assembly FEM by mapping lower level assembly FEMs. You can map any combination of part FEMs and assembly FEMs.
Import Entities from Sub-Assemblies

Import the simulation objects from the lower level assembly Sims. Right-click the assembly FEM and choose Import Simulation Entities as you would a part.
Prepare External Radiation

Create groups of external surfaces to use for both radiation and orbital heating.
Prepare Orbital Heating

Define and display the orbit.
Create temperature contours, temperature plots, and heat load reports.
Summary

• You can work completely within Teamcenter to build and solve an orbital thermal model.
• Your model will have a one-to-one correspondence to the parts and assemblies of the CAD model.
• You can input thermal couplings and loads at the part and assembly levels.
• Orbital thermal analysis is performed with Space Systems Thermal.
Where does this lead?

• NX parts are associated to the thermal model. An update to an NX part propagates automatically, with your permission, to the top level assembly FEM.
  – This will allow you to quickly assess the impact of design changes

• The thermal analysis will be linked to the mechanical parts.

• Assembly FEMs are modular.
  – You should be able to divide a spacecraft among several engineers for simultaneous analysis.

• This leads to concurrent engineering.