# Methodologies for thermo-elastic predictions and verification

# Workshop

Facilitated by ESA

**When:** Thursday 31st May

**Time:**  10:00 - 13:00 (tbc)

**Location:**  Escape Dance room, ESTEC

**Contact:** Simon Appel: [Simon.Appel@esa.int](mailto:Simon.Appel@esa.int) / Rafael Bureo Dacal: Rafael.Bureo.Dacal@esa.int

**Objectives:**

The workshop objectives are to:

* Foster exchanges in the community on the topic
* Each participant to provide a 10 minutes presentation on the current way of performing thermo-elastic analyses in their organizations
* Presentations shall cover a summary of the following:
* Typical requirements on thermal and mechanical models for thermo-elastic analysis and temperature transfer between thermal and mechanical models
* Uncertainties of the whole analysis chain and associated margin philosophy
* Worst temperature fields selection methods
* How to derive the margin philosophy (on thermal and mechanical side) vs uncertainties?
* Approaches for verification by test
* Typical problems
* Needs space community supported guidelines or handbook
* Identify possible ways to validate and improve methodologies for prediction and verification of thermo-elastic
* Explore interest and need for establishing a European wide working group on thermo-elastic analysis/verification encompassing industry, national agencies, academia and ESA representatives.

The workshop will be moderated by an ESA chairman who will collect all the contributions and will draft a development road-map for the subject. The road map will be distributed among all participants and shall constitute as the starting point for a more structured verification approach.

**Background:**

The design and verification process related to thermo-mechanical distortion and stresses is mainly based on analyses. This includes several steps with corresponding sources of uncertainties:

1. Thermal analyses: Calculation of temperature fields using, in most case, space thermal analysis tools based on the lumped parameter method.  
   Is the thermal model adequate to provide the temperature field to compute distortions and stresses?
2. Temperature mapping: Transfer the temperature results of the thermal analyses to the structural finite element model.  
   Do the temperatures end up correctly (enough) in the structural FE model? How to account for the uncertainties of the thermal analyses?
3. Thermo-mechanical analyses: Compute with a finite element model the distortions and stresses induced by the temperature fields.  
   Is the structural FE model adequate to compute thermo-mechanical distortion and stresses?

Other important aspects require attention:

* Worst case definition, which thermal cases shall be analysed?
* How to derive the margin philosophy (on thermal and mechanical side) vs uncertainties?

Every company has its own methods and tools for this process. How are these methods validated?

How to assess the accuracy of these different methods?

How can tests support the verification process?

Can advanced metrology support the validation of models and/or the verification process?

**Workshop Format:**

The workshop will start with the presentations of the participants. The chairman will highlight on a dashboard the most relevant topics raised by the participants and moderate the discussion on those topics. Based on this the chairman will start during the workshop the drafting of the development road-map which will commented life by the audience. The draft will then be distributed after the workshop.

The workshop will be supported by a presentation by ESA about past/on-going activities on the topic. The workshop will take place after the sessions on thermo-elastic have taken place, allowing to discuss what has been presented .

Note: to allow discussion and because of limitations of the room, the number of participants will be limited. Registration will be required at the registration desk. When the maximum number of participants will be reached, registration will be closed.