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Guidelines for accurate thermo-elastic analysis

Thursday, 10 October 2019 11:30 (30 minutes)

Thermo-elastic behaviour of spacecraft structures and payloads is often a critical design aspect due to the importance of dimensional stability (hence payload accuracy) and structural strength. The accuracy of thermo-elastic analysis relies to a large extent on the correct interplay between the thermal model, the structural model and the translation of the thermal results to the structural model.

Over the last years ATG-Europe has obtained extensive experience in the field and has previously presented on different parts of the topic [1,2,3]. The work presented at the ECSSMET 2018 [1] considered different thermal mapping methods and showed the importance of an accurate thermal load definition. As part of a bigger ongoing study on true-to-life structures that assesses the accuracy and validity of the existing thermo-elastic analysis procedures, ATG is now considering this more extensively, in a wider scope and on a more realistic model by performing sensitivity studies on the main modelling parameters of both the thermal and structural model. In addition, various different thermal mapping methods are considered. Specifically, geometric interpolation, conductive interpolation, patch wise mapping and the prescribed average temperature method using SINAS [4] are used. These thermal mapping methods link the structural and thermal models together for various distortion and strength based performance parameters. More details on the technical aspects of the mapping methods can be found in [1].

This study extends on current papers by ATG, specifically [1], by analysing a more realistic structure, which is not merely an academic example, and a greater amount of load cases. This presentation will comment the two main conclusions obtained from the results of this study:

- Importance of temperature spatial gradient definition
- Effect of different temperature mapping methods on local temperature gradients close to high heat input areas

The main focus will be on the implication of thermal modelling practices in combination with the used mapping method on the TE performance.

REFERENCES

[1] Temperature Mapping For Structural Thermo-Elastic Analyses; Method Benchmarking.
Menno Koot, Simon Appel, Samo Simonian.
Presented at the ECSSMET 2018, ESTEC, Noordwijk, The Netherlands

[2] Thermal Conductor Generation For Thermal And Thermo-Elastic Analysis Using A Finite Element Model and SINAS.
Menno Koot, Simon Appel, Samo Simonian.
Presented at the ECSSMET 2018, ESTEC, Noordwijk, The Netherlands

[3] Accurate thermal mapping and Finite Element Model based Conductor Generation; extended method benchmarking guidelines
Menno Koot, Alexander van Oostrum, Iñigo Urcelay, Victor Sutii, Simon Appel
Presented at the ESTEW 2018, ESTEC, Noordwijk, The Netherlands

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Track Classification: mapping of thermal results to mechanical models and guidelines for thermo-elastic (for thermal part)