An Improved Thermal Model Correlation Process Using Veritrek’s Reduced-Order mOdeling Software

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# ABSTRACT

Engineering computer-aided design models are often based on an assortment of estimated input parameters. Specifically for thermal models, this may include handbook conductance values, or vendor specified optical or thermophysical property values, to name a few. It can be challenging to determine a combination of model parameter values that accurately predict reality; and to remedy this, engineering teams go through a process of correlating the model to measured test data obtained in the lab. Often, model correlation processes involve institutional knowledge and an iterative “guess and check” method that can become time-consuming and costly. Veritrek’s Correlation Analysis feature provides a new approach to correlating thermal models to test data by using reduced-order modeling to explore thousands of parameter combinations in a few seconds. By first creating a reduced-order form of the high-fidelity model, the reduced-order model (ROM) can be used to quickly find multiple solutions that match model outputs to test data; thus, providing a way to intelligently improve the accuracy of the high-fidelity model, and leading to a deeper understanding of the relationship between model inputs and outputs.

Engineers at Ball Aerospace used the Veritrek software to help determine key parameter values that made model outputs match test data for an Internal Research and Development (IRAD) effort involving cryo instruments. Tasked to correlate a Thermal Desktop® model to ten unique test configurations, Veritrek’s Correlation Analysis feature was used to quickly find multiple solutions that met Ball’s correlation criteria (+/- 3K for ambient sensors and +/- 0.5K for cryo sensors) and provided insight into the best combination of parameter values to use. The correlation effort was split into three different sections to correlate the temperatures of 15 sensors and heat flow calculations. By splitting the correlation effort into three sections and using Veritrek, results could be focused, ROM generation time could be reduced, and additional exploration of each section’s sensitivities could be performed. With Veritrek, over 20,000 combinations of parameter values were quickly explored and produced a few dozen viable solutions for correlating the Thermal Desktop® model. These viable solutions were then independently evaluated to determine the best solution to use. The final selected values allowed the correlated thermal model to meet the goal criteria for all test configurations. In total, this model correlation effort would have typically taken an estimated 3-4 weeks to complete; but with Veritrek, a best solution was determined in an automated and repeatable fashion within a few days. Not only did the Veritrek approach save time, but it provided much more confidence in the chosen best solution.