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A MULTIDISCIPLINARY SOFTWARE CHAIN FOR INTEGRATED STRUCTURAL, THERMAL AND OPTICAL PERFORMANCE ANALYSIS OF SPACE INSTRUMENTS

Abstract

The structural, thermal and optical (STOP) performance analysis loop during the design of optical space instruments is a complicated and time consuming process. This is particularly true for large instruments with sophisticated performance requirements like cameras for high-resolution atmosphere and weather monitoring. The analysis loop spans across multiple disciplines and software tools that do not naturally interface with one another. Moreover, it is one of the key technologies for development of space based optical systems for future Earth observation and science missions, as recognized by major space agencies worldwide.

In this paper, a Multidisciplinary Performance Analysis Software (MultiPAS) is presented that was developed by OHB System AG to perform highly reliable end-to-end performance analyses of optical space instruments. It is basically a MATLAB program with a graphical user interface (GUI) that links ESATAN-TMS (for thermal analysis), Nastran (for structural analysis) and Zemax OpticStudio (for optical analysis) integrally together to calculate key optical performance parameters like Line-of sight (LOS) and wavefront error (WFE) in a user-friendly way.

In order to maintain the quality and standards offered by the analysis software of each discipline (ESATAN-TMS, Nastran, Zemax OpticStudio), MultiPAS has been implemented as an interface tool which implements the complicated data conversion between the mathematical models in a fast, standardized and verified way without any degradation of the data quality. The analyses, and such the validated quality of the solvers, remain under the responsibility of the individual software tools. As an example, the distortion of optical elements is applied in Zemax OpticStudio as a combination of rigid body motion and surface sag; consequently, the optical performance errors are calculated in Zemax OpticStudio as well and take into account all nonlinear effects of the ray tracing analysis. This way, the customers' certification of the involved tools and their results remains untouched.

The high degree of automation allows the user to perform end-to-end performance analyses faster and more economically than with traditional methods whilst maintaining full acceptability of the results. Using MultiPAS, the computational effort has been reduced by more than 80 percent on average. Even dynamic simulations are possible without major effort (e.g. one performance result every 5 minutes, while the simulated satellite is orbiting the Earth). The paper will describe details of the simulation setup and environment as well as representative results and introduce how OHB System AG will offer MultiPAS simulation service to external customers in the future.