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P4.069 Structural Thermal Optical Performance analysis for full system optical performance assessment in complex environments

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Optical design is a discipline where craftsmen assemble optical systems making use of design history and analogy to other systems, often followed by brute force optimization. In the subsequent design phase, a mechanical design is created to hold the optical elements in place and to provide adjustment mechanisms. Using this design knowledge an initial performance prediction can be made of the assembled opto-mechanical system. The impact of any environmental influence like gravity or thermal distribution often is estimated using statistical analysis of assumed perturbations or by partial analysis of deformed optical analysis. For optical systems which require ultimate performance, or which are operated under harsh environments this is a very crude and inaccurate approach.
TNO has developed a method for full system optical performance analysis where the complex influences introduced by its environment are incorporated in an accurate, and repeatable manner with built-in verifications. This Structural Thermal Optical Performance (STOP) Analysis provides a direct and reproducible link between the structural thermal analysis for combined load cases comprising nuclear heating, cooling water pressure and temperature, gravity and mounting stresses (in Ansys) and the associated changes of the optical performance, including imaging quality and alignment (in Zemax OpticStudio). This enables assessing the impact of a variety of load cases on optical performance.
This new analysis process is demonstrated on the Upper port Wide Angle Viewing System in the ITER tokamak as well as on the telescopes and UV1 spectrometer of the Sentinel 5 instrument in the EUMETSAT environment monitoring satellite. Here up to 80 different operational load cases are analyzed to accurately assess the optical performance during the various phases of the system operation.

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