Combined Opto-mechanical analysis for modern optical instruments, (10705-89)

SPIE.

J.Heijmans, R.Holzlöhner, M.Müller, European Southern Observatory (ESO)

INTRODUCTION

STOP analysis (Structural Thermal Optical) is a first essential step into a more integrated development approach and better teamwork. Integrating analysis enables a more realistic performance prediction, avoiding the step of interpretation and communication of results, reducing the effort and the possibility to make mistakes. By applying an integrated analysis process early on in the project, the risk of finding surprises and design flaws in the hardware are reduced, avoiding delays and additional costs, or failure. The process for STOP is clear but the method varies depending on the S/W.

STOP process and data sharing steps

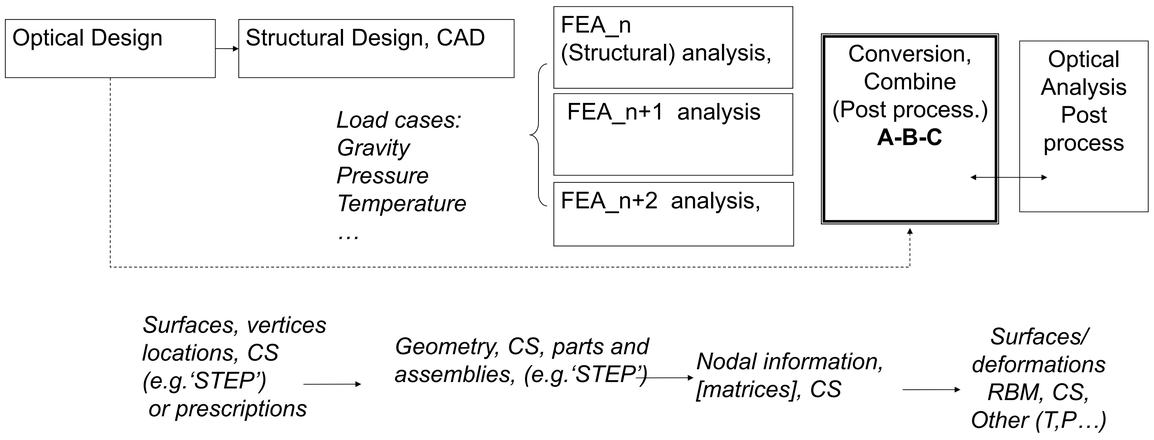
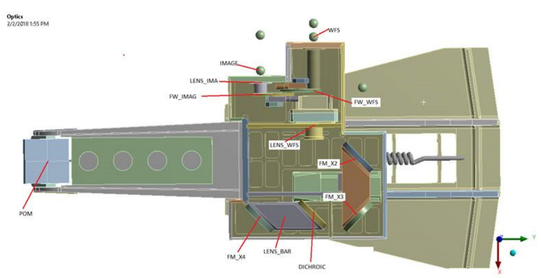


Figure 1: Schematic overview Structural Thermal Optical Performance Analysis, and data exchange

Different S/W programs and solutions exist that can integrate optical and mechanical design & analyses. An overview of the possibilities and latest developments found within the SPIE community and with some of the commercial S/W developers are:



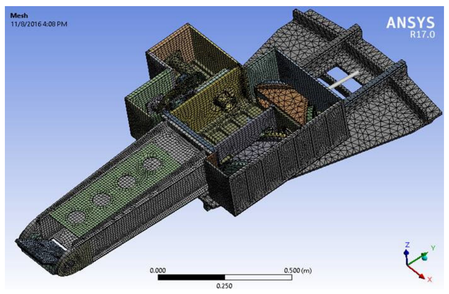


Figure 2: CAD model; FEA model of the ELT wavefront sensor concept

	FEA capability within	Ray trace capability within	Post processing	Refract index dn(dP,dT)	Active Optics		Compatibility w. Zemax®	Licensing
OOFELIE, Open Engineering	Yes through OOFELIE		Yes	Yes	Yes		Supported	Commercial S/W
Sigfit, Sigmadyne			Yes	Yes	Yes		Supported	Commercial S/W
Ray Optics w. COMSOL	Through COMSOL	Yes	Yes	Yes			No	Commercial S/W
Lensmechanix Zemax OpticsStudio	No	Yes	Yes				Directly	Commercial S/W
Tracepro +Rayviz, OSLO	No	Yes	Yes	Yes			No	Commercial S/W, educational licenses exist
APEX w.Solidworks	Through Solidworks	Yes	Yes	Only with ASAP			No, ASAP based	Commercial S/W
TOP RWTC	No	No	Yes	Yes			Supported	proprietary research S/W
NRCIM	No	No	Yes				Supported	proprietary research S/W
Sensitizer	No	No	Yes	No	Yes		Supported	Open source

Table 1: a selective list of programs and features, (known and published):

ESO development 'Sensitizer'

Dedicated Matlab program generates optical sensitivity and/or system optical performance errors from Zemax lens file by applying rigid body and Zernike Sag perturbations.

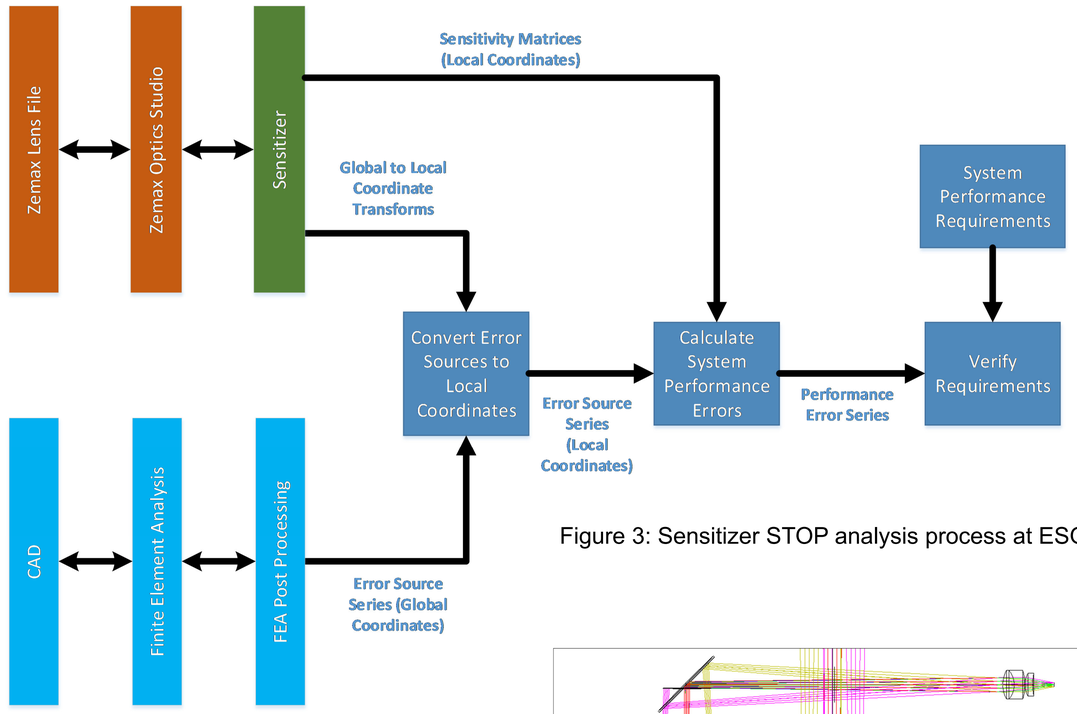
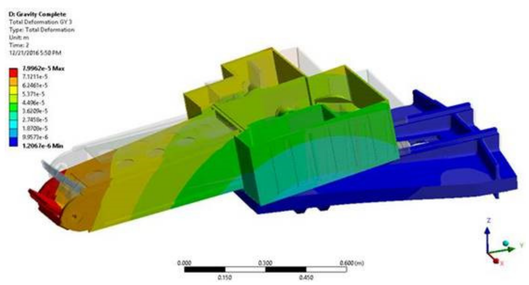


Figure 3: Sensitizer STOP analysis process at ESO



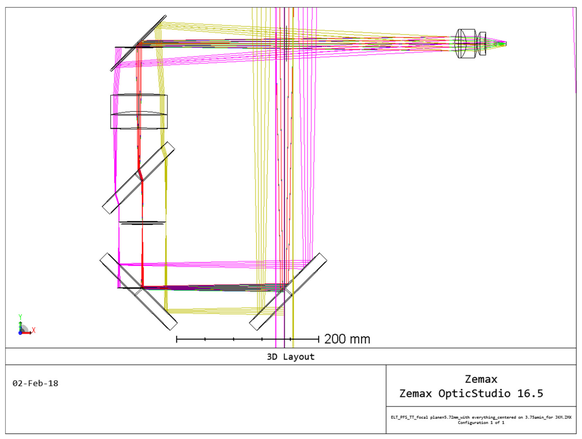


Figure 4: FEA model and Zemax model (Right) of the ELT wavefront sensor concept

- After each perturbation, computes optical quantities like centroids, defocus wavefront error, encircled energy.
- Dedicated and automized Post-processing done in Matlab and Mathematica
- Works for a wide range of Sequential focal systems, nonsequential elements can be used in hybrid, but only perturbed as a whole (Example: ELT M1 segments)
- Exit pupil and focal plane aberrations are determined from all field points in simulation using a linear mapping

The general process for STOP analysis is clear and S/W solutions are available but vary depending on the scope and complexity of the project. Depending if post processing is done within the 'optical analysis program' or by other S/W is related to the decision to use STOP analysis only as an 'optical performance evaluation' or as input to the broader 'system performance'.

Reference: www.eso.org/sci/facilities/develop/software, see all references in proceeding **10705-89**