Oofelie for Advanced Optics

Oofelie Multiphysics 2010

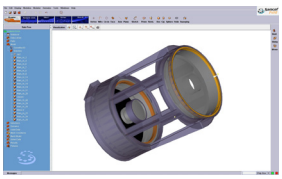
Oofelie for Advanced Optics, driven by SAMCEF Field, provides engineers and analysts with unique capabilities to analyse thermo-mechanical effects on high precision optical systems, such as lenses, optical benches, telescopes and MOEMS. You are getting at the core of the physics in one conveniently integrated simulation package. Oofelie for Advanced Optics enables the analysis and design of opto-thermo-mechanical systems through tied connection with the optical simulation software ZEMAX™.
Oofelie for Advanced Optics is a Virtual Prototyping tool for the analysis and design of opto-thermomechanical systems. Through the use of its modeling capabilities, it becomes possible to start simulating the performance of such systems even before a single physical prototype is built. Design changes can be evaluated faster and in a more affordable manner, reducing the number of actual prototypes needed to achieve a required design maturity, thus accelerating significantly product development. Thanks to such a tool, the engineers acquire a capability to isolate and analyze the effect of each parameter. With such insight available at their fingertips, information can be quickly gained to correct or improve previous designs efficiently, knowing which are the influent factors.
Reduced design time, improved quality and reduced costs are some of the benefits one can now obtain using Oofelie for Advanced Optics

MODELING ENVIRONMENT

Oofelie for Advanced Optics is driven by a user-friendly integrated graphical user interface, SAMCEF Field, for the modeling, the analysis and the post-processing of opto-thermo-mechanical systems.

SAMCEF Field, a complete and interactive user environment providing all the tools necessary to design, simulate and analyze a range of configurations, has been tailored to approach efficiently the field of opto-thermo-mechanics. Its visual and hierarchically arranged layout will guide you through all the steps of model preparation, resolution procedure and analysis.

A CAD **modeler**, as well as **import capabilities** from other leading CAD providers, is integrated for modeling and **data preparation**. As data are directly defined on the geometry, users can easily switch system components modeling level from one behavior to another.

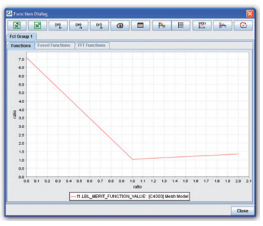


Parameterized data entry is easily done using contextual pull-down menus and pop up boxes using a wide selection of preprogrammed functions for the definition of time and frequency varying properties and boundary conditions.

As soon as the analysis is completed, the results are easily accessible from a simple click in the navigator. Results may be displayed in different forms over the whole model or through user's defined cross-sections to study detailed behavior. In addition to all the state-of-the-art **standard graphic outputs (i.e. X-Y plots, isovalues, animations, etc.),** results may also be inserted in tabular forms in the analysis report. SAMCEF Field is common to all the solutions provided by Open Engineering, allowing other analyses to be performed on the same model as for opto-thermo-mechanical simulations.

If available, optical performance indicators are automatically retrieved by Oofelie from the updated optical design (these indicators are also available in SAMCEF Field):

- The spot diagram;
- The wave front map;
- The merit function value.



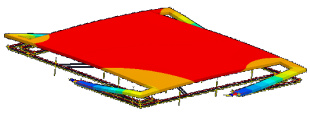
ANALYSES

Oofelie for Advanced Optics allows specific static and transient analyses for opto-thermo-mechanical systems.

Starting from the description of the optical system problem in ZEMAX, the geometry of optical components is exported to SAMCEF Field using standard CAD exchange formats. In SAMCEF Field, the surrounding support is built around these optical components and thermo-mechanical loads are applied to the system.

Before thermo-mechanical analysis, Oofelie performs a **verification process** of the sag of each node of the Finite Element mesh belonging to each optical surface. If the sag is not represented with a sufficient precision, Oofelie recomputes its value using the analytical equation of the surface provided by ZEMAX. Oofelie provides then the sag precision required by optical model tolerance. The parameters of the analytical equation are retrieved by an **automated process** based on Oofelie's **in-memory dialogue** capabilities.

After the thermo-mechanical analysis, the **updating** process of an existing optical problem takes place: the initial definition of a given optical surface is modified with the definition of **grid sag** values or coefficients from decomposition in **Zernike polynomials**. These values are computed from the knowledge of the structural deformation induced on the optical surface by the thermo-mechanical loads. If the deformed configuration contains **rigid body components** (translation and/or rotation), those parameters are identified too and are also introduced in the updated optical design. Again, with the help of its in-memory dialogue capabilities, Oofelie exchanges automatically information with ZEMAX which reduces human interventions during data transfer between the two applications, thereby gaining productivity and reducing risk of loss of data integrity.



MOEMS ANALYSIS

KEY FEATURES

In this solution, to interact with ZEMAX, Oofelie was provided with the following capabilities:

- Automated in-memory data exchanges with ZEMAX-EE
- Expression of the deformed shape in term of
  - A linear combination of Zernike polynomials
  - As grid of points
- Separation of the rigid body component
- Automated modification of the optical problem
- Automated retrieval of optical performance indicators

Oofelie for Advanced Optics

ABOUT ZEMAX-EE

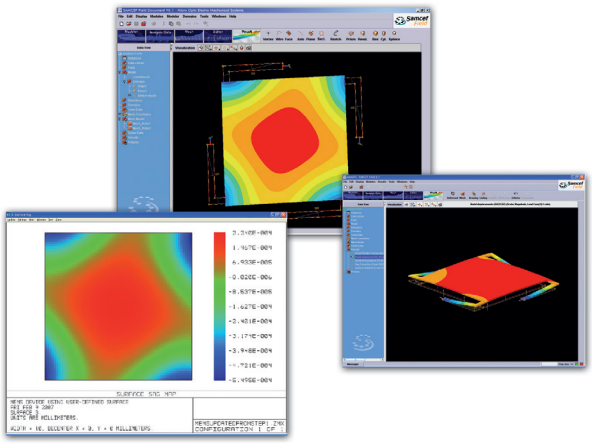
ZEMAX is a software edited and commercialized by ZEMAX Development Corporation. This software is used to study optical problems such as lens design, laser beam propagation, mirrors, ...

The Oofelie for Advanced Optics solution manages the interaction with the optical software using in-memory automated dialog capabilities. Therefore, it is the ZEMAX-EE version that is compatible with Oofelie for Advanced Optics.

APPLICATIONS

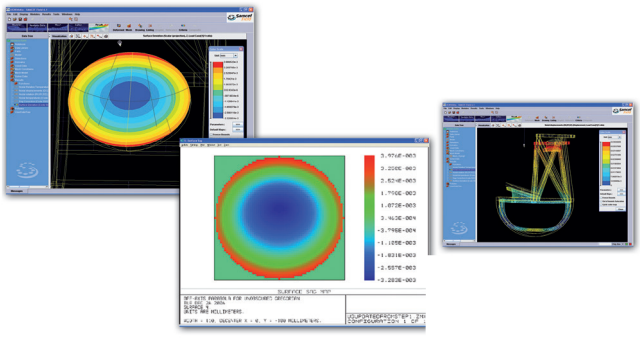
Bi-layer micro-mirror (MOEMS)

This example illustrates a simulation of the opto-electro-thermo-mechanical actuation of a bi-layer micro-mirror. This mirror is composed of two layers made of materials with different thermal expansion coefficients. The extremity of an "arm" of the system is submitted to a given electric potential while the others have a null potential. Due to this difference of potential between the different extremities, a current appears through the system and causes heating by Joule effect. Because the thermo-mechanical behavior of the two layers is different, a bending effect appears and it is possible to control the elevation of the device by modifying the applied voltage. The optical impact of mirror displacement is then obtained.



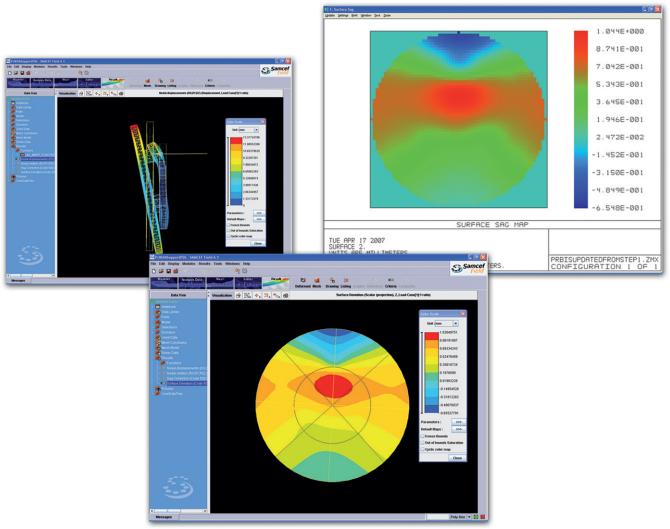
Unobscured Gregorian telescope

A support was generated around two mirrors that are defined in a ZEMAX provided design. The complete structure is cooled. The impact of the material used for the support of the two first mirrors (off-axis design) was analysed. In this particular case, a change from aluminium to titanium for the support reduces by a factor 4 the perturbation of the merit function value.



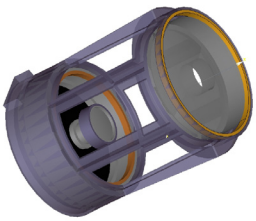
Parabolic reflector

The impact of the direction of a pressure load applied on the support of a parabolic reflector can be evaluated. The applied force at the support induces a tilt motion of the mirror. The identification of the rigid body motion parameters enables highlighting pure elastic deformations hidden by the magnitude of the rigid body motion.



Mirror telescope

Oofelie for Advanced Optics has been used to study the thermal behavior of the structure of a Mirror telescope.



EXTENSION

To control the shape of deformable mirrors with piezoelectric actuators or electrostatic effects, the Oofelie for Advanced Optics is compatible with the piezoelectric and electrostatic capabilities of Oofelie Mutliphysics.

PLATFORMS

Oofelie for Advanced Optics, driven by SAMCEF Field, is available on Windows platforms.

open engineering

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