Software Course: "Analysis and Design of Diffractive and Micro Optical Systems"

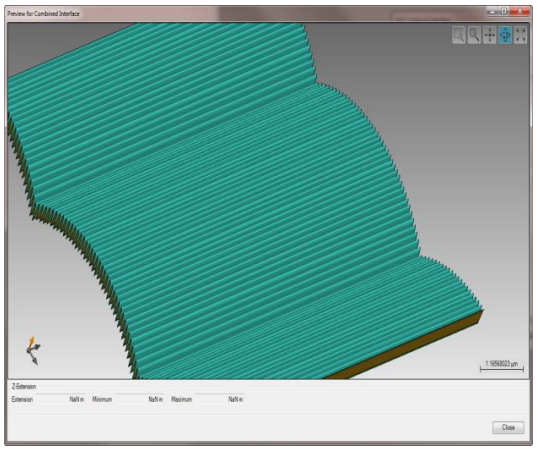
Wednesday, September 24, 2014 – Friday, September 26, 2014
Course Time: 9 am – 5 pm.

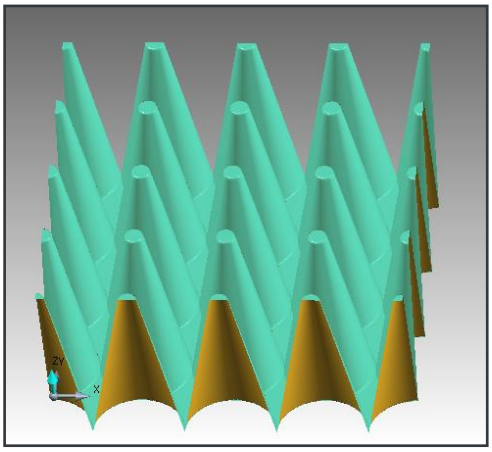
Speaker: Hartwig Crailsheim, LightTrans VirtualLab UG

Requirements: Elementary skills in using VirtualLab™ and in particular in using the light path diagram for the setup and analysis of laser systems are recommended.

Abstract:

The software course will give an introduction into the modeling and analysis of micro structured and diffractive optical components with free-form refractive, diffractive and hybrid surfaces. It will show the analysis of diffractive optical elements, diffractive lenses, hybrid lenses and lens arrays including diffraction and interference effects. This includes especially the modeling of elements with customized surface profiles and refractive index distributions. The modeling and analysis of typical tolerances of micro-structured elements will be discussed on several examples. The course will introduce the optimization of diffractive beam splitters, diffractive diffusers and diffractive beam shapers by the Iterative Fourier Transform Algorithm (IFTA). Further, micro structured elements with features in the range of the wavelength require a rigorous analysis. During the course the modeling and rigorous analysis of 2D and 3D grating structures with arbitrary surface and refractive index modulations by the Fourier Modal Method (FMM) will be practiced. At the end, local and global parametric optimization algorithms of VirtualLab™ for the rigorous optimization of gratings will be introduced.





The figure on the left side shows a cylindrical lens array with a nano-sized antireflection structure and the right figure shows the surface of a moth eye structure.

Software Course Topics, 1st Day:

- Modeling of micro optical components with freeform diffractive, refractive and hybrid surfaces.
- Approximated simulation of light propagation through micro-structured components by thin element approximation.
- Modeling of components with customized height profiles and refractive index modulations.
- Import of surface measurement data.
- Export of surface data in GDSII, CIF, STL, bitmap and ASCII format.
- Definition of periodic micro structured elements (for example micro lens arrays).
- Simulation of scattering at rough surfaces.
- Simulation of tolerances of micro-optical components, as for example, alignment errors, tilts, etching depth tolerances, edge rounding.
- Modeling of customized amplitude and phase transmissions and masks.
- Modeling and analysis of homogenization systems with micro lens arrays and diffractive optical elements.
- Modeling of temporally and spatially partially coherent light, as for example, of LED's and Excimer lasers.

Software Course Topics, 2nd Day:

- Introduction into the Iterative Fourier Transform Algorithm (IFTA).
- Calculation of physical parameters of beam splitting and light diffusing systems.
- Session editors for the generation of regular and arbitrary beam arrays.
- Session editors for the generation of diffuse Top Hats, lines and arbitrary 2D light patterns.
- Optimization of diffractive diffusers and beam splitters by the Iterative Fourier Transform Algorithm (IFTA).

Software Course Topics, 3rd Day:

- Shaping of rectangular and circular Top Hats as well as arbitrary intensity modulations.
- Optimization of diffractive beam shapers by IFTA.
- Definition of 2D- and 3D-grating structures as sequences of surfaces and homogeneous as well as inhomogeneous media (using the stack concept).
- Introduction into the rigorous analysis of periodic structures by the Fourier Modal Method (FMM).
- Rigorous near field, far field and field inside grating calculation of periodic structures.
- Analysis of reflection, transmission and polarization of sub-wavelength polarizing gratings and anti-reflection structures.
- Introduction into the local and global optimization of VirtualLab™.
- Rigorous parametric optimization of gratings.