VirtualLab Training Course

Analysis and Design of Diffractive and Micro Optical Systems

Jena, Germany
Wednesday, September 20th, 2017 – Friday, September 22nd, 2017
Course Time: 9:00 AM – 5:00 PM.
Course registration via sales@lighttrans.com

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.

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). Furthermore, 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.

Short Overview (daily program is given on subsequent pages):
- Modeling of micro optical components, import and export
- Analysis, design and tolerancing of diffractive and micro-optical systems
- Modeling and analysis of homogenization systems
- Design of diffractive and refractive beam splitters, diffusers and beam shapers
- Rigorous analysis and optimization of gratings

The design of beam splitters is discussed during the course. Flexible tools for the simulation and optimization are presented including the export tool enabling the fabrication of components.
Topics day 1:
- **Modeling of micro-optical components:** simulation of 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, simulation of scattering at rough surfaces.
- **Import and export:** import of surface measurement data, export of surface data in GDSII, CIF, STL, bitmap and ASCII format.
- **Simulation of tolerances of micro-optical components:** analysis of alignment errors, tilts, etching depth tolerances, edge rounding, modeling of customized amplitude and phase transmissions and masks.
- **Modeling and analysis of homogenization systems:** definition of periodic micro-structured elements (for example micro-lens arrays), simulation of systems with micro-lens arrays and diffractive optical elements, modeling of temporally and spatially partially coherent light, as for example, of LEDs and Excimer lasers.

Topics day 2:
- **Algorithms and basics of diffractive optics design:** introduction into the Iterative Fourier Transform Algorithm (IFTA), calculation of physical parameters of beam splitting and light diffusing systems.
- **Session editors for the design setup:** generation of regular and arbitrary beam arrays, generation of diffuse Top Hats, lines and arbitrary 2D light patterns.
- **Design of beam splitters and diffusers:** optimization of diffractive diffusers and beam splitters by the Iterative Fourier Transform Algorithm (IFTA).

Covered design processes can be applied for controlling of spatial light modulators (SLMs).

Topics day 3:
- **Design of refractive and diffractive beam shapers:** shaping of rectangular and circular Top Hats as well as arbitrary intensity modulations, optimization of diffractive beam shapers by IFTA.
- **Rigorous modeling of gratings:** 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, 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.
- **Optimization of gratings:** introduction into the local and global optimization of VirtualLab, rigorous parametric optimization of gratings.

The course is based on the latest release of VirtualLab Fusion available at the course time. Depending on the group’s dynamic, the order of the listed topics and their time assignment might vary.

Request a quote for this training via sales@lighttrans.com