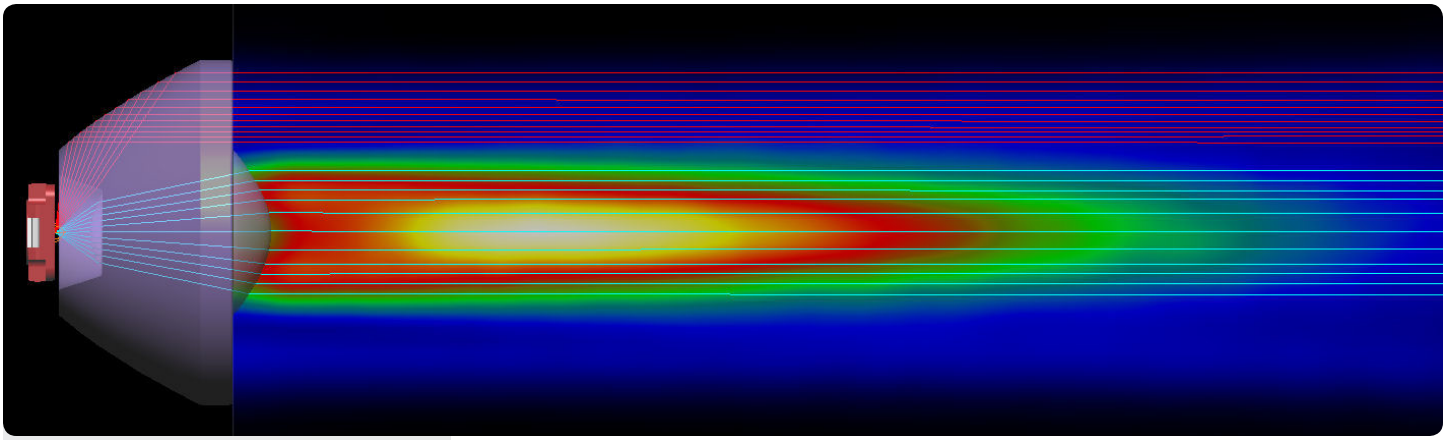
SYNOPSYS®
Silicon to Software™

LightTools Illumination Design Software

Design, Analyze, Optimize and Deliver Illumination Optics

Design Highlights



Design Highlights at a Glance

- Smart system modeling with full optical accuracy and precision
- Interactive point-and-shoot ray tracing for quick evaluation of optical behavior
- Fully integrated illumination optimization that automatically improves model performance
- Specialized, robust features for modeling complex optical surfaces and elements
- Efficient model parameter management to maintain design integrity
- Interactive, smart user interface
- Libraries of models, sources, surface finishes, coatings, filters and application-oriented utilities to speed design setup
- Custom solutions for design task automation
- CAD software interoperability for seamless information sharing

For more information, visit http://optics.synopsys.com/lighttools

The Complete Design Solution for Illumination Applications

Design accurate, cost-effective illumination optics with LightTools® software. Its unique design and analysis capabilities, combined with ease of use, support for rapid design iterations and automatic system optimization help to ensure the delivery of illumination designs according to specifications and schedule.

Smart system modeling with full optical accuracy and precision — Create designs easily with 3D solids that can be inserted into the model at any size, in any location and at any orientation. Geometry is always editable using Boolean and trimming operations that retain the optical accuracy of surface shape, position and intersection for all calculations.

Rapid evaluation of optical behavior during design iterations — With point-and-shoot ray tracing, gain an instant understanding of the system's optical behavior by graphically starting and aiming rays from any point in the model. Rays are displayed visually and updated automatically as the model is changed and they can be moved and rotated interactively to study the behavior of a model.

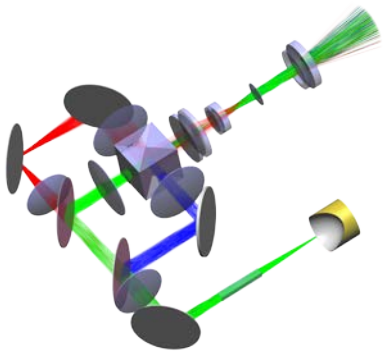


Figure 1: LightTools' smart modeling capabilities make it easy to quickly build complex illumination systems. Point-and-shoot ray tracing provides instant feedback on system alignment.

Quick convergence on the design that best meets your goals — Improve system performance automatically with the most effective illumination optimization algorithms available. LightTools' fully integrated optimization capabilities combine design and analysis features to allow you to optimize any aspect of your system to meet performance goals. For example, optimize a system to match a target illumination distribution while simultaneously maximizing total power.

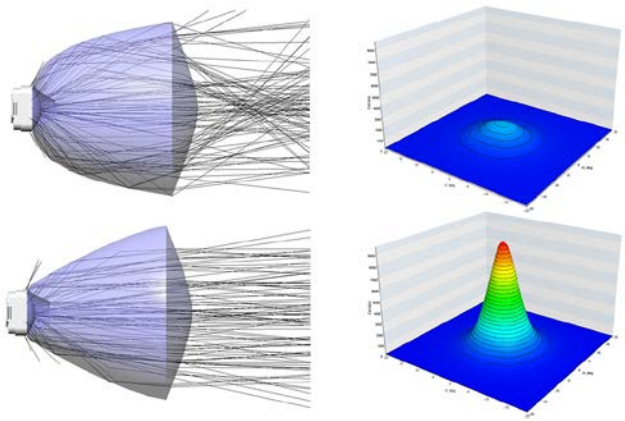


Figure 2: LED collimator modeled and optimized with LightTools' SOLIDWORKS Link Module. It was designed in SOLIDWORKS, linked to LightTools, and optimized to achieve collimated light. The top images, including intensity plot, show the starting design and the bottom images the optimized solution.

Robust modeling of complex surfaces — Model complex optical surfaces with skinned solids, a highly versatile, fully optimizable class of geometrical objects whose size and shape are defined by multiple cross-sections along their length. Apply textures — 2D, 3D and user defined — to any planar surface and vary the shape, size and spacing of texture elements as needed. Use the Advanced Design Module to quickly model freeform optics and produce optical systems that have superior light control, increased energy efficiency and innovative design forms.

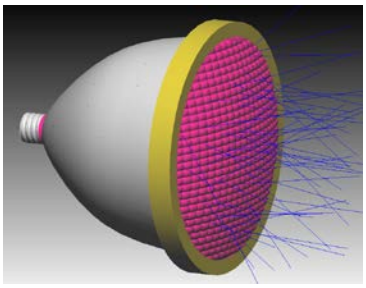


Figure 3: Spotlight model with curved cover lens. A series of toroidal lenslets on its output face spread the light into an elliptical pattern.

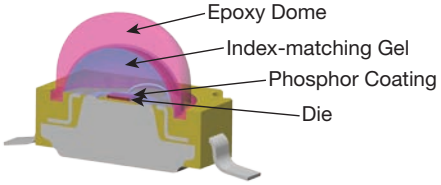


Figure 4: LightTools can easily handle complex LED packaging design requirements. You can immerse elements in one another, in multiple levels — ideal for modeling the embedded phosphor and epoxy covering in an encapsulated LED.

Efficient model parameter management — Use parametric controls to establish links among optical system parameters so that changing one parameter automatically updates all associated parameters. Design modifications correctly propagate throughout the system, maintaining both the design intent and the physical realism of the model.

Ease of use — Work faster with LightTools' smart user interface. Hierarchical data structures, editable spreadsheets, tabbed dialog boxes, multiple design views and navigation windows support interactive geometry creation and modification.

Reduced design time with libraries, example models and utilities — Jump start your design with LightTools' robust set of libraries, including sources, materials, lenses and surface treatments. Example models demonstrate key LightTools features, such as modeling sources and defining surface properties.

Custom solutions to automate tasks and leverage other tools — Have unlimited design flexibility with the LightTools COM interface. Automate repetitive design tasks using Visual Basic® macros. Incorporate LightTools functions into other COM-enabled applications such as Microsoft Excel® or MATLAB® to achieve an integrated, multi-application engineering environment.

Exceptional Software Support

When you use LightTools, you can expect to receive the most comprehensive software support in the industry to ensure that you are productive throughout your illumination design projects.

- Expert technical support staff comprised of degreed optical engineering professionals
- Dedicated customer website includes FAQs, macros, example models, tips and more
- Comprehensive documentation
- Onsite and offsite software training
- Regular program updates with customer-requested enhancements

Seamless information sharing with CAD programs — Import and export CAD data using industry-standard formats. Associate LightTools entities with CAD files and update geometry with the click of a button. Link SOLIDWORKS models to LightTools and optimize your design. Group and simplify imported geometry and perform repairs to maintain CAD model integrity and improve ray trace speed.

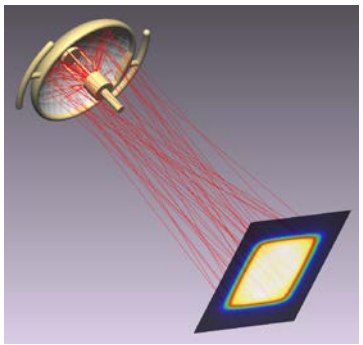
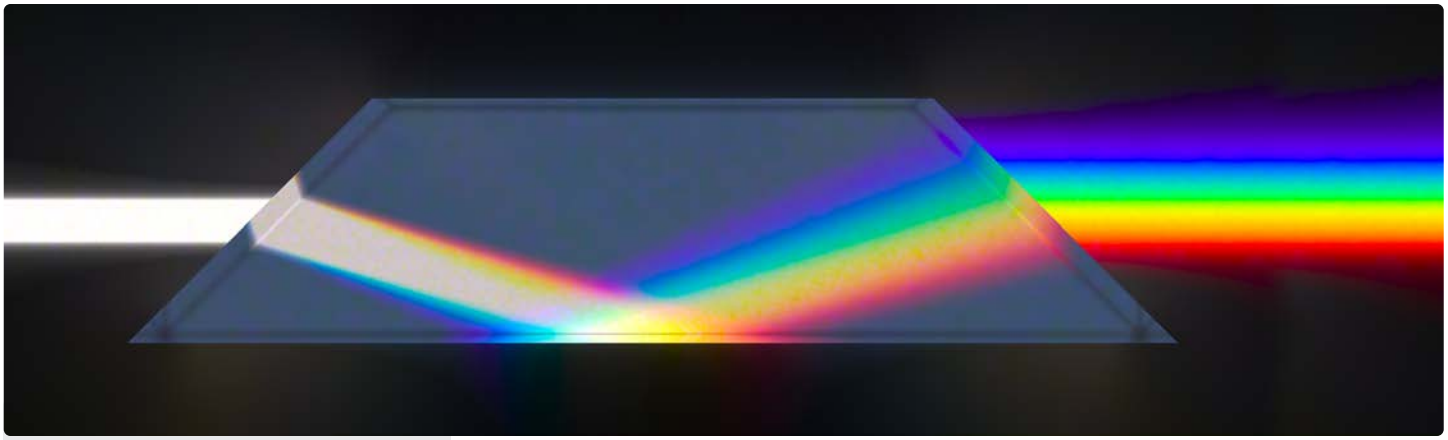


Figure 5: Surgical lamp modeled in the LightTools Advanced Design Module.

Analysis Highlights



Analysis Highlights at a Glance

- Flexible angular and spatial luminance analysis
- Accurate predictions of colorimetric performance
- Simulations of real-world effects including polarization, scattering and reflection and refraction
- Rapid, robust Monte Carlo ray tracing and accelerated ray tracing
- Visual design evaluation and communication
- Customizable, interactive charting
- Multi-CPU support to speed complex analyses and system optimization

For more information, visit http://optics.synopsys.com/lighttools

Analysis Tools That Verify and Ensure Design Performance

With LightTools' virtual prototyping capabilities, you can quickly analyze your system and perform tradeoff studies. Explore design alternatives, study light behavior and improve product quality by identifying and fixing potential problem areas early in the product development process.

LightTools calculates all the photometric and radiometric quantities needed to perform a complete illumination analysis. Define any number of receivers on real or virtual surfaces in the model to collect ray trace results for illumination analysis. Calculate illuminance, luminance, luminous intensity (near and far field) and encircled energy (angular and spatial) at any receiver.

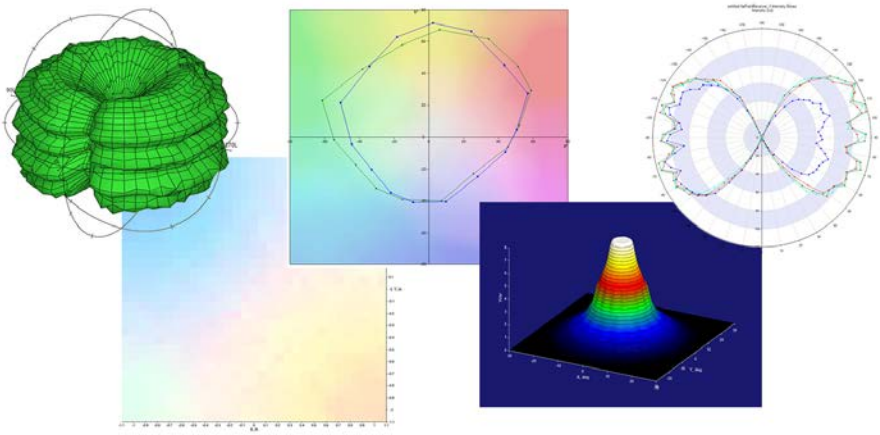


Figure 6: LightTools' full suite of analysis tools includes intensity, luminance, illuminance and color performance charts.

Angular and spatial luminance analysis — Attach angular and spatial luminance meters to surface receivers to analyze and display luminance. Move the luminance meter angle to see what the fabricated system's performance will look like at any viewing angle, in real time.

Accurate predictions of colorimetric performance — Obtain calculations of CIE coordinates (1931 x-y or 1976 u'-v') for receivers as well as the Correlated Color Temperature (CCT) as a function of position or angle. Visualize true color appearance of an illuminated surface using the RGB plotting capability.

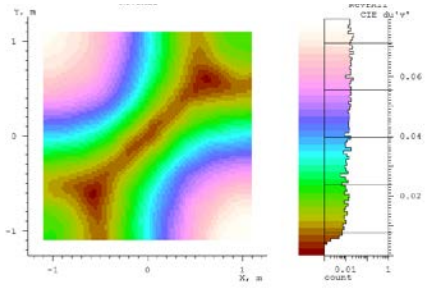


Figure 7: CIE color difference analysis calculates and optimizes system color performance. This is useful for producing an even color distribution.

Simulation of real-world conditions — Include surface effects such as polarization, scattering, reflection and refraction (with Fresnel losses) and the performance of thin film coatings. Include material effects such as dispersion, volumetric absorption, volume scattering and color filtering.

Flexible, efficient Monte Carlo ray tracing — Perform an accurate illumination analysis with rapid and robust Monte Carlo simulations. Select forward or backward ray tracing to enhance simulation speed and accuracy. Filter data according to a variety of criteria to improve your understanding of the results. Graphically display the paths of traced rays. Define aim regions for sources and surface scatterers to limit traced rays to important areas of the model.

Accelerated ray tracing — Select ray tracing shortcuts to speed up simulations. With accelerated ray tracing, control the level of accuracy on selected surfaces to increase ray trace speed by 4x to 60x or more. Turn on probabilistic ray splitting to enable LightTools to intelligently choose which rays to trace and to ignore ray paths that carry little power.

Visual design evaluation and communication — Visualize illuminance in the 3D model to quickly understand the distribution relative to model geometry. Generate photorealistic renderings to assess and demonstrate how your illumination optics look and perform. Include lit appearance in photorealistic renderings to show the luminance effects of light sources contained in the model.

Figure 8: LightTools' photorealistic renderings can demonstrate the appearance of your optical system during design evaluations and product presentations.

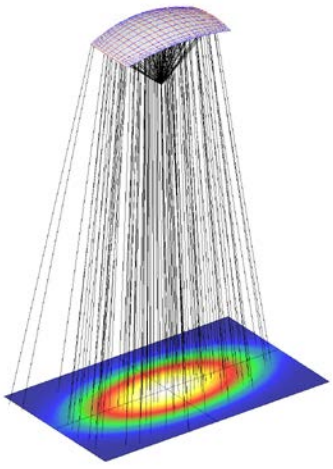


Figure 9: Visualize illuminance in the 3D model to quickly understand the shape and orientation of the distribution across a receiver relative to model geometry.

Customizable, interactive charting — Display the output of illumination calculations as line or raster plots, scatter plots, contour plots, 3D surface plots and many more formats. Interactively rotate and zoom charts to view a specific region of data. Customize charts to meet personal, company or industry standards.

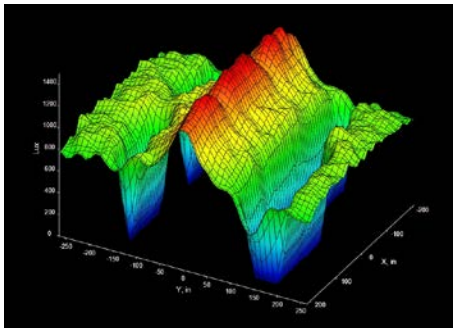
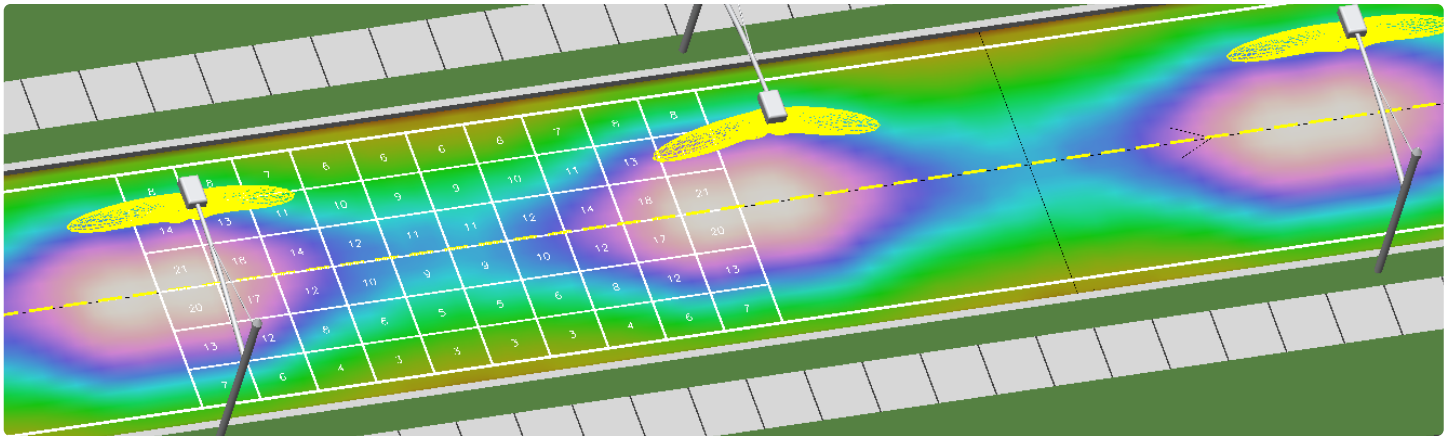


Figure 10: LightTools charting provides many options to customize illumination simulation results to meet personal, company or industry standards.

Faster solutions with increased computer power — Speed up complex analysis and optimization processes with LightTools' multi-CPU support. LightTools makes full use of hardware configurations involving multiple CPUs or single CPUs with hyperthreading or multiple core architecture.

Applications



Sample Applications and Key Features

Across a broad range of illumination applications, LightTools helps you get high-performance, cost-effective systems to market faster. Complete design and analysis features, combined with groundbreaking illumination optimization capabilities, allow you to achieve design solutions unachievable with any other software. View a gallery of LightTools applications at http://optics.synopsys.com/lighttools/lighttools-application-gallery.html.

LEDs, including LED dies, LED arrays and LED packaging

- LED utility to quickly build a complete model
- Library of pre-defined LEDs
- Multiple immersion for modeling the embedded phosphor and epoxy covering in an encapsulated LED
- Fully optimizable skinned solids for creating efficient LED couplers
- User-defined materials to model phosphor-based white LEDs
- Advanced Design Module tools for fast, robust modeling of freeform optics used in LEDs and LED collimator lenses

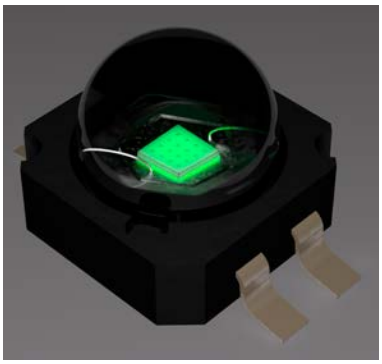


Figure 11: This photorealistic rendering of a lit LED shows a level of source model detail that can be easily achieved in LightTools.

Backlit displays

- 2D and 3D textures, including multiple appliqués, dot patterns, fine groove structures and bump structures for solids and surfaces
- User-defined 3D texture shapes and patterns for designing and analyzing arrays of complex surface reliefs
- Backlight utility that automates system setup and facilitates rapid design studies
- Backlight Pattern Optimization utility that designs and optimizes backlight extraction patterns

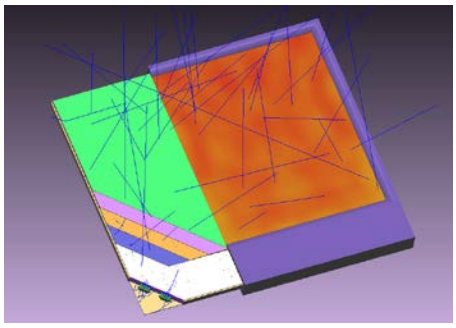


Figure 12: Cutaway of an LED-driven backlight. The pattern of extracting textures has been optimized using LightTools' Backlight Pattern Optimizer to give the uniform output shown (partially) on the right side of the model.

Digital and overhead projectors

- Library of pre-defined LCD, DMD and LCoS projector models
- Light source definition using existing ray data sources, including Radiant Source™ Models
- Built-in colorimetry analysis features to evaluate color quality and simulate display appearance
- Skinned solids to create complex mixing-rod shapes with minimal effort and optimization capabilities that automatically refine the design form
- Backward ray tracing for rapid, high-accuracy spatial luminance calculations

Lighting/luminaires

- Photorealistic renderings to visualize both how a luminare is lit and how it lights a room
- Reflector construction and automatic pattern-generation tools
- User-defined 3D textures that efficiently model a variety of complex components, from pillow optics to light diffusers for fluorescent troffers
- True-color RGB output
- Utility to read and convert IES-formatted angular intensity data files into LightTools angular apodization files
- MacroFocal Reflector tool for designing multi-surface segmented reflectors

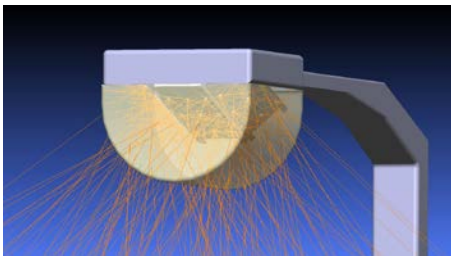


Figure 13: LED street lamp modeled in LightTools

Lightpipes

- Interactive construction, parametric editing and automatic optimization of complex shapes
- 2D and 3D texture capabilities, where each solid or surface can have multiple appliqués, dot patterns, fine groove structures or bump structures
- Probabilistic ray splitting, Fresnel loss and mixed scatter to improve speed and accuracy of light pipe simulations
- Volume scattering inside a material to simulate the diffusing characteristics of appliqués

Stray light simulation

- Ray path analysis that visually identifies stray light issues and summarizes energy flux and total power
- Point-and-shoot rays that illustrate potential ray path problems
- Receiver data filtering for multiple analyses from a single simulation
- Importance sampling using aim areas for efficient analysis of stray light in systems
- Ghost image analyzer utility
- Vehicle interior lighting and displays
- Library of pre-defined LED and filament sources
- CAD import and export to leverage existing data
- Photorealistic renderings of an optical system's lit appearance
- Virtual luminance meters that can be graphically positioned at any location in the model space to measure spatial and angular luminance and evaluate display visibility and quality

Vehicle interior lighting

- Macro control of spline, sweep and patch surfaces
- Far-field and surface receivers that collect light rays and successfully predict the luminous intensity output of lighting components
- Accelerated ray tracing of imported CAD geometry

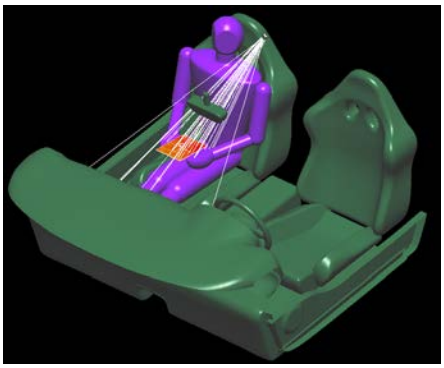


Figure 14: Automotive interior lighting modeled in LightTools

Solar collection and daylighting

- Skinned solids for classical and custom solar collection optics
- Solar utilities for modeling of solar collection systems
- 3D textures to model brightness-enhancing optics
- Fluorescence to enhance light capture in solar concentrators
- Photorealistic renderings to show the effect of daylighting enhancements

Figure 15: LightTools is useful for modeling the effect of solar radiation for daylighting and architectural applications.

Medical devices

- Full suite of volumetric optical effects, including scatter, phosphorescence and absorption
- Ability to apply Henyey-Greenstein and Gegenbauer models to a material for tissue modeling
- Extensible BSDF surface scattering capabilities

Machine vision and laser scanning components

- GRIN material modeling and a full complement of geometric laser propagation capabilities
- Accurate geometric modeling of both illumination and detection optics across the electro-magnetic spectrum
- Photorealistic renderings to evaluate illuminator and detection optics from the detector's point of view

Aerospace and defense/spaceborne systems

- Stray light and off-axis rejection analysis, including aim areas and importance sampling
- Blackbody source spectrum
- CAD import for optical mounts and assemblies

Configure LightTools to Meet Your Needs

LightTools has multiple modules that can be licensed in various configurations to meet your specific application needs. The Core Module is a prerequisite for all other modules, which include the Illumination Module, Optimization Module, Advanced Design Module, Advanced Physics Module, SOLIDWORKS Link Module, Data Exchange Modules and Imaging Path Module. These modules work together seamlessly to provide a complete design and analysis solution for illumination systems.

Core Module

The LightTools Core Module provides graphical 3D solid modeling functionality and interactive optical ray tracing for creating and visualizing optical and opto-mechanical systems, including the capability to specify properties for materials and optical surfaces.

Productivity-enhancing features include an intuitive user interface, libraries of task- and application-specific utilities and example systems, programming extensions for automating workflow and photorealistic renderings of mechanical models.

All other LightTools modules are fully integrated with the Core Module.

For more information about LightTools modules, visit http://optics.synopsys.com/lighttools/lighttools-modules.html.

Illumination Module

Enables designers to simulate and analyze light as it traverses the optical and mechanical components in a model. Includes state-of-the-art Monte Carlo ray tracing for accurate predictions of intensity, luminance and illuminance throughout the model, as well as powerful illumination analysis capabilities.

Optimization Module

Automatically improves the performance of virtually any type of illumination system. Full integration with the LightTools 3D solid modeling environment ensures practical, realistic solutions in a fraction of the time it would take to accomplish manually.

Advanced Design Module

Provides a set of specialized tools to enable fast, robust modeling of reflective and refractive freeform optics in both single-surface and segmented configurations for a diverse set of illumination applications.

Advanced Physics Module

Extends LightTools' optical modeling capabilities for custom optical parts and advanced illumination subsystems. Includes modeling of phosphors, user-defined optical properties and gradient index materials.

SOLIDWORKS Link Module

Dynamically links SOLIDWORKS mechanical models to LightTools, where you can assign optical properties, optimize and directly update your SOLIDWORKS design.

Data Exchange Modules

Provide import and export capabilities for industry-standard CAD file formats, including IGES, STEP, SAT, CATIA® V4 and V5 and Parasolid® formats.

Imaging Path Module

Defines an imaging path based on sequential optical surfaces and perform lens analyses. The Imaging Path capability can be used directly in LightTools or in conjunction with CODE V.

To Learn More

For more information on LightTools and to request a demo, please contact Synopsys' Optical Solutions Group at (626) 795-9101 between 8:00 a.m.–5:00 p.m. PST, visit http://optics.synopsys.com or send an email to optics@synopsys.com.

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