SYNOPSYS®

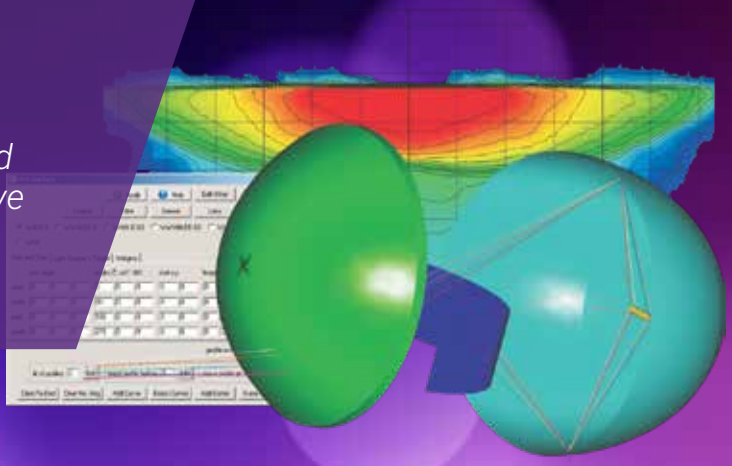
LucidShape

Computer-Aided Automotive Lighting Design

synopsys.com/optical-solutions

Overview

LucidShape is a state-of-the-art 3D system for computer-aided design of automotive lighting and optical product functions, with powerful interactive tools for design, simulation, analysis, and documentation.



Applications for LucidShape

- Projector type headlamps
- Reflector headlamps
- Dynamic lighting functions
- Adaptive lighting (AFS, ADB)
- Daytime running lights (DRL)
- All signal applications
- Lightguides
- License plate illumination
- Ultra-fast feasibility studies
- Headlamp testing
- Light data comparison
- Regulation testing
- Virtual prototyping

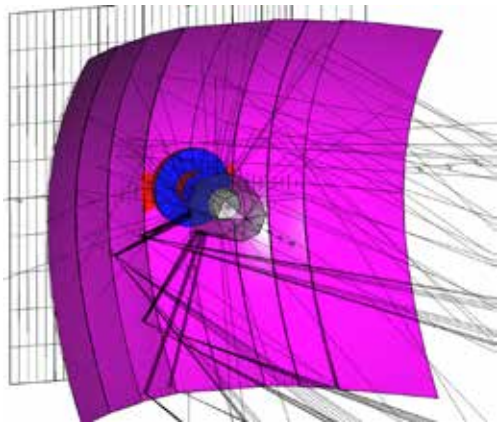


Figure 1: Headlamp and faceted reflector modeled in LucidShape

LucidShape® features:

- LucidStudio, an interactive development environment to execute all design tasks and to display and analyze geometry and simulation results
- LucidShape FunGeo, a collection of algorithms to calculate functional geometry such as freeform reflectors and lenses
- LucidShell, a script interpreter that uses a C-like language to give you freedom to customize and create your own applications
- LucidObject, a rich toolbox of lighting components to help simplify and speed the process of building complex lighting simulations
- Visualize Module, for high-speed photorealistic visualizations of an automotive lighting system's lit and unlit appearance

With its powerful tools for simulating light sources, surfaces, materials and sensors, LucidShape can be used to design a wide range of applications.

LucidShape FunGeo is the ultimate feature to help you quickly create reflector or lens geometry. LucidShape FunGeo is based on the principle that form follows function: you specify the intended lighting parameters (e.g., spread angles) and the program calculates the geometry required.

A rapid ray trace algorithm predicts the product's intended functions. LucidShape is the fastest ray tracing software for reflector design on the market.

LucidShape also includes light in motion, such as driving scenes and reflector motion.

You can define your own interfaces for design, simulation, analysis, and documentation.

LucidShape meets your individual needs.

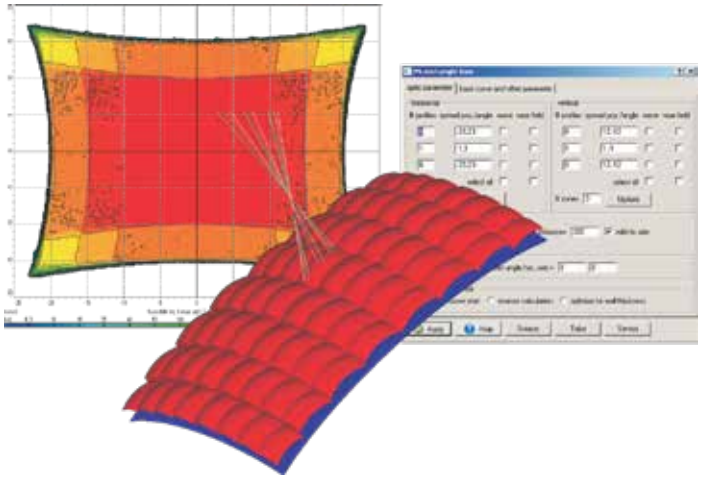


Figure 2: Tail lamp with pillow optic lens

LucidShape import and export capabilities allow you to transfer both CAD and photometry data in various formats.

To support the design process, LucidShape includes tools for examining and documenting geometry and light data.

Digital Setup for Optical and Lighting Products

In order to perform simulations and analysis, you first establish a digital setup for the automotive lighting/optical product. LucidShape supports the setup of these optical scenes in all kinds of applications.

Geometry can be defined interactively within LucidStudio, imported from a CAD file, and defined or calculated in a shell script. Complex geometry like light pipes or prism sets may be more easily defined in a shell script. On the other hand, geometry that surrounds the lighting fixture (e.g., bezels, support structures, and light shields) may be more easily designed in a CAD system and imported into LucidShape.

LucidShape supports an extensive set of different geometry, materials, and media types to model any optical setup.

Form Follows Function With LucidShape FunGeo

To achieve a desired optical or lighting effect, you need to start with the right shapes in a lighting fixture, and LucidShape FunGeo has the tools to design freeform shapes with lighting or optical behavior, such as reflectors and lenses. Calculating optical and lighting functionality is one of the main features in LucidShape FunGeo.

Simulation

A simulation is a series of calculations that allow you to predict how light will behave in a given lighting fixture. It answers questions such as, "What will be the light intensity distribution?" or "What will be the illumination distribution on the surface of interest?" Several

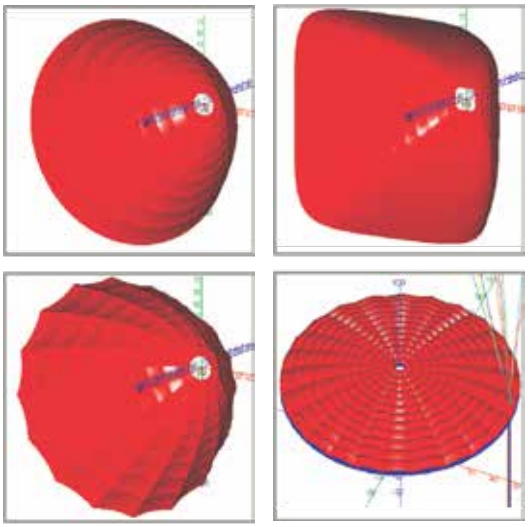


Figure 3: Procedural surfaces for reflector and lens design

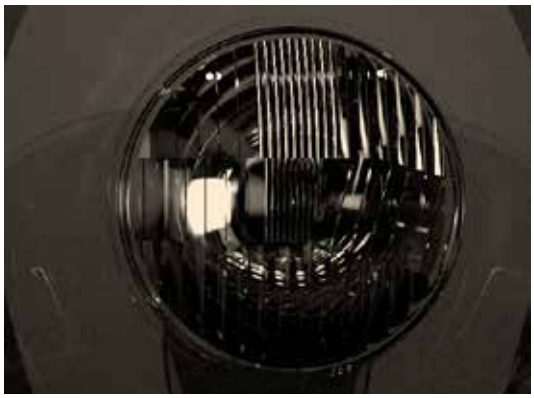


Figure 4: Simulation of lit appearance with a virtual Luminance Camera

simulation tools are available, differing mainly in calculation time and precision of the calculated results:

- Forward Monte Carlo ray trace
- Spectral ray trace
- Multi-processor ray trace
- Accurate NURBS ray trace or fast triangle intersection
- Fast light mapping
- Interactive ray trace
- Random rays
- Lit appearance with luminance image from backward ray trace
- Gather sensor light (load sensors directly from light sources)
- Reverse sensor light (calculates light source distribution in reverse, from sensors)

Interactive Ray Path Trace for Reflector and Lens Design

Being able to visualize light rays traveling through a scene is an effective way to investigate the behavior of reflectors and lenses.

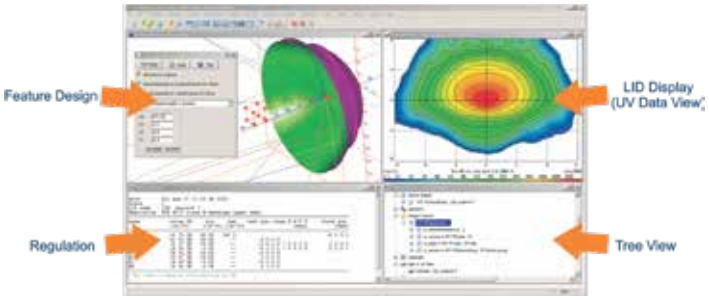


Figure 5: Lighting design in LucidShape with simulation result and photometric test table

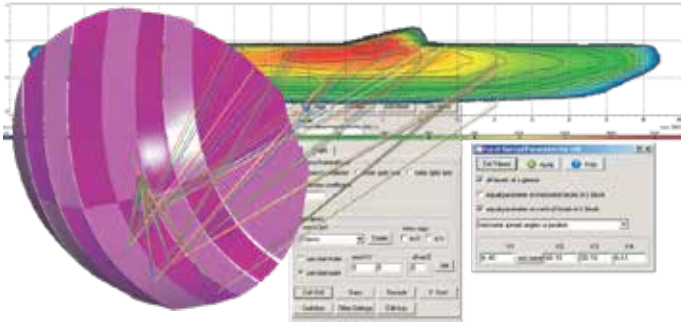


Figure 6: Interactive ray trace for a low beam reflector

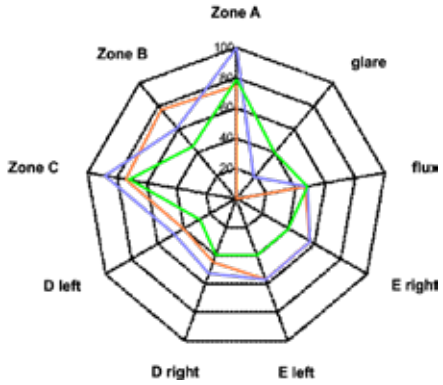


Figure 7: Vehicle headlamp benchmark with CIE TC4-45 assessments

Figure 8: Lit appearance image created in the LucidShape Visualize Module

In LucidStudio, you can interactively "touch" shapes in the scene to see how rays behave as they travel from a source to the touch point—and then bounce through the scene, stop at an absorber or launch to infinity.

Light Data Analysis

To perform an analysis, you can use light data generated during a simulation, as well as imported data from a goniometer measurement of a real lighting fixture.

A typical analysis might compare results from a simulation (computer prediction) and the final results produced in hardware.

Light data analysis includes:

- Measurement tables for automotive lighting for ECE, SAE and JIS regulations
- Light data analysis and operations: gradients, filter, addition, subtraction, scale, mirror, etc.
- Light data display properties such as log/linear scale and color mode
- CIE TC4-45 headlamp benchmark

Visualize Module

LucidShape's Visualize Module delivers high-speed photorealistic images of an automotive lighting system's lit and unlit appearance. Because the Visualize Module depicts all interactions between system geometry and light sources, it provides designers with a physically correct diagnostic tool for evaluating how a lighting system will be perceived by the human eye.

To Learn More

For more information about LucidShape and to request a demo, please contact Synopsys' Optical Solutions Group at (626) 795-9101 between 8:00 a.m.– 5:00 p.m. PT, visit https://www.synopsys.com/optical-solutions.html, or send an email to lucidshapeinfo@synopsys.com.

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