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LucidShape Reverse Simulation Analysis With the Ray History Sensor

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Author

Steffen Ragnow
Synopsys

Abstract

LucidShape® software's Ray History Sensor (RHS) tool provides reverse analysis results for Monte Carlo simulations.

You can pass a region in the light target domain to the RHS and get as a result all rays that went into this region during the simulation. The rays (or a user-defined fractional amount of them) are displayed in the geometry view, thus allowing identification of the optical parts that are relevant to the specified target region.

The RHS may be used as a lux or candela sensor. You set up the RHS before the simulation and it keeps track of the origins of all incoming rays. It processes this information in such a way that you can perform fast location queries on the RHS after the simulation.

Introduction

During early development phases of complex optical systems, it is not unusual to get unwelcome artifacts in the simulation results. Such artifacts may be regions in the light data views with unacceptable amounts of scattered rays or irregular light patterns. It is then a non-trivial task for the developer to identify the optical parts of the geometry that are responsible for the distortions and to fine tune the critical parts. In the case of optical systems with dozens or even hundreds of parts, this task is especially demanding.

You can also use the RHS to categorize the parts of the system according to the amount of light they send into specific parts of the target sensor; for example, for documentation or demonstration purposes.

Application to a Simple Beam Pattern

We will use a standard headlamp reflector computed by LucidShape's FunGeo in Figure 1, as a simple example to analyze its low beam pattern and show with the RHS tool the beam's individual ray directions.

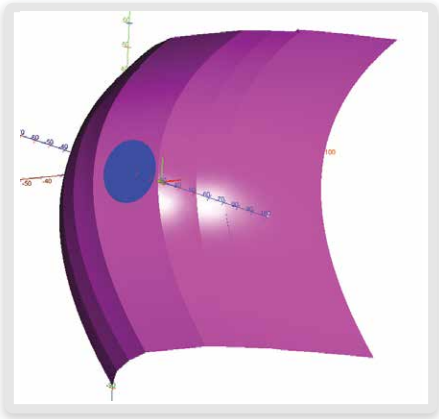

Figure 1. Headlamp reflector

Step 1: We set up an RHS that will gather the ray origins during the simulation. The corresponding dialog box is shown in Figure 2. In short, the user can provide the sensor's dimensions (here: [-45,45] x [-15,5], according to the domain of the beam pattern), the angle type, a switch to reject incoming rays directly coming from the light source, and a file name to store the ray accumulations for later use.

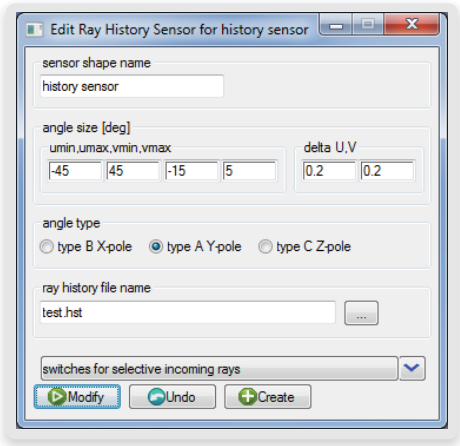

Figure 2. The Create Ray History Sensor dialog box parameters

Step 2: We start the Monte Carlo Simulation and get the low beam pattern result shown in Figure 3.

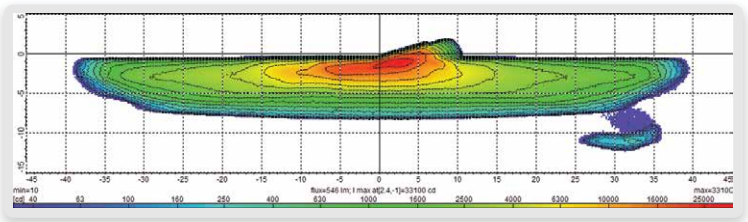

Figure 3. Candela sensor with low beam pattern and scattered light (bottom right) produced by headlamp reflector

Step 3: We select interesting regions (scattered light) with a rectangle at the candela sensor display in Figure 4.

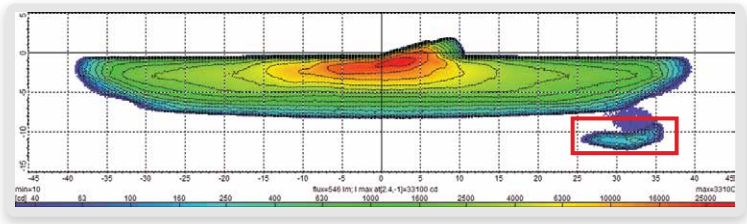

Figure 4. The low beam pattern with marked region [25,37]x[-9,-13]

You can also define the region in the RHS dialog box. Entering this region into the Restore Rays from Ray History Sensor dialog box (Figure 5) and limiting the number of rays displayed to 10 makes those rays visible in the geometry view when they fall in the specified region during the simulation.

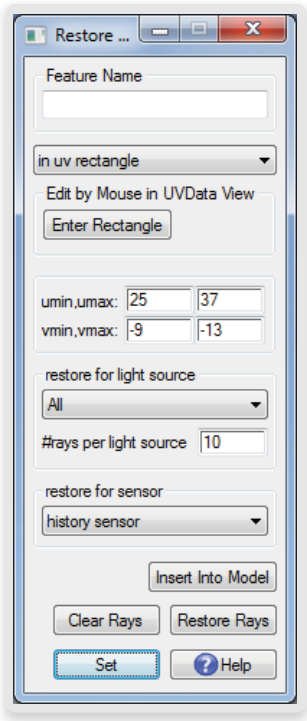

Figure 5. The *Restore Rays* dialog box

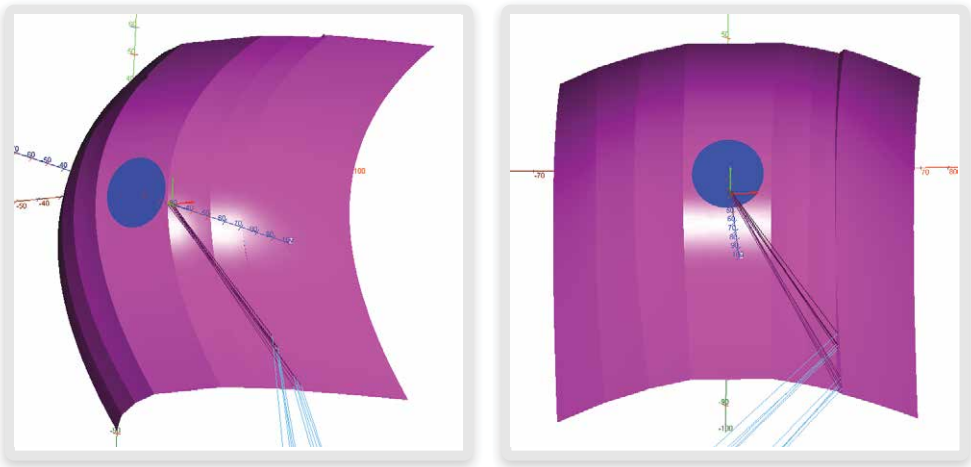

Figure 6. Headlamp reflector with responsible rays that went to the marked region at the candela sensor display

It is quite obvious that the marked region at the candela sensor display is made up of rays that come from a reflector facet gap (which might not be too surprising for an experienced headlamp engineer).

Conclusion

In the development of complex optical systems, reverse simulation analysis is a valuable tool for the evaluation of individual parts of the system. The Ray History Sensor presented here allows an easy and quick identification of parts of the optics causing distortions in the required light function.

To Learn More

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

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