TracePro is the first truly visual three-dimensional illumination software tool.

It’s the breakthrough optical and mechanical designers have been waiting for—a ray tracing tool that allows lens and solid modeling data to be shared in a Windows program.

No matter how you have been designing and analyzing, TracePro will give you incredible speed, accuracy and versatility with three editions of the software to choose from. If you have been building and testing your systems manually, you will do in minutes what currently takes weeks. If you have been using a lens design program that is incompatible with a mechanical designer’s program, you will have compatible data for the first time. And if you have been using a DOS-based integrated program that was merely adapted for Windows, you will get dramatically greater capabilities.

TracePro excels! It’s...

- #1 in standardization—importing and exporting more CAD and lens design program formats
- #1 in using the ACIS kernel—used in more than 200 programs as the main interface for 3D modeling
- #1 in handling complex geometry that uses new algorithms—enabling TracePro to define and ray trace millions of surface entities for lighting and back-light display analysis
- #1 for using the Scheme macro language for iterative and multiple configuration analysis
- #1 in volume scatter and volumetric flux calculation
- #1 in analyzing thin film stacks

Analyze every factor, avoid every pitfall. TracePro performs illumination, stray light and optical system analysis by simulating polarization, scattering, absorption, diffraction, reflection and refraction. Use it to compute:

- Irradiance, intensity, flux, temperature dependence and spectral distributions
- Stray light (including ghosts), scattered light and aperture diffraction
- Light distributions in imaging and non-imaging systems
- Throughput, loss or system transmittance
- Polarization effects
- Scattering and propagation in biological tissue
- Uniformity of displays
- True color appearance

You can even use TracePro for faster design work. Models can easily be created using the CA D-like interface and libraries of optical components. And, there’s an extensible database of properties to ensure that your objects have the correct properties, including materials, surface properties, gradient index, bulk scatter and multilayer coating stacks.

Integrating Optical and Solid Modeling for Fast, Accurate Analysis.

TraceAnySurface and Any Solid Model.

Trace rays to any surface with TracePro. Solid models you create with CAD or solid modeling software can be imported into TracePro and raytraced. For example, you can model:

- Telescopes and camera systems
- Infrared imaging systems
- Spectrometers
- Light pipes and multi-mode fibers
- LCD projection systems
- Illumination systems
- Luminaires and light fixtures
- Automotive lighting
- Medical applications
- Laser systems

TracePro is ideal for analyzing lamps and luminaires, which can be used as sources in projection systems.

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The ACIS Engine Gives You the Power You Need.

TracePro is the only program for opto-mechanical modeling based on ACIS, the state-of-the-art, industry-standard solid modeling engine. ACIS provides a vast array of capabilities for exchanging data between programs, and creating, visualizing, and manipulating designs, including NURBS surfaces.

**ACIS is the key that opens both mechanical and lens design files.** It allows you to directly share data with more than 200 other ACIS-based programs. To use an ACIS model you simply open the SAT file using the File Open menu in TracePro.

**Model without limits.** TracePro is the first object-oriented tool for opto-mechanical system analysis. There is no limit on the size or number of models you can work with, and you can arbitrarily add and remove objects.

**Define and combine various shapes.** Define primitive solid shapes, including spheres, elliptical and circular cylinders and cones, blocks, and tori and 2D primitive shapes that can be extruded and swept to create a wide variety of unusual 3D geometry. Define shapes needed in optical systems, such as lens elements, luminaire reflectors, tubes and baffle vanes. Combine shapes using Boolean operators to intersect, subtract and unite.

**Translators Let You Communicate in Many Design Languages.**

Lens and mechanical designers can now share data. Import mechanical models into lens designs and optical components into mechanical designs. Translators exchange information about solid models, not just lines or wires. All mechanical data is preserved when information is exchanged.

**Incorporate light sources of any geometry.** A ny surface or object can be turned into a source and your model can include any number of sources.

**Import lens design files automatically.** Data from popular lens design programs, such as ACCOS V, Code V, OSLO, Sigma and ZEMAX, can be imported into TracePro simply by opening the lens design data file. TracePro automatically creates a solid model of the lens design using the curvature, thickness, material and clear aperture data, and saves it as an SAT file, the ACIS file format. During the translation, TracePro converts the lens design materials to the equivalent TracePro materials.

It’s just as easy to import IGES, STEP, VDAFS and STL files*—and more file formats will be included in future upgrades. You import these industry-standard files into TracePro simply by opening them.

**TracePro Is as Quick as a Mouse.**

TracePro is based on the sophisticated 32-bit environments of Windows 95, 98, 2000 and NT. It was built “from the ground up,” not by adding a Windows interface to a Windows port of old code. The result: a multi-threaded program with tremendous capacity. You will learn fast, work fast and stay current with the easy-to-learn TracePro graphical user interface.

**Learning TracePro is as easy as pointing and clicking.** In fact, if you have used any Windows application, you know how to use TracePro. There’s little need to memorize commands. Functions are easily performed via toolbar buttons and many pop-up menus.

**Edit and view your work easily and clearly.** Use the mouse to draw objects in seconds. Then quickly apply material and surface properties. With a click of the mouse, control the view. Move and rotate objects. Zoom in and out. For quick reference, the coordinates of the mouse are always displayed on the status bar at the bottom of the application window.

**Move between tasks quickly.** You can open multiple models and many views of each model at the same time. Since many operations are based on a modelless dialog boxes, you can also move back and forth between tasks by keeping the dialog open. Windows can be cascaded, tiled and minimized using standard Windows controls. You can copy and paste from one model to another.

**Use commands whenever you prefer them.** For those times when commands are more powerful, TracePro uses the powerful Scheme macro language that expands your design power. Scheme is taught by hundreds of universities and sold throughout the world as an educational tool for 3D object creation. Use Scheme to loop through several iterations and output results to a disk for later browsing without user intervention.

**Help is always at your fingertips.** One click, using the standard Windows “Help” toolbar button or F1 key, gives you help for all features.

**Stay up to date.** Choose Lambda’s support option to receive new versions of TracePro whenever its analysis tools are upgraded. TracePro is constantly being upgraded and maintained to create new features in both the user interface and analytical capabilities.

* These features are available for an additional fee.
Be Confident in Sampling and Modeling.

The Monte Carlo method takes the gambling out of sampling. TracePro uses the standard in non-sequential ray tracing, the Monte Carlo method, to accurately model scattering and diffraction of light. GUERAP, the ancestor of TracePro, was the first Monte Carlo optical ray-tracing program, developed more than 30 years ago.

Instead of propagating a distribution of light, as in deterministic sampling, the Monte Carlo method propagates discrete samples or rays. Samples are randomly chosen using the scattering distribution as a probability density. The method uses variance reduction techniques to greatly reduce the number of rays needed to get a reliable result.

Define Sources Your Way.

Using TracePro, you can define sources of any four ways: by using a grid emitter, a surface emitter or Radiant Imaging measured sources; or by creating a user-defined data set ray by ray.

Creating a grid of rays that diverges, converges or collimates is a snap. Just use three simple dialog boxes to define the shape, size, origin, and direction and polarization state for the grid.

Any surface or object can be a source in the program. Sources can emit in a Lambertian, uniform or collimated distribution or by using a surface property to define the intensity versus angle in a spreadsheet interface. This allows you to quickly specify flux, irradiance or blackbody temperature. In addition, these sources can be defined for single or multiple wavelengths and for continuous wavelength emission for accurate simulation of blackbody sources.

Simulate light sources by using measured data from Radiant Imaging, Inc. Radiant sources are complete, three-dimensional, spatial-angular source characterizations. Using TracePro, you no longer have to build a precise geometrical model to get an accurate source characterization. Many off-the-shelf sources are available, including HID lamps, arc lamps, LEDs and more.

You can have complete control of each ray. Define individual rays by position, direction and flux (power). You can create these rays in a text file using any standard text or word processor.

Focus on your area of interest with importance sampling. TracePro allows you to choose a random distribution of rays, then select the direction of the rays you are most interested in. You will trace fewer rays to achieve an accurate result.

You will be sure your models are buildable. TracePro lets you construct models using solid pieces of material—rather than a wire-frame approximation—much like constructing a building with bricks and mortar. There’s no chance to design a five-sided cube.

Here Are the Features that Give You Powerful Design Capabilities.

Visualization: Seeing Is Understanding.

Ray sorting is a visual method to see rays as a function of how they reach selected surfaces. Options include sorting by percentage, as a function of single or multiple scatterers or specular transmission, as a function of wavelength shown either by exact wavelength color or as a function of flux intensity by color. You can also view irradiance/illuminance maps based on these sorted rays.

Three-dimensional irradiance maps allow flux representation as it appears photometrically on a surface or object. This is one method of quickly determining if uneven illumination is present on any object or surface.

Output: Information that Helps Solve Problems.

Flux reports, incident ray tables and ray histories are essential to understand where light is being absorbed, lost, scattered, reflected or refracted. These reports include the often-neglected stray light information necessary to alleviate problems.

TracePro excels at reporting how the light reached each surface. The Flux Report details where energy is lost or absorbed and the Incident Ray Table shows all information on optical path length, position, direction and polarization state for every ray incident on the surface. Any of this information is available for post-processing using File Save features.

You can view any system using shaded rendered images to aid in your visualization of the model or for preparing presentations. The illustration at right shows an automotive speedometer pointer.
**Unique Algorithms and Utilities: More Tools than You Thought Possible.**

**Bulk Scatter.** The bulk scatter feature allows scattering in 3D volumes. When a ray enters an object that has bulk scattering, the ray propagates a distance, then the direction of the ray is deviated. The algorithm is based on the Henyey-Greenstein phase function, which accurately models scattering in human tissue when coupled with the correct tissue absorption, index of refraction, anisotropy factor and scattering coefficient. The algorithm has also been successfully applied to volume scattering in space.

**BSDF Wizard.** The BSDF wizard is a utility that graphically fits TracePro’s A Berg BSDF model to measured surface scatter data. You can also import a standard data taken by goniometers that are specifically designed to measure scattered light from samples.

**Gradient Index.** TracePro’s gradient index material (GRIN) feature defines a new approach to tracing rays in GRIN material. The program uses an algorithm in which you define the accuracy tolerance for propagating through the material. TracePro automatically calculates the step size to meet this tolerance.

In addition, curved ray segments are traced, not straight-line approximations. You can define almost any type of GRIN material, including Gradium and Selfoc, and you can use your own “user-defined” material.

**Temperature Dependence.** With TracePro, create material, surface and object properties that vary versus temperature. Define the index of refraction versus temperature, do waveband calculations and calculate thermal dependence for systems in the lighting, display and energy industries.

**Thin Films.** You can precisely define thin film stacks or multi-layer coatings by specifying the thickness and material properties of each layer. TracePro calculates the macroscopic properties of the stack using Maxwell’s equations to correctly model propagation of light through the stack. You can also plot the reflectance, transmission and absorbance of the stack versus wavelength, angle of incidence and polarization.

**Polarization.** TracePro models polarization effects using the Stokes vector-Mueller matrix method. This method allows you to define the polarization behavior of a surface property or create a polarizing element by applying a Mueller matrix to an object. The Mueller matrix defines almost any polarization state that occurs in an object, including polarization from retarders, linear and circular polarizers, and customizable types.

A major advantage of the Stokes vector-Mueller matrix method is that it allows you to model unpolarized light. For example, you can emit light from an unpolarized source, propagate it through an optical system with polarizing components and accurately predict the polarization state. Polarization maps, incident ray tables and ray histories show polarization in detail as it propagates through the polarizing components in your system, surface by surface.

**Volume Flux Calculations.** Another unique program feature performs volume flux calculations. For any raytrace, you can describe a set of contiguous brick-shaped cells to collect energy for laser cavity flux calculations. For each of the cells, four flux values are calculated for the given raytrace and the results are saved to a user-specified file for later post-processing. From a given raytrace, you can perform the volume flux calculation numerous times. By changing the inputs, you can write the results of various sets of cells to various files. These files are then perfect to use as sources to other laser cavity propagation programs like LASCAD.
Optional Modules: The Color and Geometry You Need.

Lambda Research offers several optional modules to help translate and import files into TracePro.

TracePro’s optional Bitmap module takes you one step further in analyzing the imaging quality of your system. The Bitmap module translates any BMP or JPEG files into an RGB source file that you use as a light source in TracePro. You can propagate the source through your system to learn how well your system will image in true color by using the RGB option in the irradiance/illuminance map.

Exchanging files between CAD programs has always been a challenge. Import problems occur due to lack of precision in the exporting program, conversion of surfaces to solid geometry, NURBS issues, and poor mechanical engineering techniques. TracePro’s solution is to bundle our IGES, STEP and VDAFS translators with our healing husk to solve problems even if you can’t see them. Importing IGES, STEP and VDAFS files can be a challenge, especially when surfaces do not meet, or gaps or NURBS are present. The healing husk uses today’s technology to take the guesswork out of yesterday’s surface-based models by converting them into solid models.

The healing husk can simplify NURBS surfaces by converting them to analytic surfaces to speed up ray tracing, stitch surfaces together into solid objects, tighten up loosely-defined geometry, or just analyze the geometry to tell you how good it is. After healing, the husk analyzes the geometry again to let you know how successful the healing was. Thus you can create solids from surfaces even when edges do not touch, fix gaps and holes where they shouldn’t exist and convert NURBS geometry into simpler geometry.