Photon ENGINEERING
Illuminating Ideas

FRED

V 9.110

New Features Introduction

October 2010

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Contents

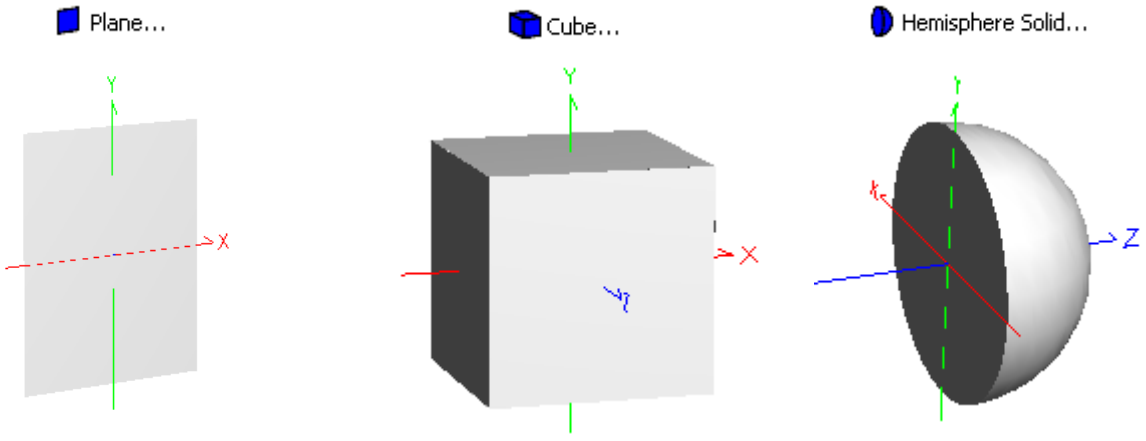
Element Primitives

Element Primitives are commonly used geometries which can be created and modified through a single dialog in the graphical user interface (GUI). Each geometry is completely specified through a minimal set of parameters unique to the element primitive type, and bulk properties can be conveniently assigned to the primitive from the single dialog interface. When created, the element primitive will be added to the object tree as an element primitive parent node with child surfaces that are used to construct the physical geometry.

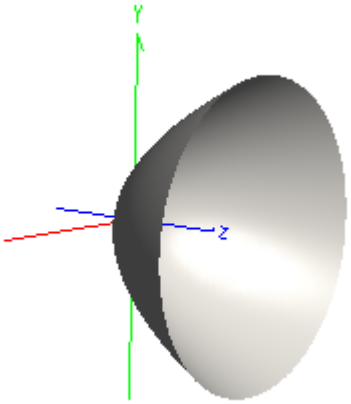
Why use element primitives? Take as an example the creation of a cube in FRED. As a surface based program, creating a cube from scratch using a custom element would involve (at minimum) individually managing 6 planes, 18 apertures and 1 custom element. In contrast, a cube type element primitive is completely specified in a single dialog by only one parameter (semi-aperture) and FRED internally handles the sizes and positions of the individual planes to ensure a properly closed volume.

Geometry Types

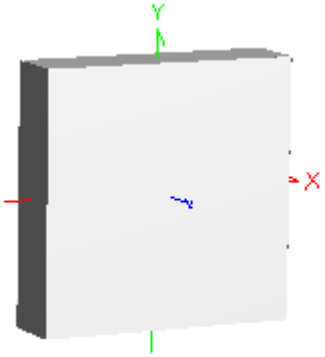
The following geometries can be created as Element Primitives:



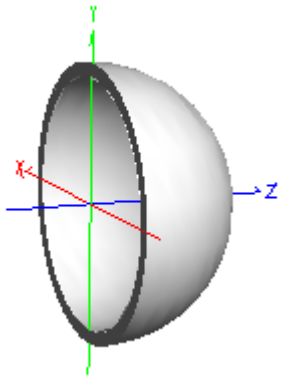
Paraboloid...



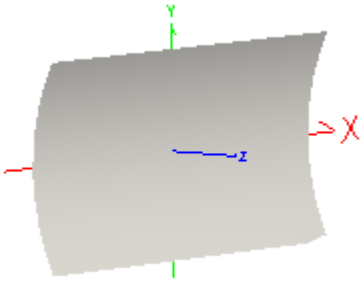
Block...



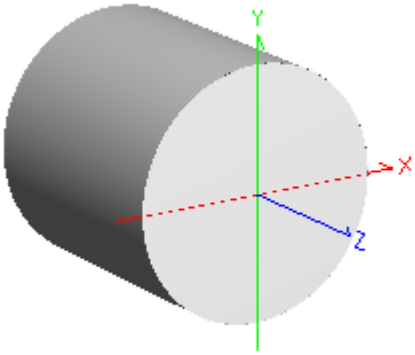
Hemisphere Shell...



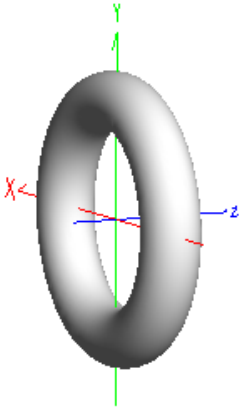
Parabolic Trough...



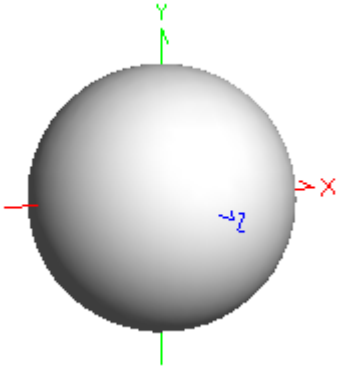
Rod...



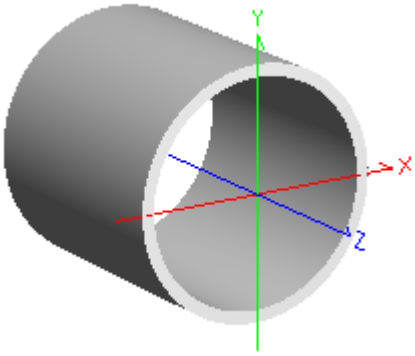
Torus...

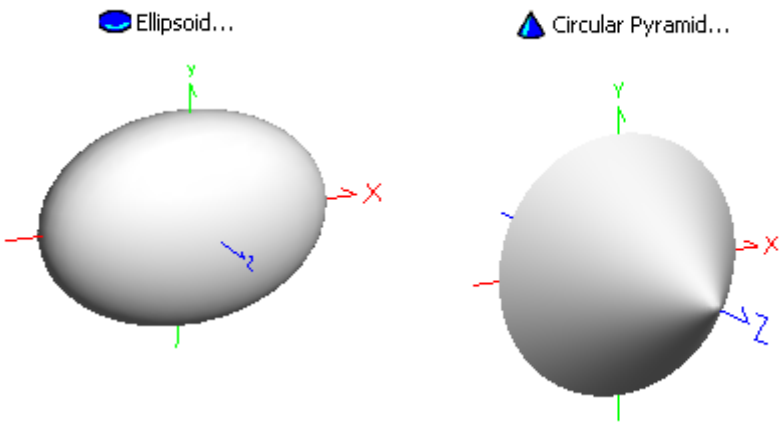


Sphere...



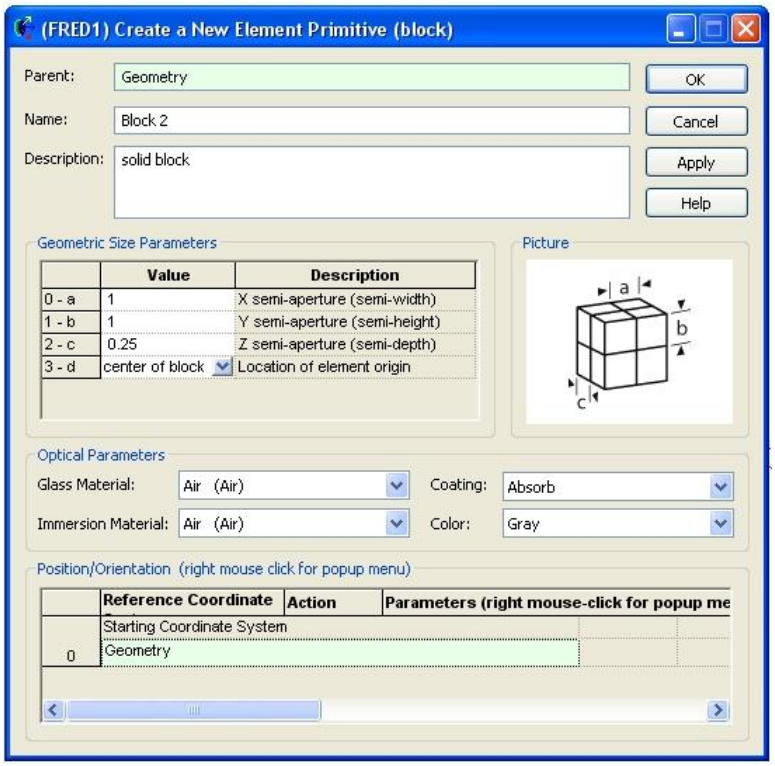
Pipe...



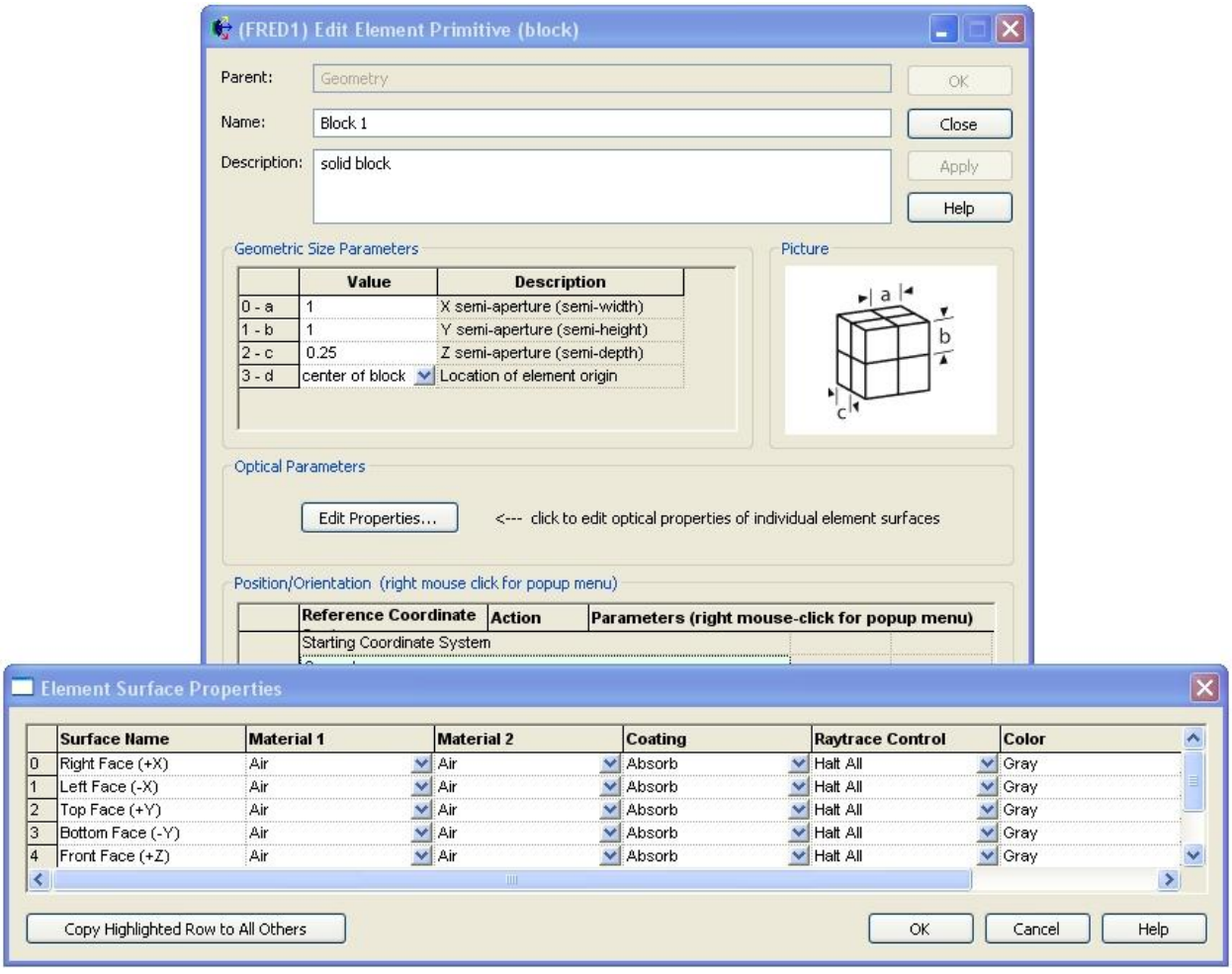


Assigning Properties

The component surface materials, coating and color can be assigned in bulk during creation of the element primitive directly from the dialog, as shown below:

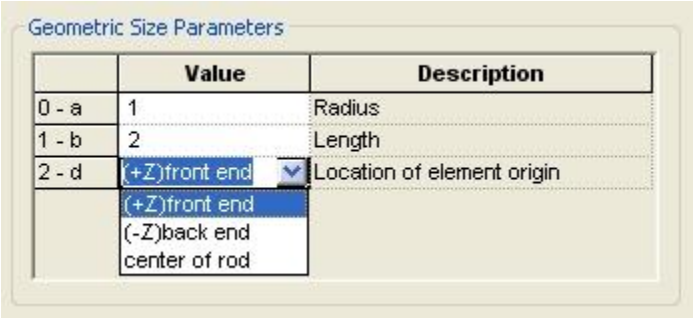


After an element primitive has been created, the dialog functionality is changed for assigning surface materials, coatings, raytrace controls and color. Initially, the “Create New Element Primitive dialog” allows the assignment of materials, coating and visualization color through a set of drop down menus for each property. In the “Edit Element Primitive” dialog the individual optical parameters drop down menus are replaced by an "Edit Properties" button that gives access to a surface spreadsheet editor, as shown below:



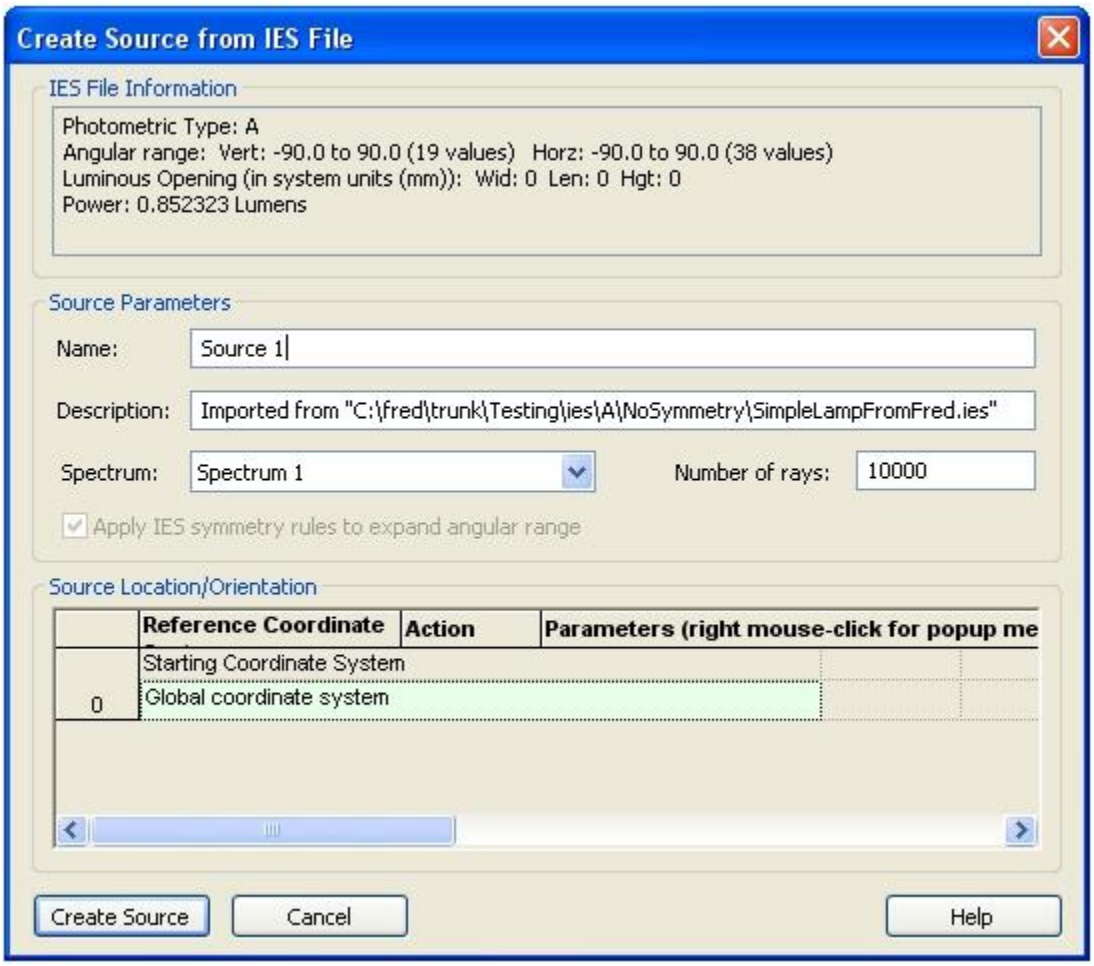
Coordinate Origin

Certain element primitive types (cube, block, rod, pipe) allow user-specification of the element origin as either the center point or a specific surface of the element primitive. When available, this option is listed as a parameter in the Geometric Size Parameters list of the element primitive dialog. This parameter can be very useful for convenient positioning of an element primitive with respect to mechanical references.

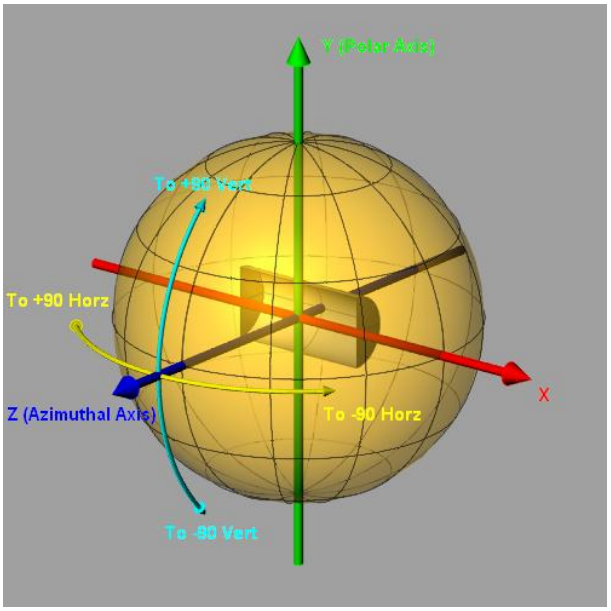


IES Source Import

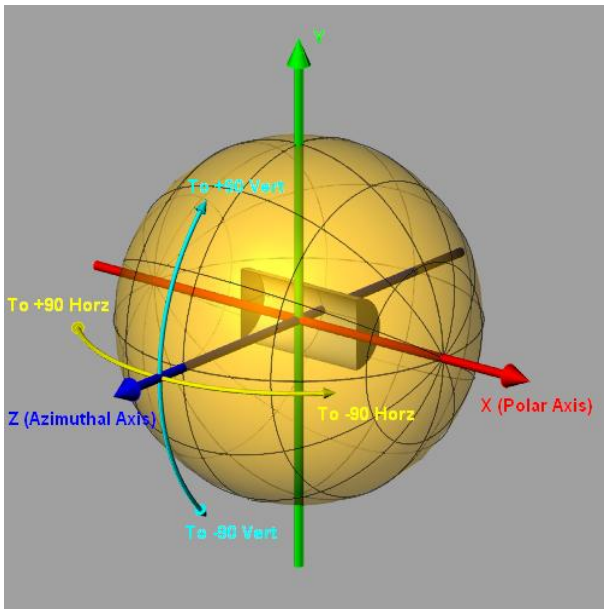
This feature creates a detailed optical source from an IES file according to the ANSI/IESNA LM-63-2002 format. Source ray positions are random volume with dimensions equal to the luminous opening, ray directions are generated randomly according to the intensity distribution and the total power is specified in units of lumens. As values in the IES specification are edge oriented, bilinear interpolation is performed to acquire center oriented values. A spectrum must be used with this source type.



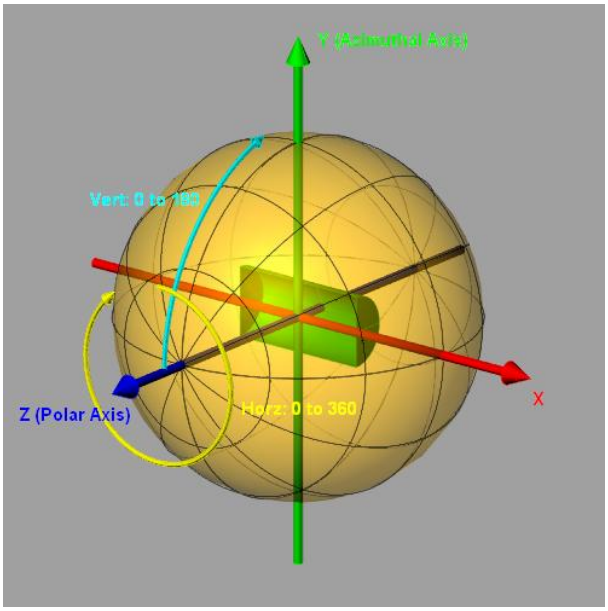
The source photometry type will be listed in the IES File Information section of the source creation dialog. The images below indicate FRED's angle conventions for each of the source types and can be used with a Directional Analysis Entity (DAE) for verification of proper source import and post-creation position/orientation operations. While the IES convention uses azimuthal angles on the range of 0 - 360 degrees, FRED uses azimuthal angles on the range -180 - 180 degrees with the proper interpretation. Photometric zero (all angles = 0 degrees) is along the +Z axis for all photometric source types.



IES Orientation Type A

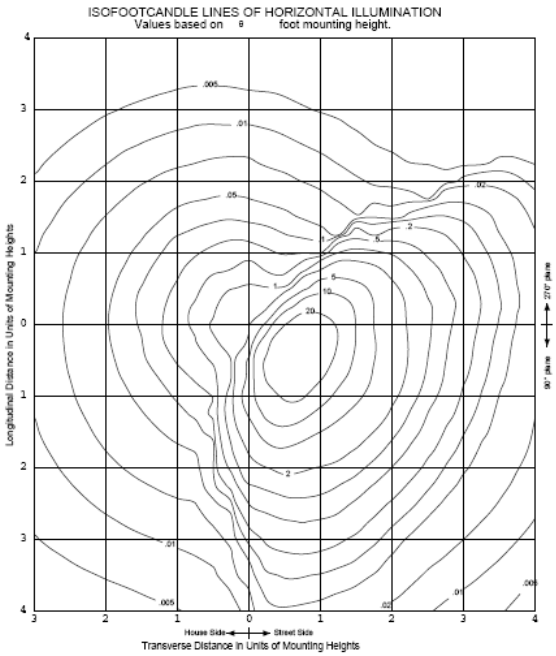


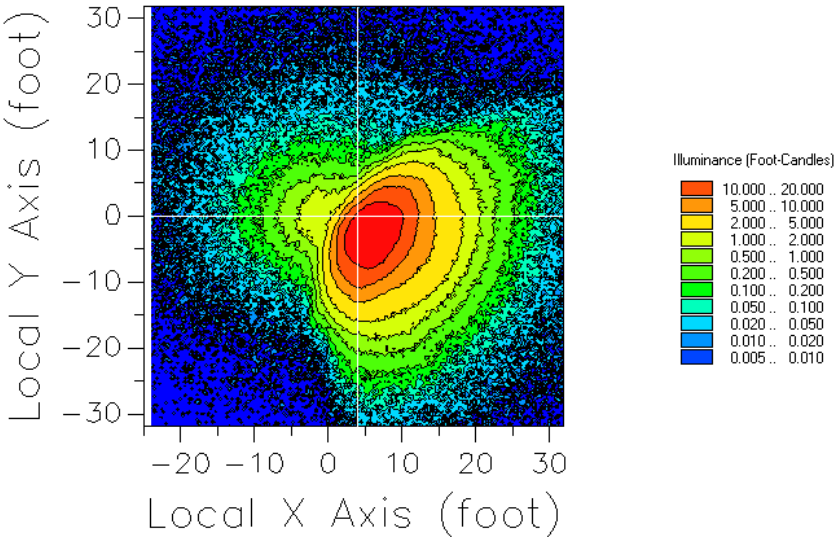
IES Orientation Type B



IES Orientation Type C

A comparison between FRED's new IES Source creation and measured data from Kim Lighting was made and the results are shown below.





Ray Direction – Randomly according to intensity distribution

In support of the IES Source functionality the ray direction specification "Randomly according to intensity distribution" has been added. The Randomly according to intensity distribution option generates ray directions based on a set of weighting factors in polar and azimuthal directions such that more rays are generated in the directions of large weighting factors. The weighting factors can be optionally entered using the digitization tool, interpolated using an *.fgd file, or read from a *.txt file.

Ray Directions

Type: Randomly according to intensity distribution

Parameters:

	Parameter	Description		
Num Directions	1	Number of random ray directions per ray position		
	Intensity Distribution			
	X	Y	Z	Description
Polar	0	0	1	Direction of polar axis
Azimuth	0	1	0	Direction of azimuth axis
Polar Angles (0-180deg)	Azimuth Angles (-180<=ang<=+180deg)			
	-180	-90	0	90
0	105	119	75	10
2.5	102	122	74	10
5	99	110	60	30

Improved Raytrace Intersection Algorithms

A new raytrace intersection algorithm is being used for surfaces of revolution and tabulated cylinders whose generatrix curve is a segmented curve type. In previous versions of FRED the ray intersection calculations for such surfaces were performed "live" during the raytrace. The new algorithm pre-calculates relevant information about the segmented curve before the raytrace proceeds so that the ray intersection search is evaluated much faster during the raytrace. Benchmarks for the new intersection algorithm show factors up to 100X speed improvement when compared to an identical trace using the previous algorithm.

Realized Lumens Output

For sources whose power units are specified as Lumens, the real photometric power of the source (Realized Lumens) calculated using the rays that are actually generated during source creation is printed to the output window. This quantity should be compared to the user requested power in the source dialog as an indicator of how accurately the source's spectrum is represented by the rays that are actually generated.

New Scripting Commands

Element Primitives

ElemAddBlock - Add a block type element primitive

ElemAddCircularPyramid - Add a circular pyramid type element primitive

ElemAddCube - Add a cube type element primitive

ElemAddEllipsoid - Add an ellipsoid type element primitive

ElemAddHemisphereShell - Add a hemisphere shell type element primitive

ElemAddHemisphereSolid - Add a hemisphere solid type element primitive

ElemAddParabolicTrough - Add a parabolic trough type element primitive

ElemAddParaboloid - Add a paraboloid type element primitive

ElemAddPipe - Add a pipe type element primitive

ElemAddPlane - Add a plane type element primitive

ElemAddRod - Add a rod type element primitive

ElemAddSphere - Add a sphere type element primitive

ElemAddTorus - Add a torus type element primitive

IsElementPrimitive - Check to see if a node is an element primitive type

Element Primitive Parameters

ElemGetParmCount - Get the number of parameters used to define an element primitive

ElemGetParmDescription - Get the description of an element primitive parameter

ElemGetParmName - Get the name of an element primitive parameter

ElemGetParmValue - Get the value of an element primitive parameter

ElemSetParmValue - Set the value of an element primitive parameter

Element Primitive Properties

ElemAddScatter - Add a scatter model to all surfaces in an element primitive

ElemSetCoating - Sets the coating specification for all surfaces in an element primitive

ElemSetMaterials - Sets the materials for all surfaces in an element primitive

ElemSetRaytraceCtrl - Sets the raytrace control set for all surfaces in an element primitive

Detailed Source Specifications

GetSourceDirSampledPolar - Gets attributes of a source's "Randomly according to intensity distribution" ray direction specification

GetSourceIthUserRay - Gets the i'th user ray in a source using user-defined rays

IsSourceDirSampledPolar - Checks to see if a source's ray direction specification is "Randomly according to intensity distribution"

SetSourceDirSampledPolar - Sets a source's ray direction specification to be "Randomly according to intensity distribution"

Analyses

IntensityAtSpecifiedDirections - Computes the intensity or luminous intensity at user specified directions given an acceptance cone size

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