DATASHEET

CODE V Beam Synthesis Propagation

Obtain Accurate Analysis of Diffraction-Related Characteristics

Features at a Glance

- Uses highly accurate beamlet-based diffraction propagation algorithm
- Includes effects of aperture clipping, intermediate image structure, and lens aberrations
- Can propagate both scalar and vector fields
- Can propagate strongly anamorphic beams
- Handles segmented-aperture systems
- Can achieve previously unattainable accuracy levels
- Includes a Pre-Analysis feature to help determine appropriate inputs for resident optical system
- Provides wide range of graphical outputs
- General complex field input supports custom input beam descriptions
- Complex field output can be used to calculate fiber coupling efficiency including polarization dependent loss
- Applicability to a wide range of optical systems

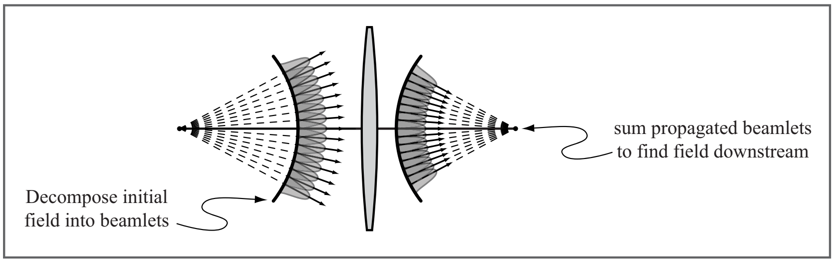

Figure 1: BSP's beamlet-based wave propagation algorithm performs beam propagation analysis more accurately and efficiently than any other commercially available tool

Accurate, Efficient Diffraction Analysis

The CODE V® Beam Synthesis Propagation (BSP) feature sets an industry standard for accuracy, efficiency, and ease of use. BSP's beamlet-based wave propagation algorithm includes proprietary enhancements designed to deliver extremely accurate and efficient modeling of diffracted wavefronts propagating through an optical system. BSP was originally developed for NASA to solve the stringent accuracy challenges of the Terrestrial Plant Finder mission. It met the mission's requirements with its ability to model irradiance that distinguished a very dim, Earth-like planet outside our solar system from the surrounding stars.

Advanced, Beamlet-Based Algorithm

BSP approximates the optical field as a collection of individual beamlets. A beamlet consists of a base ray and a field that is initially localized about the base ray. The base ray defines the reference location and direction for each beamlet.

Based on the fact that the wave equation is linear, these beamlets are propagated independently and can be summed anywhere downstream to get the propagated optical field. This method can propagate beams through anything that can be ray traced, including:

- Gradient-index (GRIN) materials
- Birefringent materials
- Non-sequential ranges

Pre-Analysis: An Industry-Leading Innovation

Determining appropriate inputs for any beam propagation algorithm can be challenging. BPS's groundbreaking Pre-Analysis feature automatically recommends analysis settings based
on your lens system and delivers an accurate answer in the shortest time possible.

Pre-Analysis performs a fast scan of your system using a subset of probe beamlets and provides recommended values for key inputs, including:

- Input field sampling
- Resampling surfaces
- Clip checking surfaces
- Output grid location, size, and sampling

Pre-Analysis also estimates the analysis execution time based on the recommended values. Use of this feature is optional but highly recommended.

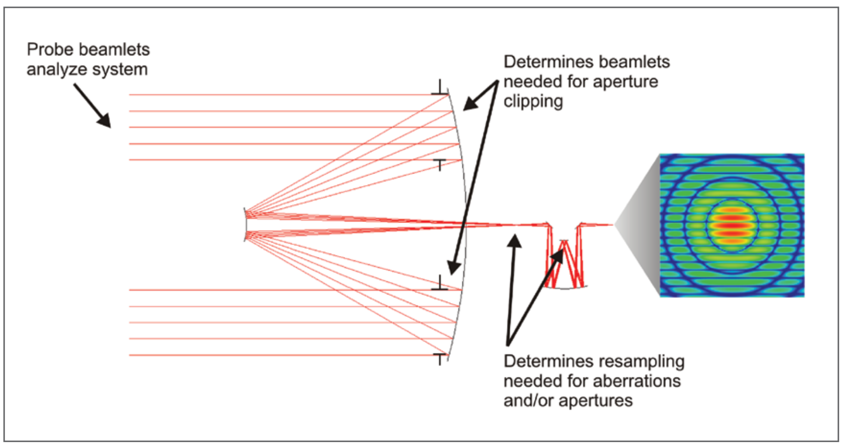

Figure 2: BSP's Pre-Analysis feature recommends analysis parameters that are customized for your lens system

Flexible Input and Output Options

The input optical field can be a plane wave, a uniform spherical wave, or an elliptical Gaussian beam. BSP supports general complex field input, which gives you flexibility to customize the input beam description by providing detailed maps of the beam's intensity and phase. For example, complex optical field data can be imported from external software programs that model waveguides. This feature also allows the definition and propagation of higher-order laser modes.

The output can represent a variety of quantities associated with the field at different surfaces, including amplitude, phase, intensity, and irradiance. The output can be saved in a Macro-PLUS® worksheet buffer, or any of various graphical or tabular formats:

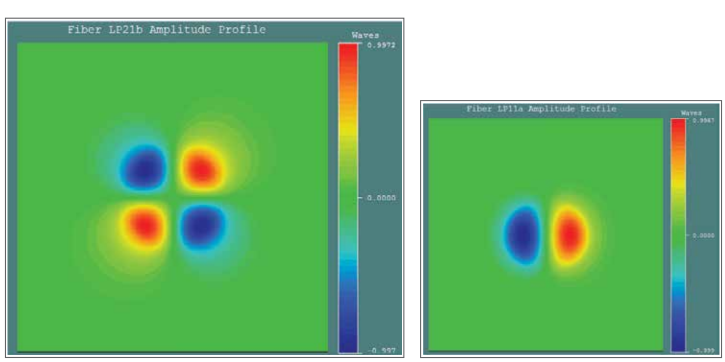

Figure 3: General complex field output

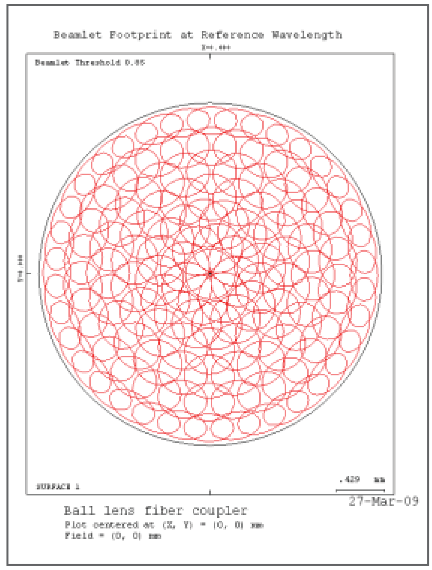

Figure 4: Beamlet footprint plot

- Beamlet footprint plots (shown)
- Cross-sectional slice plots
- Raster plots
- Contour plots
- Oblique projection plots
- Gaussian beam tables

You can save the beamlet set at any location in a lens system and use it as an input for a subsequent run on the next section. This allows analysis on system sections and increases computational efficiency.

Advanced Propagation Controls

For the advanced user, BSP offers a high level of control of the propagation process, thresholds, and parameters. Controls are provided for:

- Polychromatic analysis
- Transmission variation checking
- Clip checking fidelity
- Computational accuracy

Applicability to a Wide Range of Systems

Systems with astigmatic beams, polarized input optical fields, low f-numbers (e.g., microlithography lenses), or non-contiguous pupils are accurately analyzed with BSP. The feature is also useful for near-field diffraction analysis and for optical systems where the amplitude or phase is modified near the focus, such as with a grating, phase plate, or spatial filter. BSP supports multiple wavelengths and polarization.

For more information about CODE V, visit https://www.synopsys.com/optical-solutions.html or send an email to optics@synopsys.com.