

RSoft Product Applications

Complete design solutions for photonic components,
circuits and systems

RSoft Photonic Design Software Applications

Synopsys' RSoft™ products are used to design and simulate optical telecommunication devices and systems, optical components and nano-scale photonic structures. RSoft products offer accurate, advanced features to help you deliver great photonic products to market faster, from fiber optic networks and semiconductor lithography equipment to silicon optical chips and LEDs.

Within the physical layer, the **Photonic Component Design Suite** enables you to design and simulate both passive and active photonic devices for optoelectronic components and subsystems.

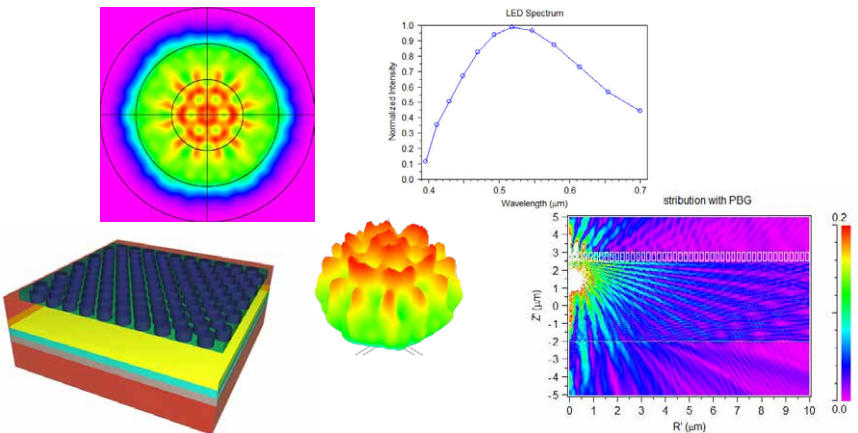
The **Photonic System Design Suite** enables you to design and simulate current and next-generation optical communication systems and photonic integrated circuits (PICs) at the signal propagation level.

The following pages provide examples of RSoft product applications along with key design and analysis capabilities.

PHOTONIC COMPONENT DESIGN SUITE

LED Extraction Analysis

- FullWAVE™ and LED Utility™ tools



The figure displays four simulation results for LED extraction analysis: 1) A top-down view of a circular LED structure with a color-coded intensity distribution. 2) A 3D perspective view of the LED structure showing its layered construction. 3) A line graph titled 'LED Spectrum' showing 'Normalized Intensity' on the y-axis (0.0 to 1.0) versus 'Wavelength (μm)' on the x-axis (0.4 to 0.7), with a peak at approximately 0.55 μm. 4) A 2D plot titled 'distribution with PBG' showing the intensity distribution in the R-Z plane, with 'R (μm)' on the x-axis (0 to 10) and 'Z (μm)' on the y-axis (-5 to 5).

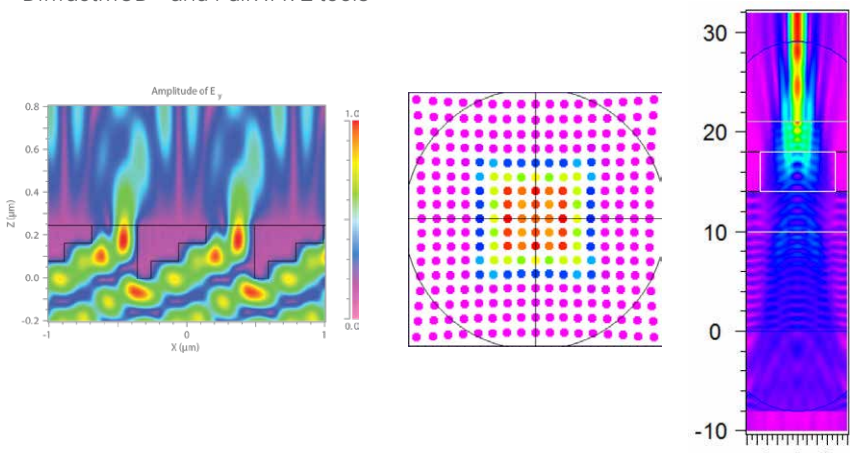
Key Capabilities

- Light extraction from LED/OLED structures
- Flat or textured structures
- Polarized and unpolarized light analysis
- Extraction efficiency optimization
- User-defined radiation spectrum

PHOTONIC COMPONENT DESIGN SUITE

Diffractive Optical Element (DOE) Design

- DiffractMOD™ and FullWAVE tools



The figure displays three simulation results for DOE design: 1) A 2D plot of 'Amplitude of E_y' showing the field distribution in the X-Z plane, with 'X (μm)' on the x-axis (-1 to 1) and 'Z (μm)' on the y-axis (-0.2 to 0.8). 2) A top-down view of a circular DOE structure with a grid of colored dots representing the phase distribution. 3) A vertical cross-section plot showing the field distribution along the Z-axis, with 'Z (μm)' on the y-axis (-10 to 30).

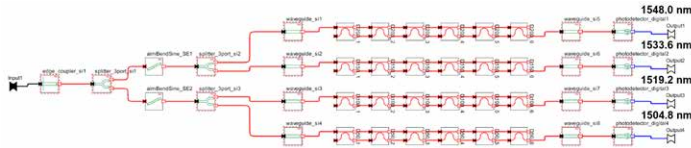
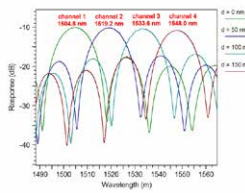
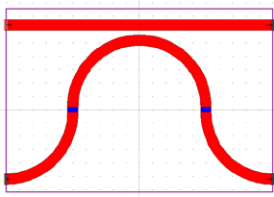
Key Capabilities

- Diffraction of transmitted and reflected light from a DOE
- Diffraction efficiency of each diffraction order
- Field distribution inside the DOE
- Far-field patterns of both transmission and reflection
- Optical spectra vs. wavelength, incident angles
- Polarization dependence
- Automatic polarimetric BSDF file generation for interface with Synopsys' LightTools® and other ray tracing software

PHOTONIC COMPONENT & SYSTEM DESIGN SUITES

Custom PDK/PIC Element Design

- BeamPROP™, FullWAVE and ModePROP™ tools (Component Design)
- OptSim™ Circuit tool (System Design)



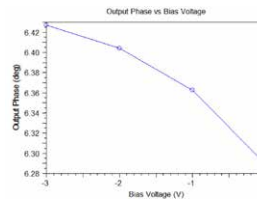
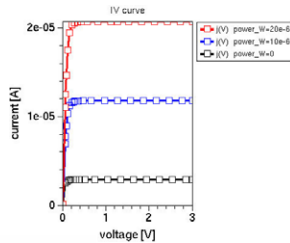
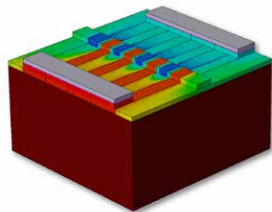
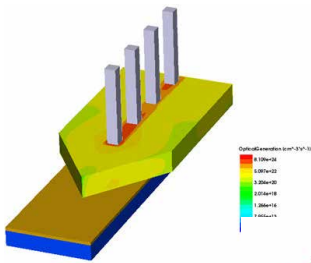
Key Capabilities

- S-Matrix/PDK Generation Utility automates creation of custom PDK models to augment existing PDKs, create new PDKs and generate IP
- Platform-neutral custom PDKs (silicon photonics, InP, SiN)
- Simulate single- and multi-stage PICs with custom PDKs in OptSim Circuit
- Generate netlists for PICs in OptSim Circuit and create GDS II masks in Synopsys Phoenix Software OptoDesigner

PHOTONIC COMPONENT DESIGN SUITE

Optoelectronic Design

- BeamPROP and FullWAVE tools



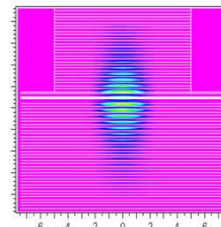
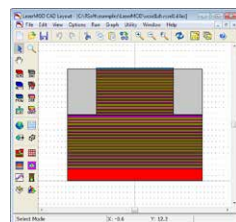
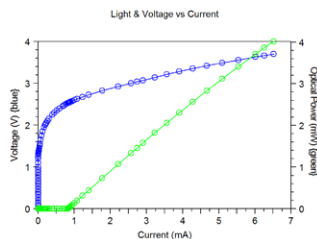
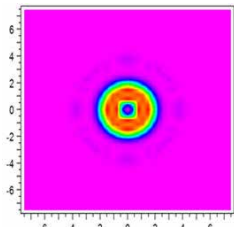
Key Capabilities

- Optoelectronic device performance modeling
- Modulators
- Photo-detectors
- Optical mode calculation
- Optical field propagation
- Optical absorption profile
- IV curves
- Carrier distribution
- Integrated into the Synopsys Sentaurus™ TCAD tools, using shared geometry, materials and native file formats

PHOTONIC COMPONENT DESIGN SUITE

VCSEL Design

- LaserMOD™ tool



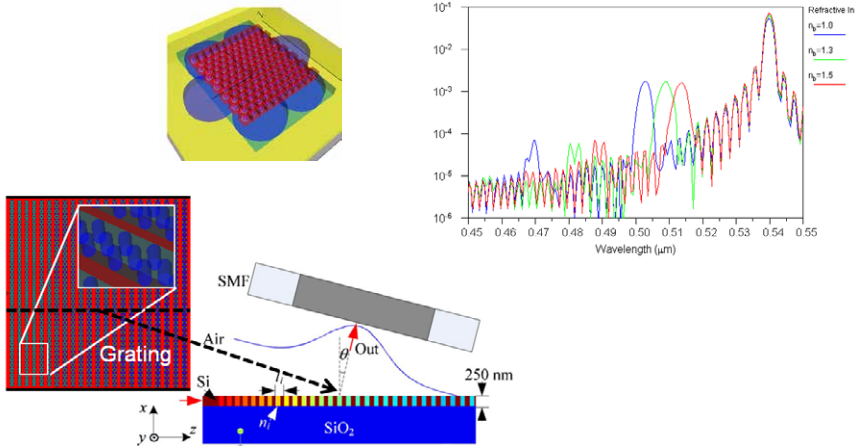
Key Capabilities

- VCSEL performance modeling
- Cavity mode calculation, single mode and multi-mode
- Optical spectrum analysis
- Carrier transport simulation
- Gain spectrum analysis
- Thermal effects
- Self-heating effects
- Spatial hole burning
- L-I-V curve
- Far-field pattern

PHOTONIC COMPONENT DESIGN SUITE

Nano-Photonics and Meta-Materials Design

- FullWAVE tool



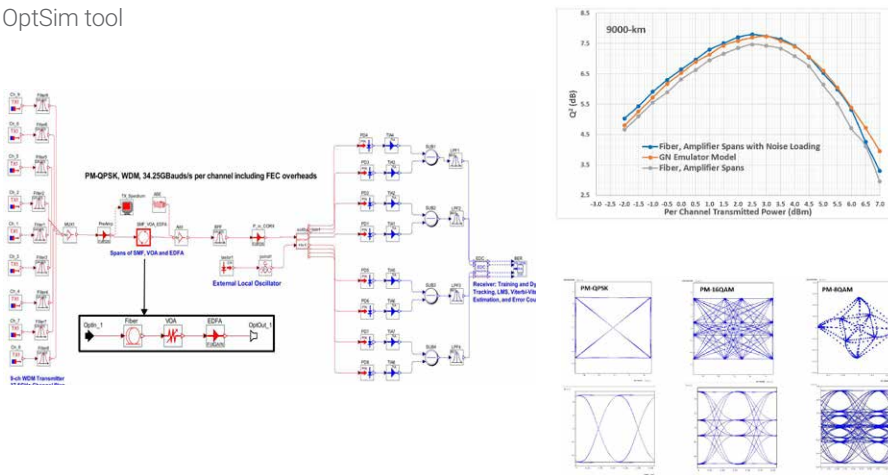
Key Capabilities

- Liquid crystals
- Lithography systems
- Plasmonics
- Photonic crystals
- Material properties of subwavelength structures
- Volume and surface scattering
- Nonlinear phenomena analysis

PHOTONIC SYSTEM DESIGN SUITE

Long-Haul Transmission

- OptSim tool



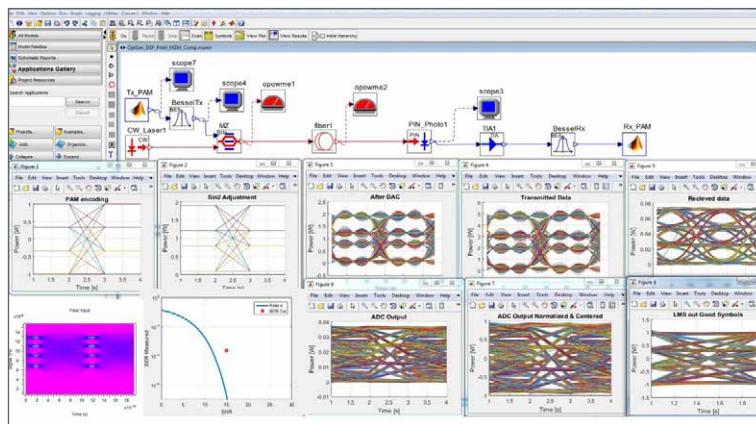
Key Capabilities

- Modeling of spectrally efficient Nyquist WDM superchannel coherent systems
- Advanced modulation formats: PM-BSK, PM-QPSK, PM-mQAM
- Coherent receivers with advanced DSP and MATLAB library of DSP algorithms
- Gaussian Noise emulator model
- Monte Carlo simulations and error counting

PHOTONIC SYSTEM DESIGN SUITE

Data Center Interconnects (DCIs) and On-Board Optics

- OptSim tool

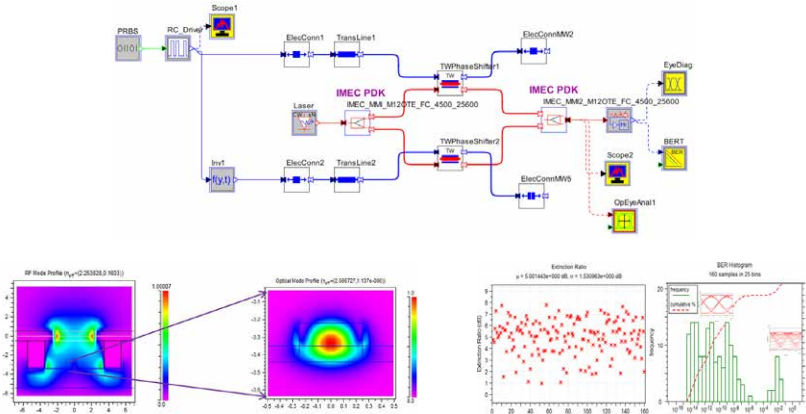


Key Capabilities

- Modeling of 100G, 200G and 400G mPAM and mQAM over single mode fiber (SSMF) for inter-data center metro connectivity
- Advanced digital signal processing (DSP) toolkit
- Bit and symbol rate error (BER, SER) counting and estimation

Photonic Integrated Circuits (PICs)

- OptSim Circuit tool

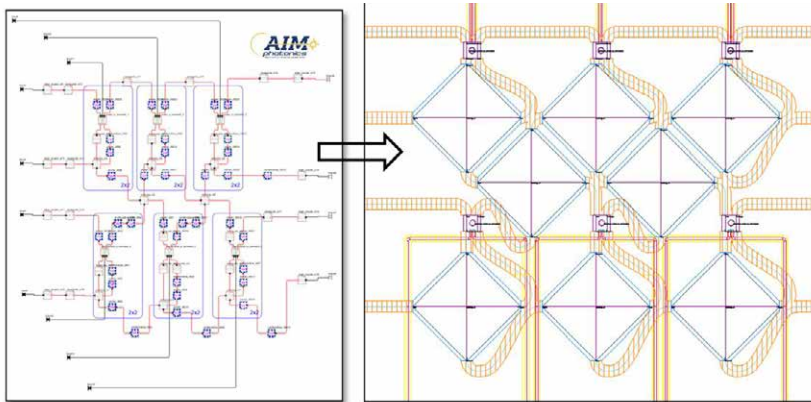


Key Capabilities

- Modeling of Travelling-Wave Mach-Zehnder (TW-MZM) PICs
- Schematic-driven circuit simulation with foundry PDKs
- Design for manufacturing (DFM): Monte Carlo analysis and performance bounds for wafer-to-wafer (WTW) and run-to-run (RTR) foundry process and component variations

Silicon Photonics

- OptSim Circuit tool

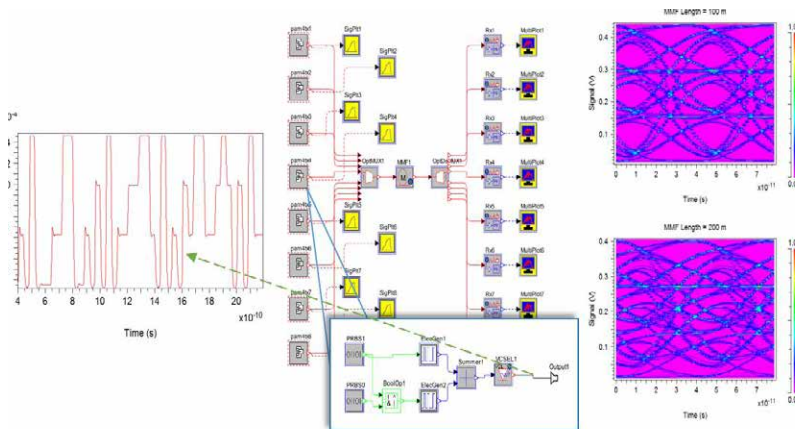


Key Capabilities

- Modeling of silicon photonics high-radix data center switching fabric
- PDK-based, schematic-driven circuit simulations
- Generate netlists for PICs in OptSim Circuit and create GDS II masks in Synopsys Phoenix Software OptoDesigner
- Create and use custom PDK elements with the RSoft Photonic Component Design Suite. See "PIC/Custom PDK Element Design" on page 3

Multimode Fiber Links

- ModeSYS tool



Key Capabilities

- Modeling of inter- and intra-rack DCIs using PAM-4 over Multimode Fiber (MMF)
- Modal dispersion, refractive index perturbations, mode coupling, alignment tolerances
- Interplay of relative intensity noise (RIN), multi-path interference (MPI), jitter and receiver noise
- Impact effective modal bandwidth (EMF), differential mode delay (DMD), encircled flux (EF) and bit error rate (BER)

See More RSoft Application Examples and Case Studies

Many more RSoft application examples and case studies are available at synopsys.com/optical-solutions/rsoft/rsoft-product-applications.html.

Try the RSoft Tools

For more information or to start your free 30-day evaluation, contact Synopsys' Optical Solutions Group at (626) 795-9101, visit synopsys.com/optical-solutions/rsoft or send an email to optics@synopsys.com.