

Photonic Solutions Design Applications

Photonic Device Design and Optimization • Photonic System and Circuit Simulation • Photonic IC Design

Complete Design Solutions for Photonic and PIC Technologies

Synopsys is accelerating the adoption of photonic and PIC technologies with software to design energy efficient, high-performance photonic devices, systems, and integrated circuits. The Photonic Solutions portfolio offers a seamless design flow from concept to manufacturable design, supported by photonics experts. We are dedicated to helping our customers design the next generation of communications, sensing, and imaging solutions.

The **RSoft Photonic Device Tools** provide the industry's widest portfolio of simulators and optimizers for passive and active photonic and optoelectronic devices.

OptSim supports the simulation of single and multimode fiber optic systems and photonic integrated circuits.

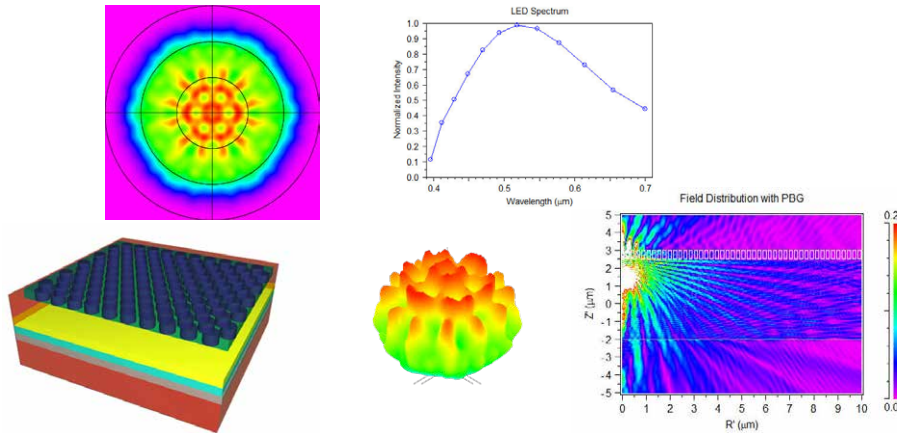
OptoCompiler™ is a unified electronic and photonic design platform that combines mature and dedicated photonic simulation, implementation, and verification technology with Synopsys' industry-proven custom design tools to enable engineers to produce and verify complex photonic IC designs quickly and accurately.

Following are examples of Synopsys Photonic Solutions applications.

PHOTONIC DEVICE DESIGN

LED Extraction Analysis

• RSoft Photonic Device Tools: FullWAVE FDTD and LED Utility



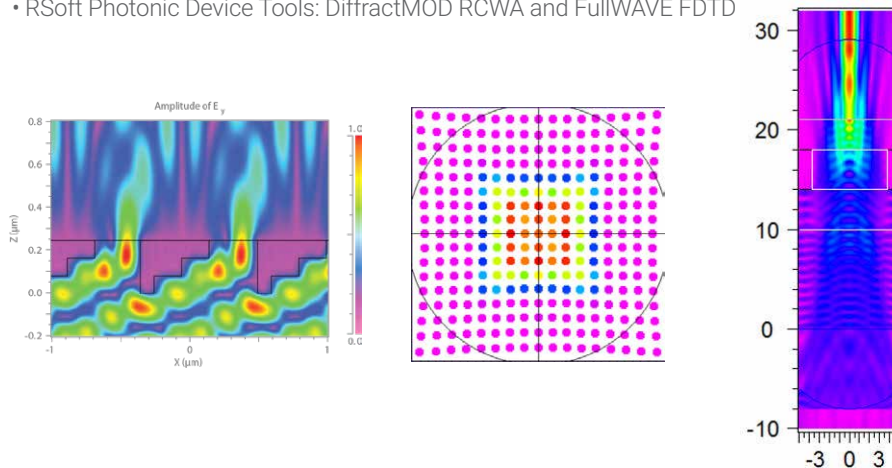
Key Capabilities

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

PHOTONIC DEVICE DESIGN

Diffraction Optical Element (DOE) Design

• RSoft Photonic Device Tools: DiffractMOD RCWA and FullWAVE FDTD



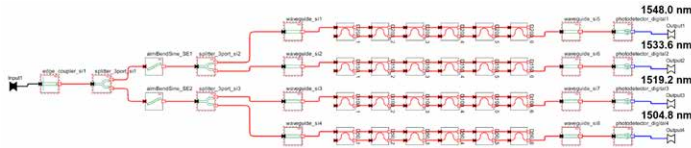
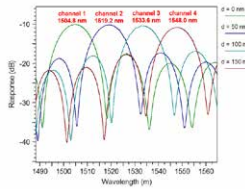
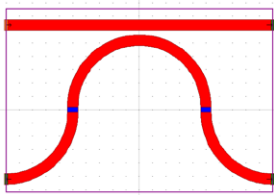
Key Capabilities

- 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 BSDF file generation for interface with Synopsys' LightTools and other ray tracing software

PHOTONIC IC DESIGN

PIC/Custom PDK Element Design

- RSoft Photonic Device Tools: BeamPROP BPM, FullWAVE FDTD
- OptoCompiler



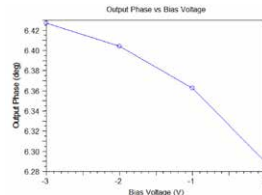
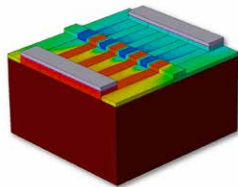
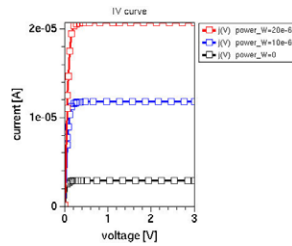
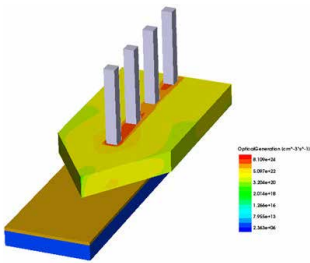
Key Capabilities

- PIC simulation using models to represent individual components in the circuit
- Custom PDK Utility automates creation of custom passive and active components to augment an existing PDK, create a new PDK or for use in IP generation
- Custom PDK model simulation in OptSim; designs can be exported to OptoDesigner for layout

PHOTONIC DEVICE DESIGN

Optoelectronic Component Design

- RSoft Photonic Device Tools: BeamPROP BPM and FullWAVE FDTD



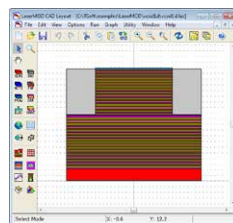
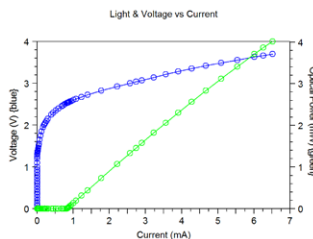
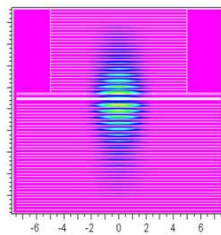
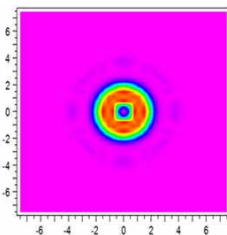
Key Capabilities

- Integrated in Synopsys' Sentaurus TCAD workbench for seamless 3D co-simulation
- Optoelectronic device performance modeling
- Modulators
- Photo-detectors
- Optical mode calculation
- Optical field propagation
- Optical absorption profile
- IV curves
- Carrier distribution
- Frequency Response

PHOTONIC DEVICE DESIGN

VCSEL Design

- RSoft Photonic Device Tools: LaserMOD

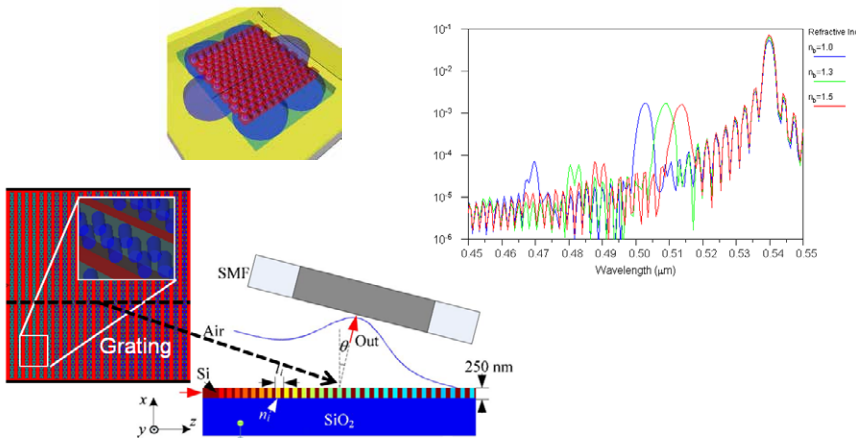


Key Capabilities

- 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

Nano-Photonics and Meta-Materials Design

• RSoft Photonic Device Tools: FullWAVE FDTD

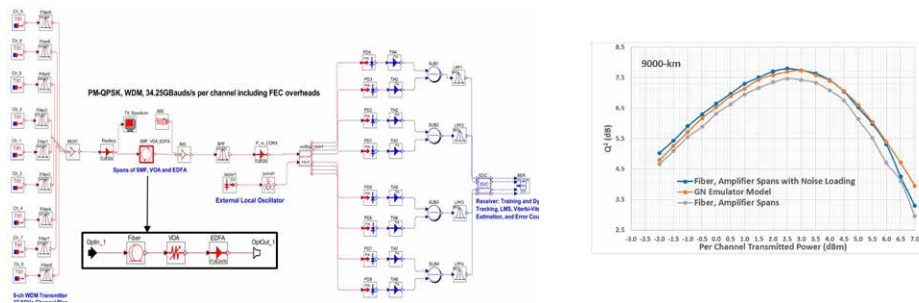


Key Capabilities

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

Long-Haul Transmission

• OptSim

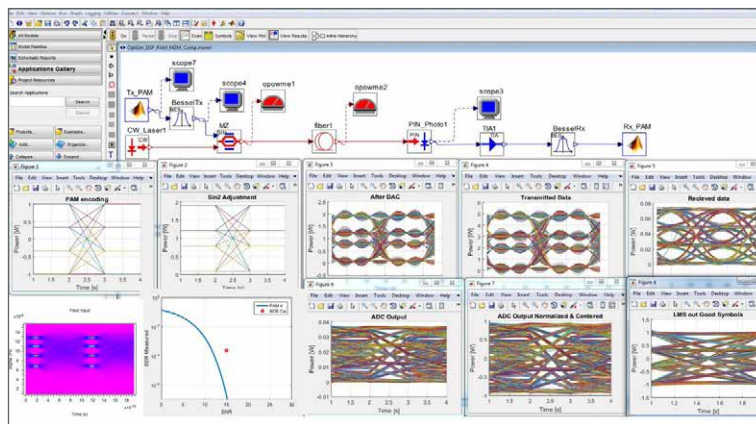


Key Capabilities

- Modeling of spectrally efficient Nyquist WDM superchannel coherent systems
- Terabits per second long-haul transmission
- Simpler fiber-plant
- Advanced modulation formats: PM-BSK, PM-QPSK, PM-mQAM
- Coherent receivers with advanced DSP
- Gaussian Noise emulator model
- Viterbi and Viterbi M-th power carrier phase estimation

Data Center Interconnects

• OptSim



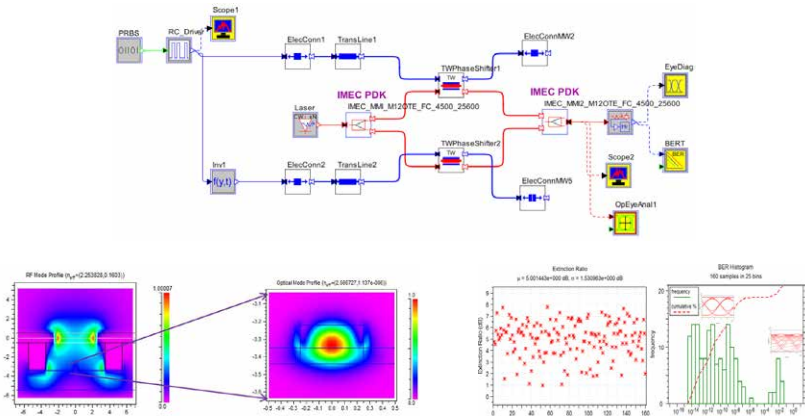
Key Capabilities

- Modeling of 100G and 200G PAM4 over 80 km standard single mode fiber (SSMF) for inter-data center metro connectivity
- Advanced digital signal processing (DSP) toolkit for analog-to-digital and vice versa conversions (ADC, DAC)
- Encoding
- Multistage equalizers
- Bit and symbol rate error (BER, SER) counting and estimation for m-PAM systems

PHOTONIC IC DESIGN

Photonic Integrated Circuits (PICs)

- OptoCompiler



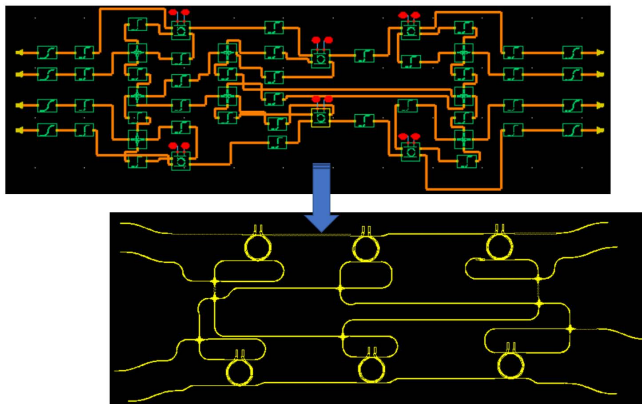
Key Capabilities

- Modeling of Travelling-Wave Mach-Zehnder (TW-MZM) PICs
- Impact analysis of wafer-to-wafer (WTW) and run-to-run (RTR) foundry process variations

PHOTONIC IC DESIGN

Silicon Photonics

- OptoCompiler



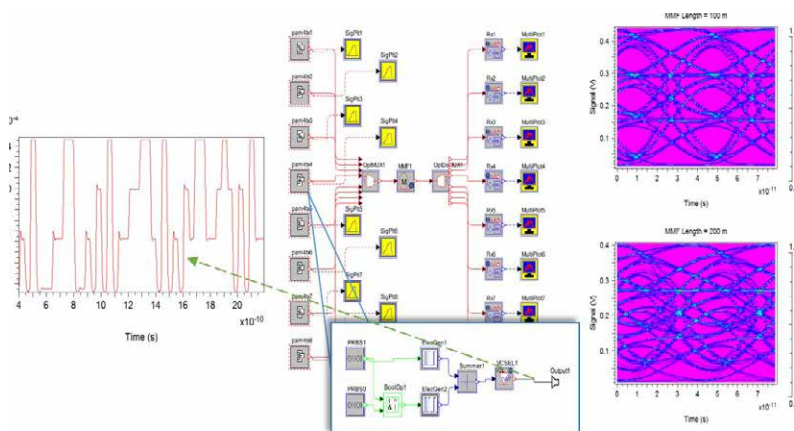
Key Capabilities

- Modeling of silicon photonics for data center switches
- PDK-based, schematic-driven simulations
- Foundry PDK support
- Mask layout generation for PICs

PHOTONIC SYSTEMS AND CIRCUITS

MultiMode Fiber Links

- OptSim



Key Capabilities

- Modeling of inter- and intra-rack Data Center Interconnects (DCI) using PAM-4 over Multimode Fiber (MMF)
- Modal dispersion
- Refractive index perturbations
- Mode coupling
- Alignment tolerances
- Impact effective modal bandwidth (EMF), differential mode delay (DMD), encircled flux (EF) and bit error rate (BER)

Customer Testimonials

"Synopsys has been a great partner in enabling TowerJazz's PH18 - the world's first open foundry silicon photonics process. Their expertise in both silicon photonics design automation and design has helped us put together a truly differentiated design environment that has been successfully used by several of our mutual customers."

EDWARD PREISLER, PH.D. | DIRECTOR OF TECHNOLOGY DEVELOPMENT
AT TOWER SEMICONDUCTOR

"As a design house, we need a complete software framework that supports us in the developments for our customers. Synopsys has the proper tools for modeling and design, circuit simulation and layout that allow us to work in a fast, cohesive and efficient way. We're proud of working with them."

IÑIGO ARTUNDO, PH.D. | CEO OF VLC PHOTONICS

See More Application Examples and Case Studies

Many more Photonic Solutions application examples and case studies are available at [synopsys.com/photonic-solutions/product-applications.html](https://www.synopsys.com/photonic-solutions/product-applications.html).

Try the Photonic Solutions Platform

For more information or to start your free 30-day evaluation, contact Synopsys at +1 (626) 795-9101, visit [synopsys.com/photonic-solutions](https://www.synopsys.com/photonic-solutions) or send an email to photonics@synopsys.com