

Synopsys Optical Simulation Solutions

Everything you need to enable innovation in optical design

Automotive, AR/VR, Mobile Devices, Healthcare, Imaging Lenses, Lighting, Displays

SYNOPSYS®



For more information, please email optics@synopsys.com

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Learn more

Everything You Need to Enable Innovation in Optical Design

Automotive, AR/VR, Mobile Devices, Healthcare, Imaging Lenses, Lighting, Displays



CODE V

Must-Have Lens Design Software

Supports optimization, analysis, tolerance analysis, and manufacturing-related analysis in lens systems.



LightTools

Complete Illumination Design Software

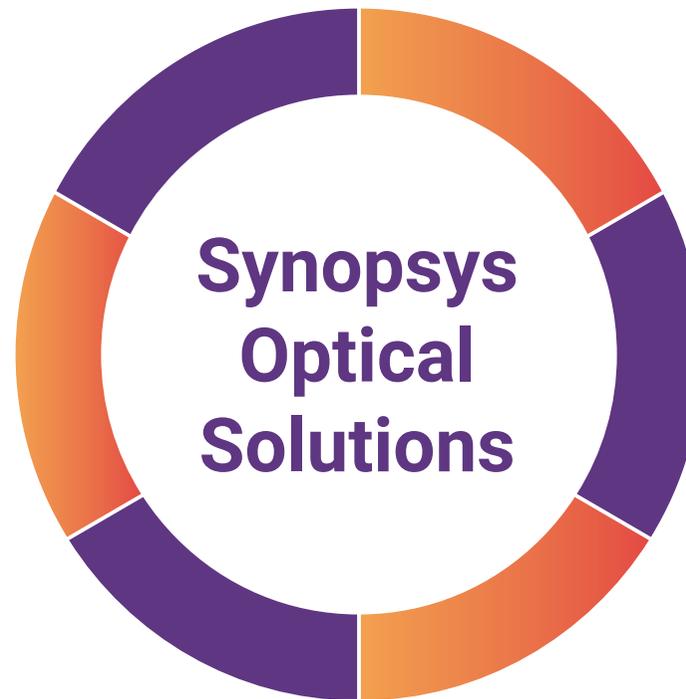
User-friendly tools help you speed illumination design, increase your success rate, and reduce prototyping time.



LucidShape

Optical Design Software Developed Exclusively for Automotive Engineers

LucidShape products help optical engineers explore the future of automotive lighting designs.



RSoft Photonic Device Tools

Empowering Photonic Innovations

Industry's largest portfolio of simulators and optimizers to design nanoscale passive and active photonic and optoelectronic devices.



Optical Engineering Services

Custom Optical Design Consulting Services

Experts from Synopsys provide imaging, lighting, and systems engineering services to help you with your optical design challenges.



Optical Scattering Measurement Equipment and Services

Accurate, Highly Efficient Optical Scattering Data

Equipment to measure optical samples and import customized data into Synopsys optical software tools to enhance your product research and development.

Automotive Optics | P 5-6

Silicon photonics components and systems
P13-14

Imaging lenses P15-16
Displays P17-18



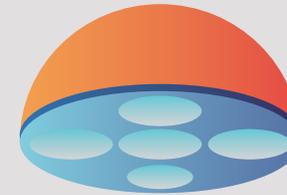
xLED P19
Illumination design P20

Semiconductor lasers P21

Medical & Health Management | P 11

Silicon photonics components and systems
P13-14

Imaging lenses
P15-16



Illumination design
P20

AR/VR/MR | P 7-8

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P13-14



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Mobile Devices | P 9-10

Silicon photonics components and systems
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Imaging lenses P15-16
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xLED P19
Illumination design P20

Semiconductor lasers P21

Silicon photonics components and systems | P 13-14

xLED

| P 19

Imaging lenses | P 15-16

Illumination design

| P 20

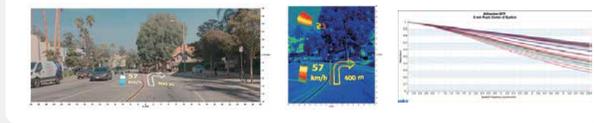
Displays | P 17-18

Semiconductor lasers

| P 21

1 Head-Up Display (HUD) CODE V x LightTools x RSoft

- Import the windshield model into CODE V and design HUD freeform surface
- Utilize LightTools for overall system performance and visualization analysis
- Design diffractive optical elements by RSoft such as reflective gratings



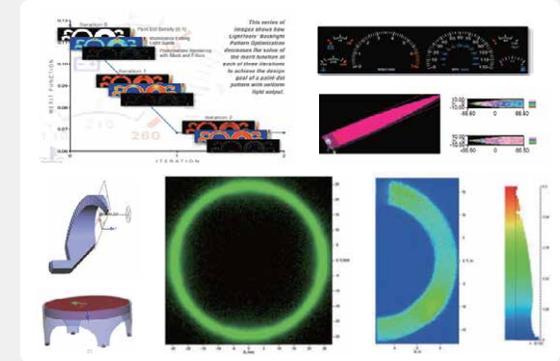
2 Automotive Interior Display LightTools

- Design of mini-LED display
- Design of curved backlight module



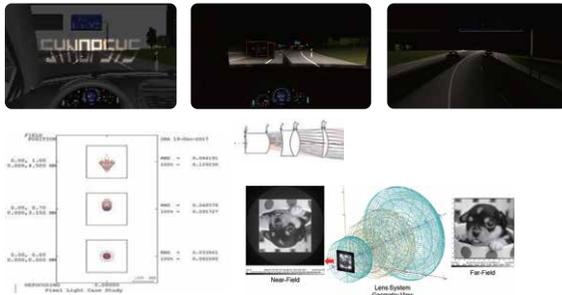
3 Dashboard and light guide design LightTools

- Optimization for dashboard backlight patterns
- Uniformity design for light guide



1 Design of Pixel Headlight CODE V x LucidShape x LucidDrive

- Projection system lens design by CODE V
- Lighting simulation and analysis of the overall system conducted by LucidShape
- Night driving simulation by LucidDrive



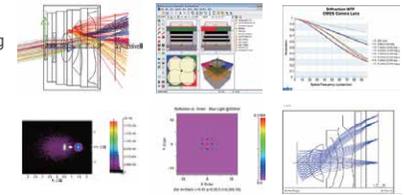
3 LiDAR LightTools x CODE V x RSoft

- Modeling and design of mechanical LiDAR
- Atmosphere interference analysis
- On-chip LiDAR modeling and design
- Signal quality analysis(Synopsys OptSim)



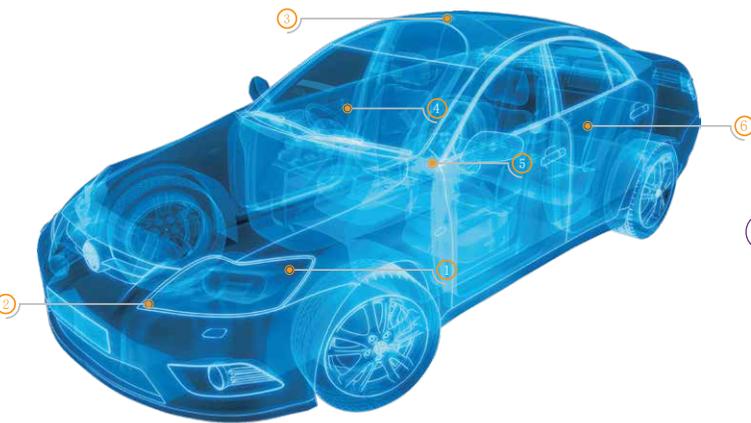
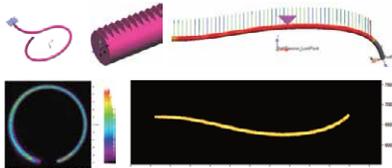
4 Automotive Lens LightTools x RSoft x CODE V

- Lens for dashboard camera
- Lens for auxiliary monitoring
- Night vision auxiliary lens
- Wide-angle lens
- Stray light analysis for lens
- Diffracted stray light simulation of CMOS image sensor



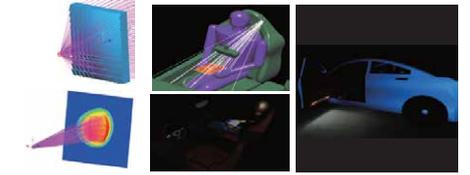
2 Design of Daytime Running Light LightTools / LucidShape CAA

- Support various types of daytime running lights
- Light extractors of light guide
- Uniformity simulation of multi-viewing angle luminance



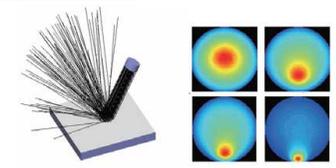
5 Automotive Interior Lighting LightTools

- Reading light
- Puddle light
- Interior light
- Ambient light



6 Surface BSDF Scattering Measurements Synopsys Optical Measurement Equipment

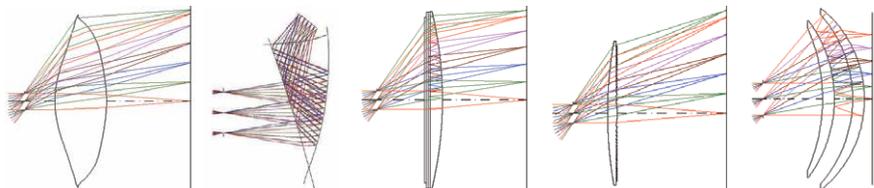
BSDF data can be measured by the equipment and applied in simulation software to improve simulation accuracy



Lens Designs

CODE V

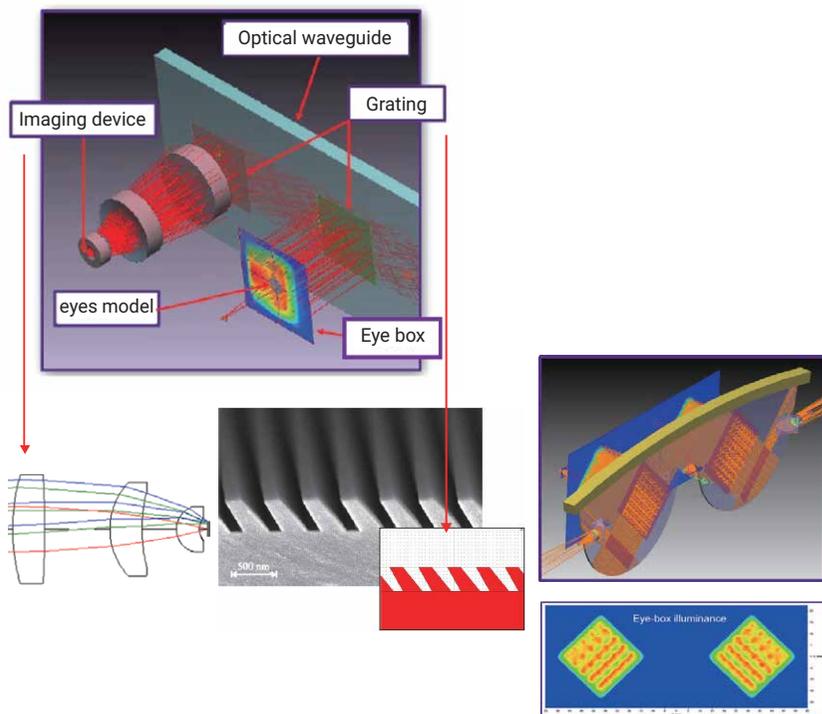
A wide range of lenses including aspheric lenses, Fresnel lenses, freeform lenses, DOEs, and pancake lenses can be designed with CODE V



Waveguide and Diffracted Gratings

LightTools x RSoft x CODE V

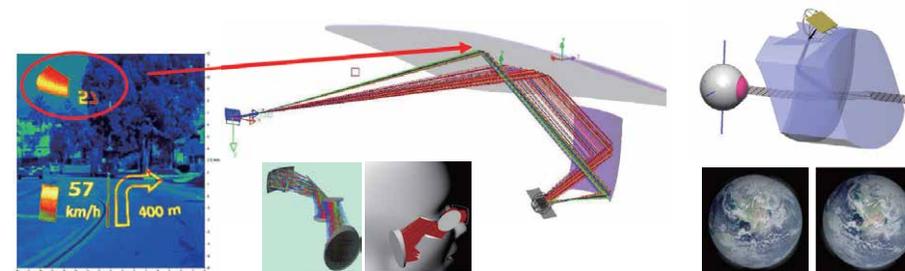
AR design of diffracted grating and waveguide includes CODE V for imaging design and RSoft for gratings design. System analysis can be performed when both results are imported into LightTools. For multi-grating design, the parameters in the RSoft BSDF files can be integrated and optimized in LightTools.



Optical Path Design and Moiré Pattern / Stray Light Analysis

LightTools x CODE V

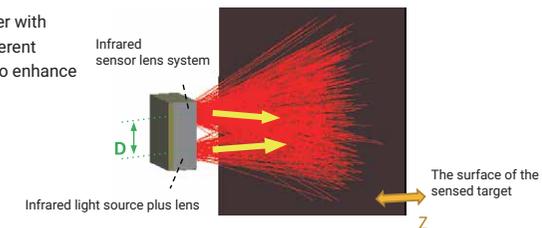
Optical path design and stray light analysis for various types of devices can be performed by CODE V and LightTools



Infrared Distance Sensor

LightTools

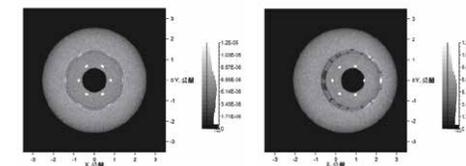
Analyze the detected power with different surfaces and different distances. Design lenses to enhance light collection efficiency



Eye Tracking System

LightTools

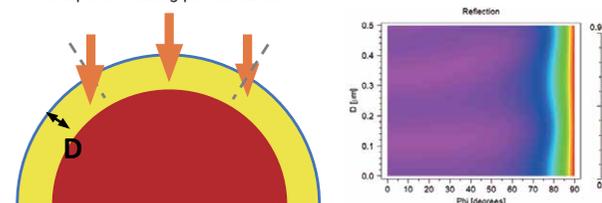
Use LightTools to create and simulate eye tracking system models



Coating Design

LightTools x RSoft

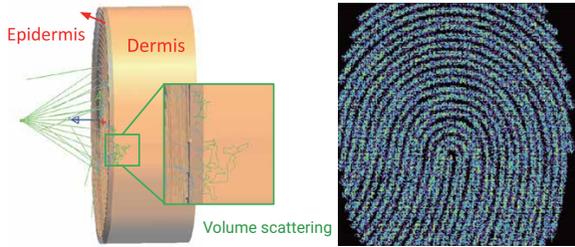
LightTools integrates RSoft BSDF for optimization, fully presenting the influence of surface shape on coating performance



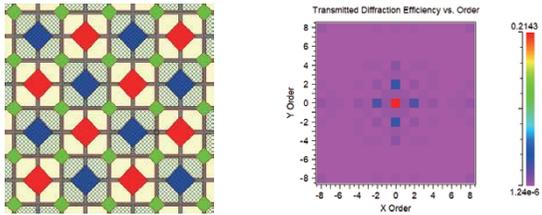
① In-Display Fingerprint

LightTools x RSoft x CODE V

- Biological tissue modeling
- Fingerprint image simulation



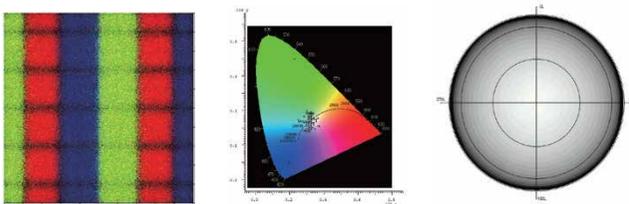
- Diffraction effects by display panels



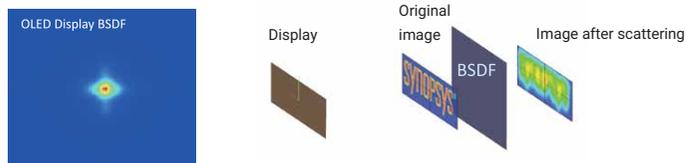
② OLED Panel

LightTools x Volume-scattering measurement

- Color simulations



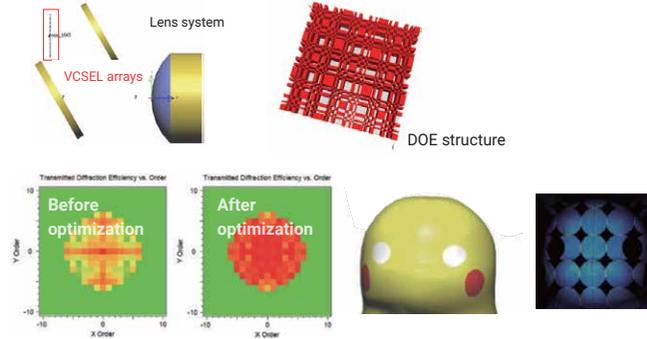
- Scattering measurement and simulation verification of OLED panels



③ Structured Light Sensing

LightTools x RSoft x CODE V

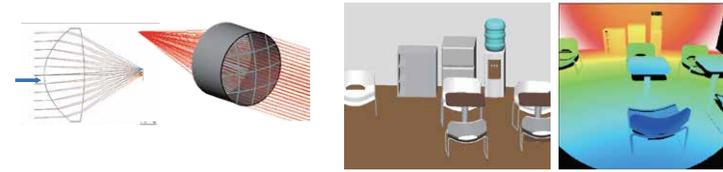
- Diffraction efficiency analysis for DOE



④ LiDAR

LightTools x CODE V

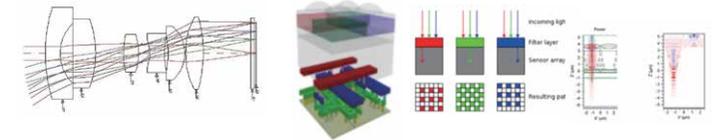
- Transceiver lens design
- Real-scene sensing



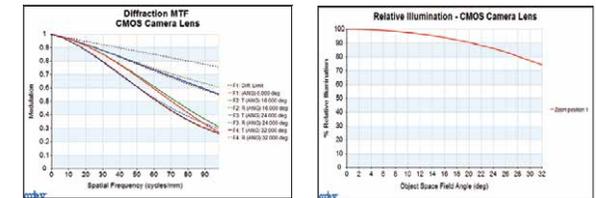
⑤ Cell Phone Lens, Stray Light Analysis, and CIS

LightTools x CODE V x RSoft

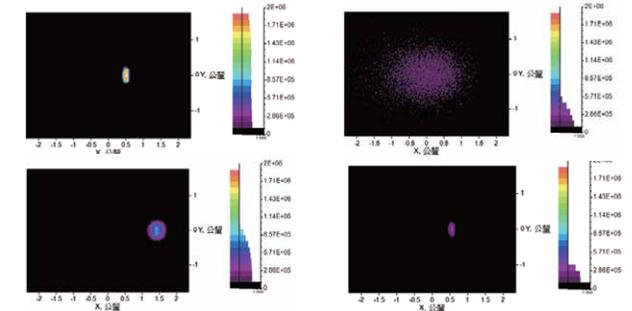
- Lens design
- CMOS image sensor



- Image performance analysis



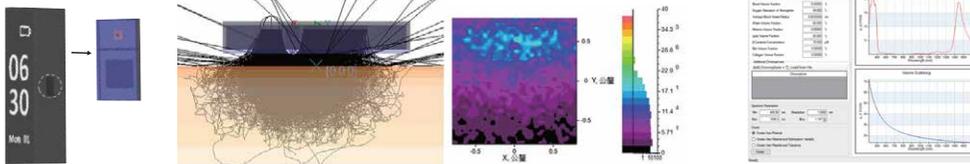
- Stray light analysis



Design of Photoplethysmogram Sensor

LightTools

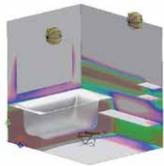
Provide biological tissue database and human tissue utility, which can simulate skin tissue with the Henyey Greenstein scattering model



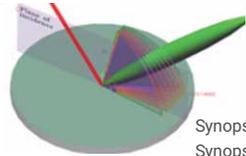
Simulation of UV Sterilization

LightTools

Simulation of UV light distribution in bathroom space



Scattering Measurement of Surface Properties

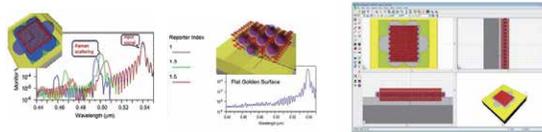


Synopsys Mini-Diff V2
Synopsys Mini-Diff VPRO
Synopsys REFLET 180S

Biological Sensing Chip

RSoft

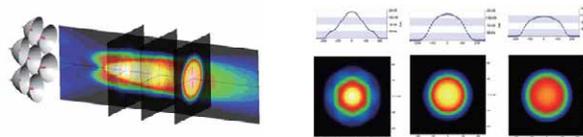
- Analysis of optical properties of biological samples
- Design of biosensing chips
- Analysis of photonic crystal samples



Design Solutions for Surgical Lights

LightTools

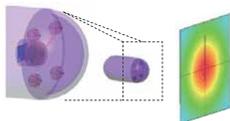
Design reflector cups to abide by the regulation of illuminance distribution



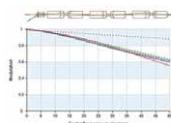
Applications of General Endoscopy and Capsule Endoscopy

LightTools x CODE V x RSoft

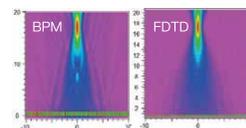
- LED lighting analysis for endoscopes



- Design endoscope lenses and analyze image quality by CODE V



- Design Metalen of endoscopes with RSoft



Design of Inspection Lens

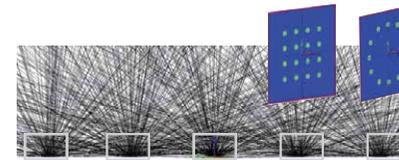
CODE V

Please refer to P15-16 for the lens design

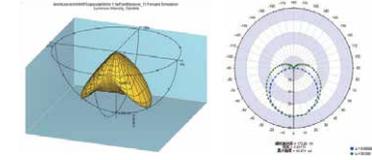
Illumination Design for Inspection System

LightTools

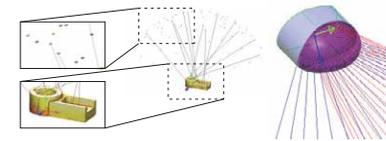
- Design of light source array



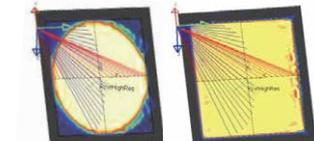
- Intensity distribution analysis of luminaires



- Object inspection



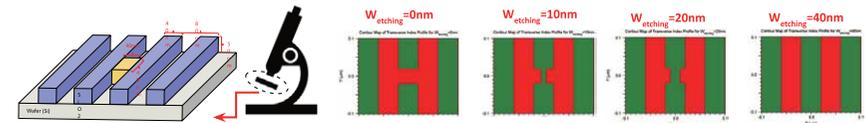
- Design of the special light shaping



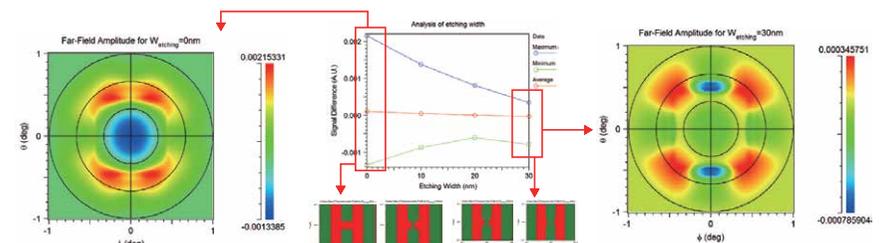
Wafer Defect Simulation

RSoft

- Defect modeling

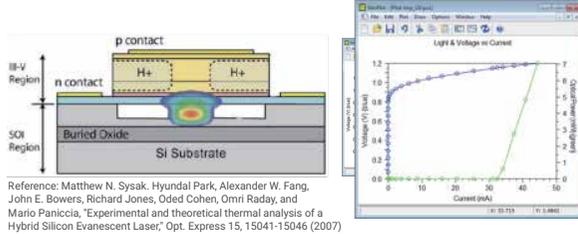


- Analyze simulation results for different defect conditions



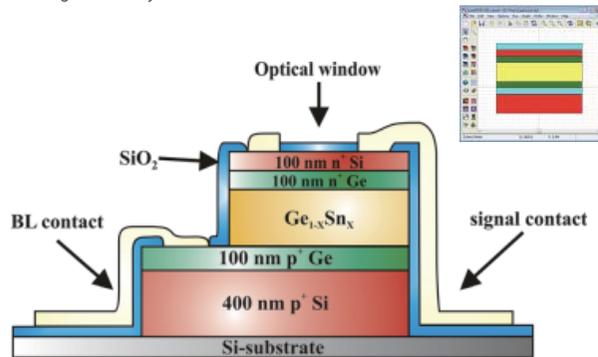
① Analysis and Design of Semiconductor Laser RSoft

- Design of VCSEL, DFB, DBR, and FP laser
- Analysis of Tapered laser



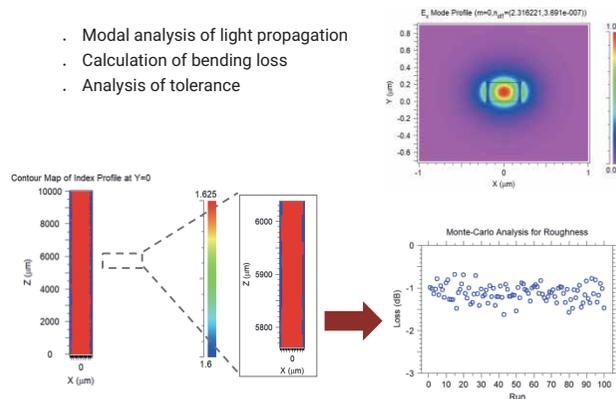
① Analysis and Design of Receiver RSoft

- Design and analysis of APD and PIN structure



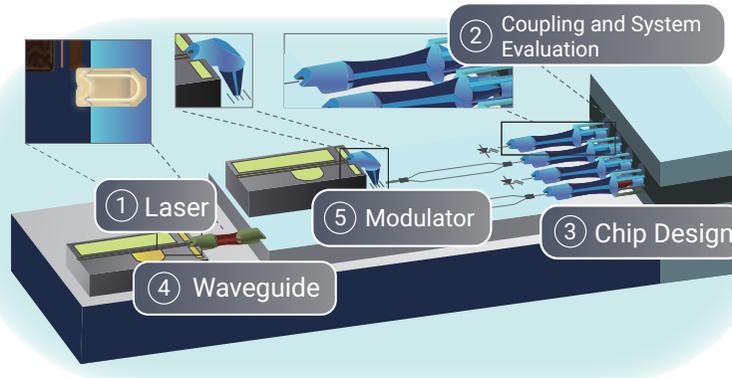
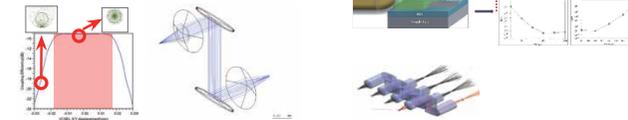
④ Analysis and Design of Waveguide RSoft

- Modal analysis of light propagation
- Calculation of bending loss
- Analysis of tolerance



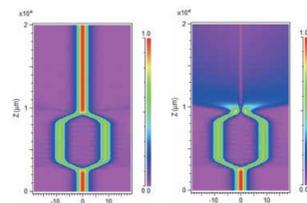
② Design and Optimization of Fiber Coupling LightTools x CODE V x RSoft

- Fiber/Waveguide Coupling
- Coupler design
- Coupling lens design
- Mechanism stray light analysis
- Evaluation of component

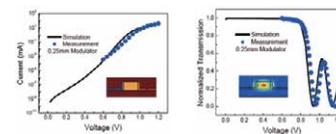


⑤ Analysis and Design of Modulator RSoft

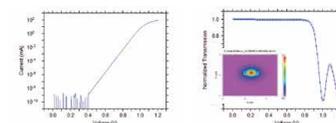
- Electro-optic modulator
- Thermo-optic modulator
- Carrier modulator
- EAM analysis



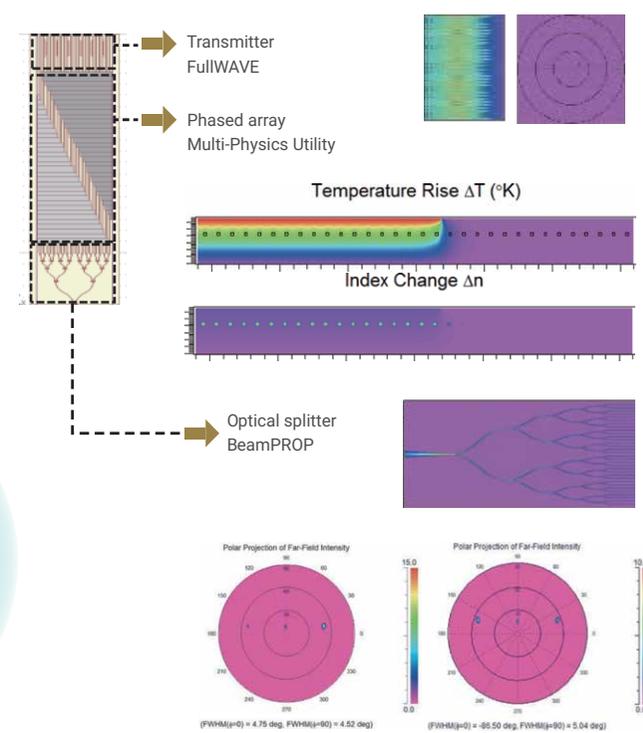
Simulation and experiments of S-Device



RSoft simulation



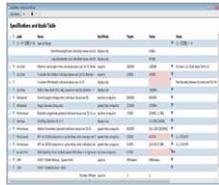
③ LiDAR On-chip RSoft



Domains	Applications	Tools
Active/passive device	Fiber optics, waveguides, and laser modulators	RSoft Photonic DeviceTools
Wafer level simulation	Integrated optics/circuit Communication	PIC Tools -Synopsys OptSim -Synopsys PrimeSim Continuum
System-level simulation	system	Synopsys OptSim
Mechanism analysis	Coupling Lenses Mechanism stray light analysis	CODE V, LightTools
Electrical components	Analysis of electrical characteristics of semiconductor process (EDA)	Sentaurus TCAD

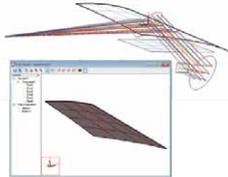
1 Specification Definition and Evaluation CODE V

Designers can quickly build a complete set of project specifications and goals for optical design and monitor them at any time



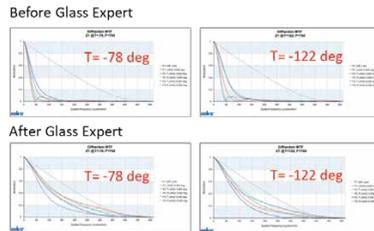
Importing CAD CODE V

Use CAD models directly for display and ray tracing



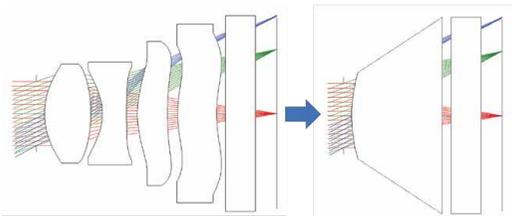
Thermal Analysis and Optimization CODE V

Simultaneously generate and optimize multiple structures with different temperatures and pressure time



8 Powerful Hidden Lens Module CODE V

Hide the parameters of the surface perfectly and deliver the design without revealing its details

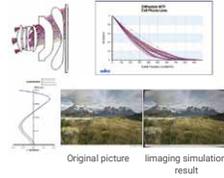


2 Lens Design CODE V x RSoft

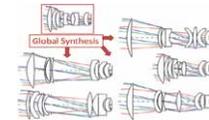
Wide-angle design



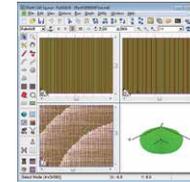
Lens design and optical performance analysis



Powerful global optimization
Get multiple solutions that all meet required constraints, or confirm that the final design is the best one

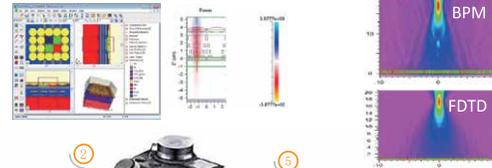


Metals Design and Simulation



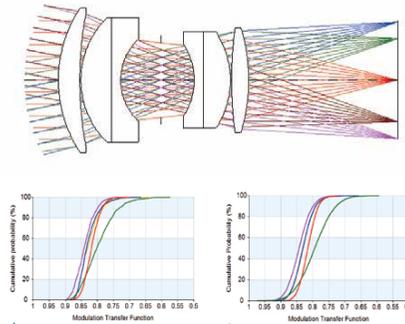
5 Crosstalk Analysis of Detector RSoft

Optical simulation of microlens
Use CODE V output light field as the light source to process crosstalk analysis of detector



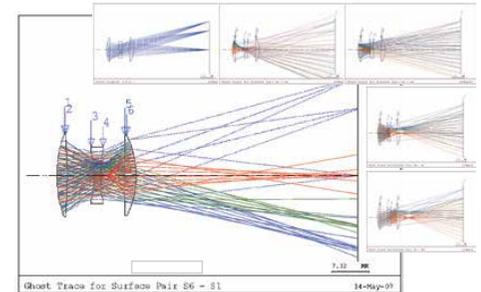
3 Fastest Tolerance Analysis CODE V

Tolerance can be directly applied into the optimization, which can significantly shorten the time of trial production adjustment



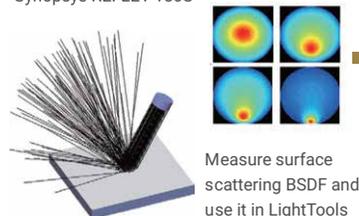
4 Ghost Analysis CODE V

CODE V can simulate ghost images that are caused by total internal reflections

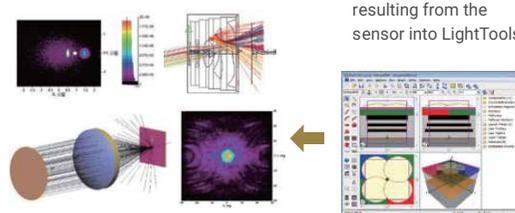


7 Stray Light Analysis LightTools x RSoft

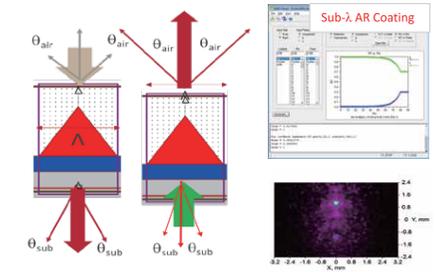
Synopsys Mini-Diff V2
Synopsys Mini-Diff VPRO
Synopsys REFLET 180S



Analyze stray light by integrating reflective scattering/diffraction resulting from the sensor into LightTools

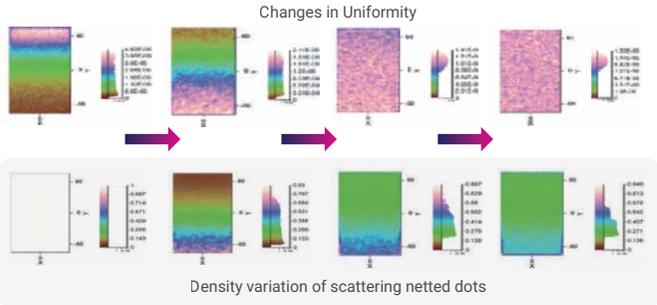


6 Coating Design RSoft

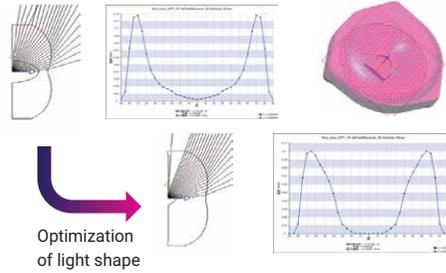


① Backlight/Design of Active Light Source LightTools

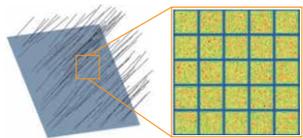
· Optimization of backlight texture of side emitting backlight



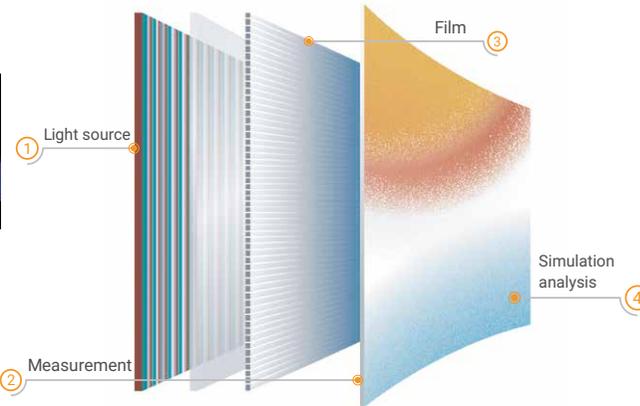
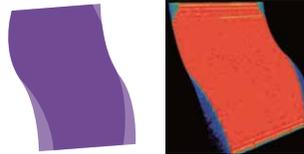
· Optimization of direct-light-type lens



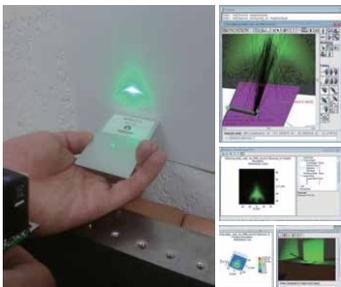
· MicroLED/OLED pixel array



· Design of curved display



② Scattering Simulation LightTools x Scattering measurements



Synopsys Mini-Diff V2
Synopsys Mini-Diff VPRO
Synopsys REFLET 180S

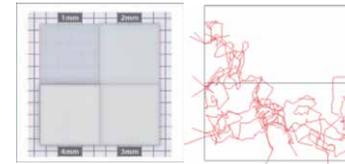
↓
Scattering measurement data is imported into LightTools to perform simulation

② Viewing Angle Measurement Synopsys Mini-Diff V2

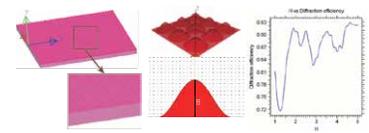


③ Structure of Film LightTools x RSoft x Volume-scattering measurement service

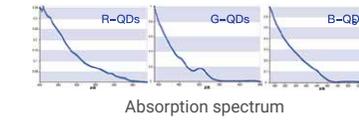
· Volume scattering / Brightness enhancement film



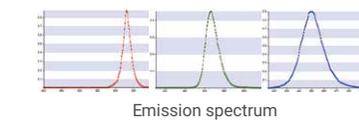
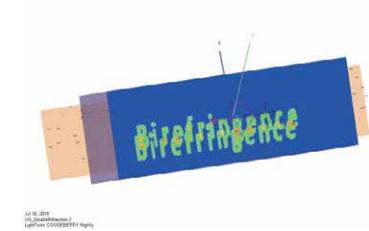
· Microstructure film



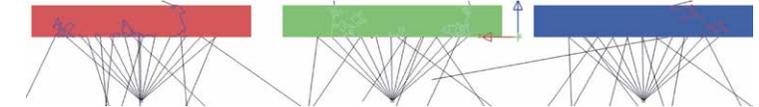
· Simulation of quantum dot and phosphor



· Birefringent materials

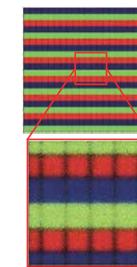


· Color conversion films



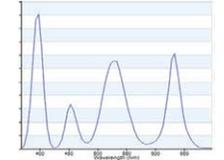
④ Simulation Analysis LightTools

· Color analysis



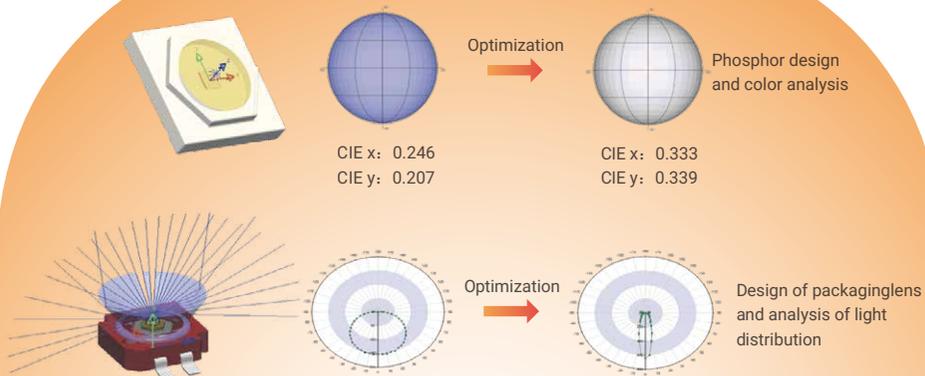
· Multi-point uniformity analysis

測定位置	測定値	規格値	測定位置	測定値	規格値
10.00	7.119	25	10.72	10.27	6.771
10.72	10.27	6.771	11.44	11.44	11.44
11.44	11.44	11.44	12.16	12.16	12.16
12.16	12.16	12.16	12.88	12.88	12.88
12.88	12.88	12.88	13.60	13.60	13.60
13.60	13.60	13.60	14.32	14.32	14.32
14.32	14.32	14.32	15.04	15.04	15.04
15.04	15.04	15.04	15.76	15.76	15.76
15.76	15.76	15.76	16.48	16.48	16.48
16.48	16.48	16.48	17.20	17.20	17.20
17.20	17.20	17.20	17.92	17.92	17.92
17.92	17.92	17.92	18.64	18.64	18.64
18.64	18.64	18.64	19.36	19.36	19.36
19.36	19.36	19.36	20.08	20.08	20.08
20.08	20.08	20.08	20.80	20.80	20.80
20.80	20.80	20.80	21.52	21.52	21.52
21.52	21.52	21.52	22.24	22.24	22.24
22.24	22.24	22.24	22.96	22.96	22.96
22.96	22.96	22.96	23.68	23.68	23.68
23.68	23.68	23.68	24.40	24.40	24.40
24.40	24.40	24.40	25.12	25.12	25.12
25.12	25.12	25.12	25.84	25.84	25.84
25.84	25.84	25.84	26.56	26.56	26.56
26.56	26.56	26.56	27.28	27.28	27.28
27.28	27.28	27.28	28.00	28.00	28.00
28.00	28.00	28.00	28.72	28.72	28.72
28.72	28.72	28.72	29.44	29.44	29.44
29.44	29.44	29.44	30.16	30.16	30.16
30.16	30.16	30.16	30.88	30.88	30.88
30.88	30.88	30.88	31.60	31.60	31.60
31.60	31.60	31.60	32.32	32.32	32.32
32.32	32.32	32.32	33.04	33.04	33.04
33.04	33.04	33.04	33.76	33.76	33.76
33.76	33.76	33.76	34.48	34.48	34.48
34.48	34.48	34.48	35.20	35.20	35.20
35.20	35.20	35.20	35.92	35.92	35.92
35.92	35.92	35.92	36.64	36.64	36.64
36.64	36.64	36.64	37.36	37.36	37.36
37.36	37.36	37.36	38.08	38.08	38.08
38.08	38.08	38.08	38.80	38.80	38.80
38.80	38.80	38.80	39.52	39.52	39.52
39.52	39.52	39.52	40.24	40.24	40.24
40.24	40.24	40.24	40.96	40.96	40.96
40.96	40.96	40.96	41.68	41.68	41.68
41.68	41.68	41.68	42.40	42.40	42.40
42.40	42.40	42.40	43.12	43.12	43.12
43.12	43.12	43.12	43.84	43.84	43.84
43.84	43.84	43.84	44.56	44.56	44.56
44.56	44.56	44.56	45.28	45.28	45.28
45.28	45.28	45.28	46.00	46.00	46.00
46.00	46.00	46.00	46.72	46.72	46.72
46.72	46.72	46.72	47.44	47.44	47.44
47.44	47.44	47.44	48.16	48.16	48.16
48.16	48.16	48.16	48.88	48.88	48.88
48.88	48.88	48.88	49.60	49.60	49.60
49.60	49.60	49.60	50.32	50.32	50.32
50.32	50.32	50.32	51.04	51.04	51.04
51.04	51.04	51.04	51.76	51.76	51.76
51.76	51.76	51.76	52.48	52.48	52.48
52.48	52.48	52.48	53.20	53.20	53.20
53.20	53.20	53.20	53.92	53.92	53.92
53.92	53.92	53.92	54.64	54.64	54.64
54.64	54.64	54.64	55.36	55.36	55.36
55.36	55.36	55.36	56.08	56.08	56.08
56.08	56.08	56.08	56.80	56.80	56.80
56.80	56.80	56.80	57.52	57.52	57.52
57.52	57.52	57.52	58.24	58.24	58.24
58.24	58.24	58.24	58.96	58.96	58.96
58.96	58.96	58.96	59.68	59.68	59.68
59.68	59.68	59.68	60.40	60.40	60.40
60.40	60.40	60.40	61.12	61.12	61.12
61.12	61.12	61.12	61.84	61.84	61.84
61.84	61.84	61.84	62.56	62.56	62.56
62.56	62.56	62.56	63.28	63.28	63.28
63.28	63.28	63.28	64.00	64.00	64.00
64.00	64.00	64.00	64.72	64.72	64.72
64.72	64.72	64.72	65.44	65.44	65.44
65.44	65.44	65.44	66.16	66.16	66.16
66.16	66.16	66.16	66.88	66.88	66.88
66.88	66.88	66.88	67.60	67.60	67.60
67.60	67.60	67.60	68.32	68.32	68.32
68.32	68.32	68.32	69.04	69.04	69.04
69.04	69.04	69.04	69.76	69.76	69.76
69.76	69.76	69.76	70.48	70.48	70.48
70.48	70.48	70.48	71.20	71.20	71.20
71.20	71.20	71.20	71.92	71.92	71.92
71.92	71.92	71.92	72.64	72.64	72.64
72.64	72.64	72.64	73.36	73.36	73.36
73.36	73.36	73.36	74.08	74.08	74.08
74.08	74.08	74.08	74.80	74.80	74.80
74.80	74.80	74.80	75.52	75.52	75.52
75.52	75.52	75.52	76.24	76.24	76.24
76.24	76.24	76.24	76.96	76.96	76.96
76.96	76.96	76.96	77.68	77.68	77.68
77.68	77.68	77.68	78.40	78.40	78.40
78.40	78.40	78.40	79.12	79.12	79.12
79.12	79.12	79.12	79.84	79.84	79.84
79.84	79.84	79.84	80.56	80.56	80.56
80.56	80.56	80.56	81.28	81.28	81.28
81.28	81.28	81.28	82.00	82.00	82.00
82.00	82.00	82.00	82.72	82.72	82.72
82.72	82.72	82.72	83.44	83.44	83.44
83.44	83.44	83.44	84.16	84.16	84.16
84.16	84.16	84.16	84.88	84.88	84.88
84.88	84.88	84.88	85.60	85.60	85.60
85.60	85.60	85.60	86.32	86.32	86.32
86.32	86.32	86.32	87.04	87.04	87.04
87.04	87.04	87.04	87.76	87.76	87.76
87.76	87.76	87.76	88.48	88.48	88.48
88.48	88.48	88.48	89.20	89.20	89.20
89.20	89.20	89.20	89.92	89.92	89.92
89.92	89.92	89.92	90.64	90.64	90.64
90.64	90.64	90.64	91.36	91.36	91.36
91.36	91.36	91.36	92.08	92.08	92.08
92.08	92.08	92.08	92.80	92.80	92.80
92.80	92.80	92.80	93.52	93.52	93.52
93.52	93.52	93.52	94.24	94.24	94.24
94.24	94.24	94.24	94.96	94.96	94.96
94.96	94.96	94.96	95.68	95.68	95.68
95.68	95.68	95.68	96.40	96.40	96.40
96.40	96.40	96.40	97.12	97.12	97.12
97.12	97.12	97.12	97.84	97.84	97.84
97.84	97.84	97.84	98.56	98.56	98.56
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99.28	99.28	99.28	100.00	100.00	100.00

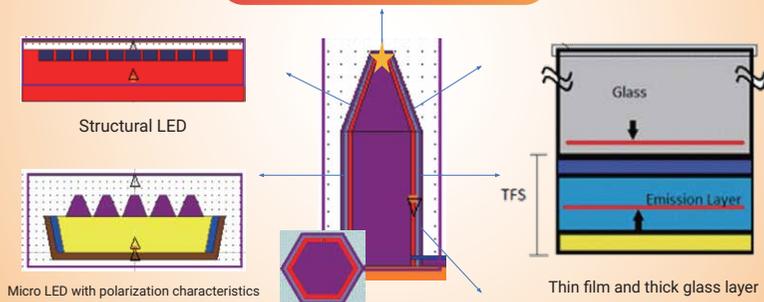


Packaging Design

LightTools

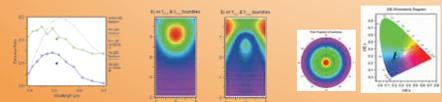


Chip Design



RSoft

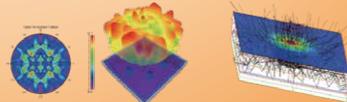
- Improve light extraction efficiency by designing and simulating microstructures
- The characteristics of light source for non-coherent and nonfixed polarization can be calculated with the LED Utility
- Calculate the light extraction profile and rate at the chip-level



Analysis of light extraction efficiency
Near-field distribution in X and Y directions
Photometric and chromaticity diagrams

RSoft x LightTools

- LED Utility calculates the characteristics of luminosity at the chip level and exports light data files into LightTools format
- Import the parameterized BSDF data into LightTools to generate large-scale coating layers to process the optimal design

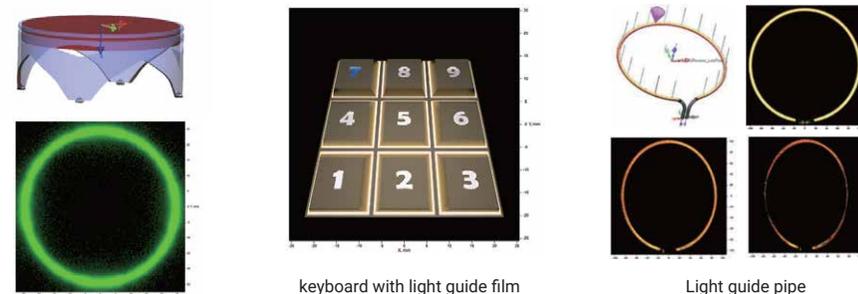


Far-field light distribution
Illumination distribution

Light Guide Systems

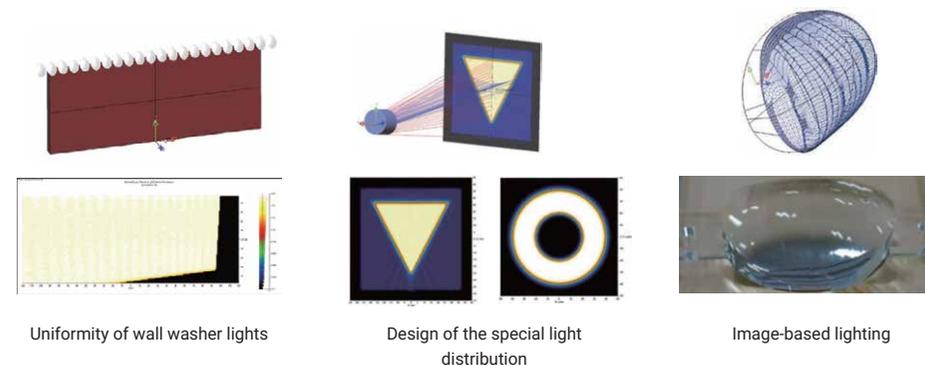
LightTools

Diversified and powerful design capabilities
Support any type of light guide design



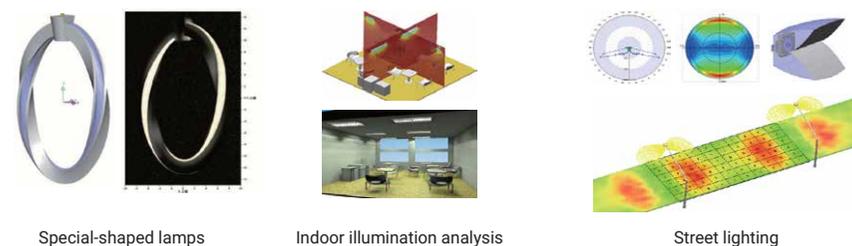
Freeform Lens/Reflector

LightTools



Indoor/Outdoor Lighting Design

LightTools



Semiconductor Lasers and Their Applications RSoft

Semiconductor Photodetector RSoft

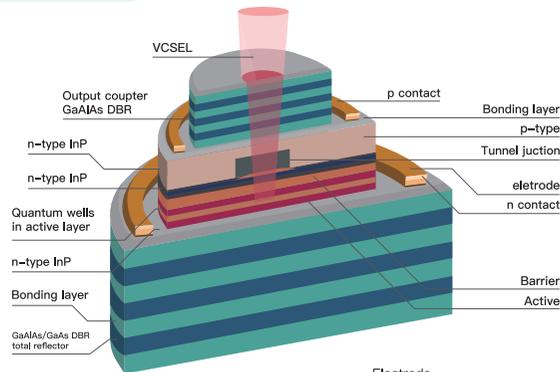
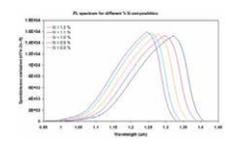
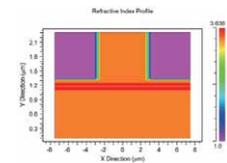
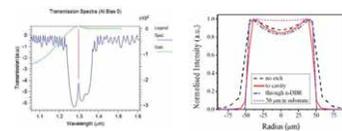
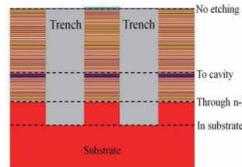
LaserMOD utilizes the fully coupled numerical method to apply the spatial quantification of the component geometry to solve the carrier transport, optical properties, as well as the electronic interactions of the charge carriers

Alloy material parameters and doping concentration

- Ternary and quaternary materials
- Band structure
- Gain
- Refractive index
- Strain compensation

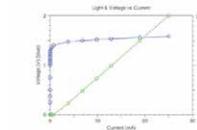
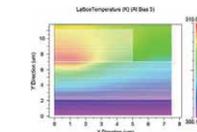
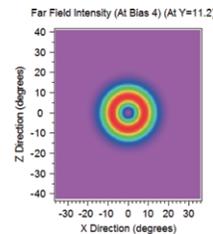
Laser cavity structure design

- Groove depth
- Pore size of oxidation
- MQW design
- DBR design



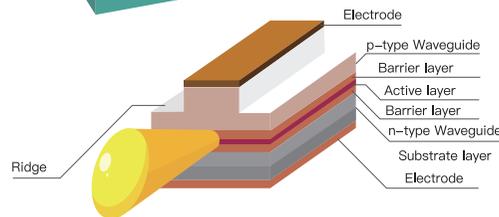
Output characteristics

- L-I-V
- Near and far field
- Temperature distribution
- Dynamic response



Modal calculation

- Iterated Ritz method (IRM)
- Beam propagation method (BPM)
- Finite element method (FEM)
- Transfer matrix method (TMM)

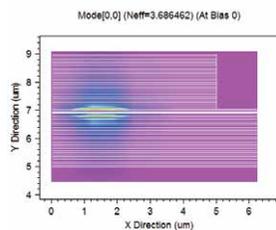
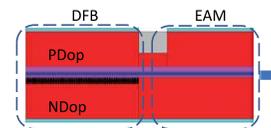
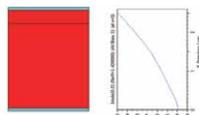


Application types:
Fabry-Perot, VCSEL, DFB

Light sensor

- Photocurrent
- Energy distribution

EML application



Build Better Optical Designs Faster with Synopsys

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The Synopsys Optical Solutions Group provides design tools that model all aspects of light propagation. With intelligent, easy-to-use solutions and an expert support team anchored by optical engineers, Synopsys helps organizations deliver superior optics to market faster.

Our innovative software packages include CODE V® imaging design software, LightTools® illumination design software, the LucidShape® products for automotive lighting, and the RSoft™ Photonic Device Tools for passive and active photonic and optoelectronic devices. We offer optical design services, with more than 5,500 completed projects in imaging, illumination, and optical systems engineering. And our optical measurement solutions give customers access to precision light scattering data for materials and media used in optical systems.

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