

SYNOPSYS®

How does Synopsys enable AR|VR|MR?

EPIC AR/VR Conference

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May 12th, 2023



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AGENDA


- Synopsys Solutions for AR|VR|MR
- AR|VR|MR Challenges, from a SW tool provider standpoint
- How do we bring AR|VR|MR to the next level?

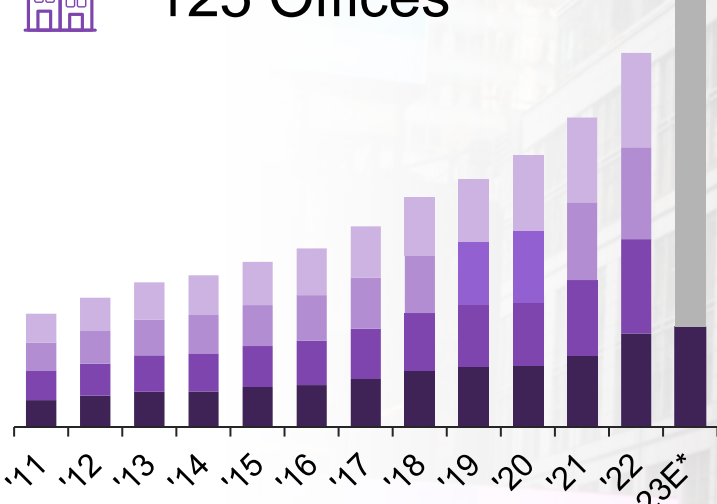
Synopsys – From Silicon To Software

 ~\$5.17B Revenue (TTM)

 19,410 Employees

 3,380 Patents

 125 Offices



'Leader' In Gartner's Magic Quadrant for Application Security Testing

Broadest IP Portfolio and #1 Interface, Foundation & Physical IP

#1 Electronic Design Automation Tools and Services



PROCESS FUNDAMENTALS  Broadest System Design Coverage  DEPLOYED SYSTEM

Dealing with Disruptive AR|VR|MR Systems

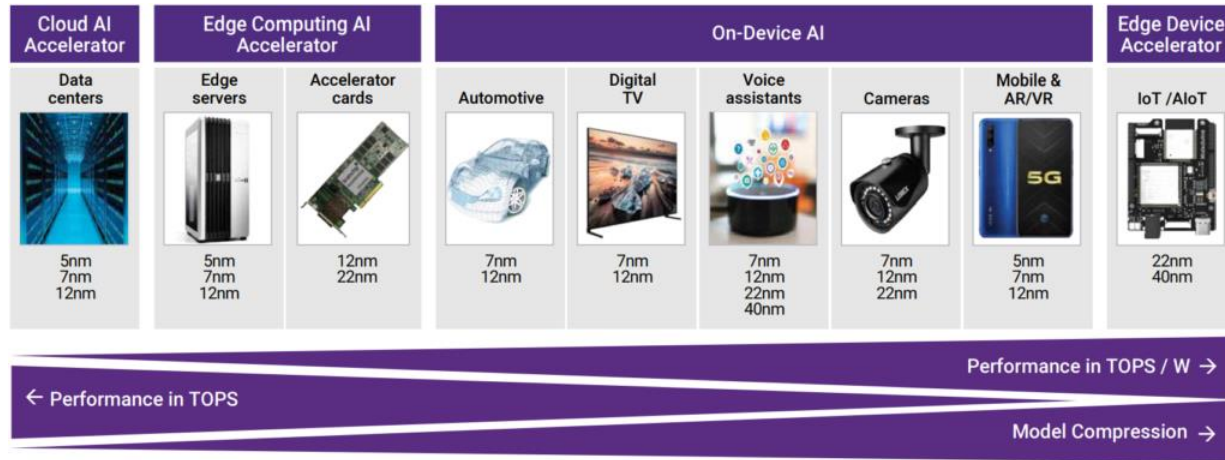
- **For great AR|VR|MR systems, you need:**
 - A great chip, AI enabled
 - A great optics, fully optimized
 - A great microdisplay, providing great images
 - Great cameras, leveraging metalenses

- Let's see why Synopsys is your partner for AR systems comprehensive development



3DIC and AI Specialized SoC IP Solutions for AR|VR|MR

AR|VR|MR chips are embedded and heterogeneous



Specific IP blocks for embedded vision applications

- AI and TOPS/W are critical for embedded systems

→ DesignWare® ARC® EV7x Embedded Vision Processor family combines :

- A high-performance vision engine
- A Deep Neural Network (DNN) accelerator for machine learning and artificial intelligence (AI) edge applications.

[Synopsys' New Embedded Vision Processor IP Delivers Industry-Leading 35 TOPS Performance for Artificial Intelligence SoCs - Sep 16, 2019](#)

Including 3DIC solutions for heterogeneous chips

- Demand for compute remains relentless. To meet these demands, multi-die architectures are emerging as a catalyst in application areas like AI, high-performance computing, and mobile.

→ For AR/VR/MR, this 3DIC portfolio (design and IP) will be particularly useful for CIS and displays

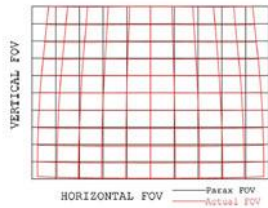
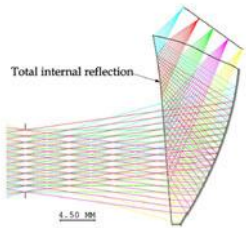
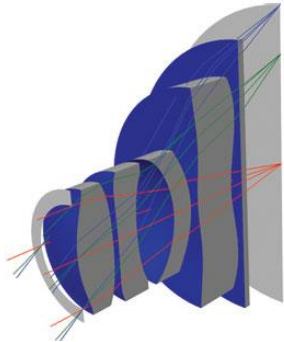
[3DIC Technology Sparks Innovation | SNUG Silicon Valley 2022 \(synopsys.com\)](#)

Optical Solutions with a Focus on AR|VR|MR

IMAGING

With CODE V®

cameras



Freeform prism



Submitted by Dewen Cheng for the 2009 ORA student optical design competition

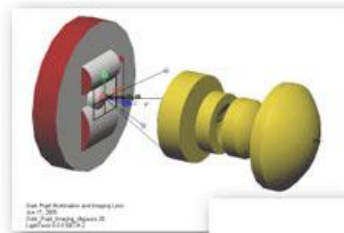
Lens and freeform prism optimization, analysis including image simulation, tolerancing and fabrication support

ILLUMINATION

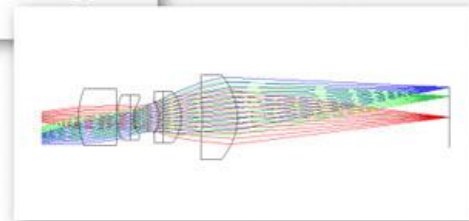
With LightTools®



cameras



Light sources



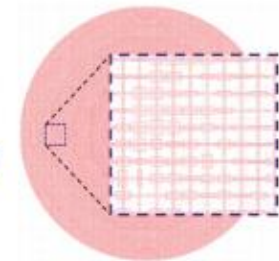
Straylight analysis, light source simulation, optimization, Virtual prototyping, and visualization

PHOTONIC DEVICE

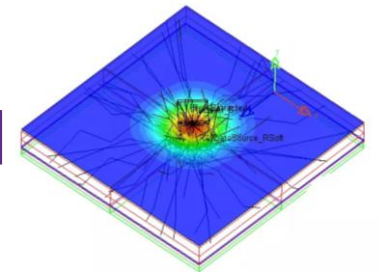
With RSoft Photonic Device Tool®



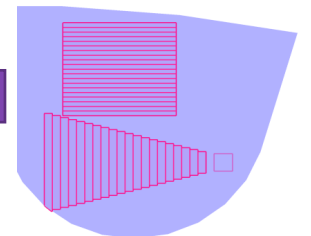
microLED displays



metalenses



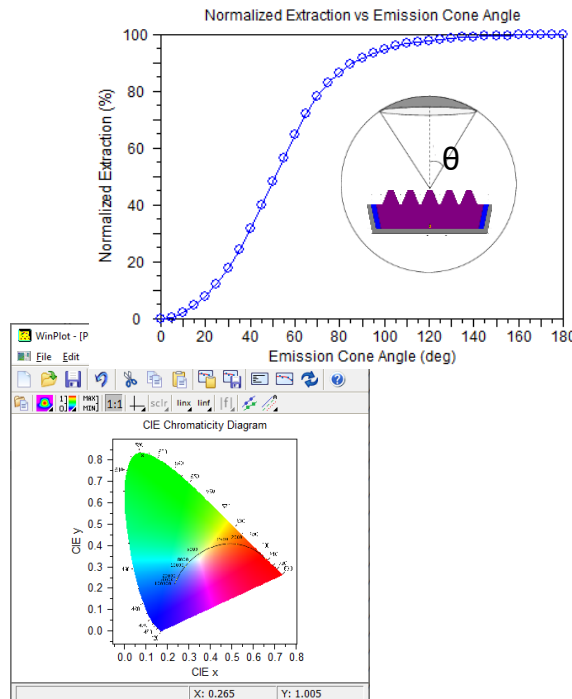
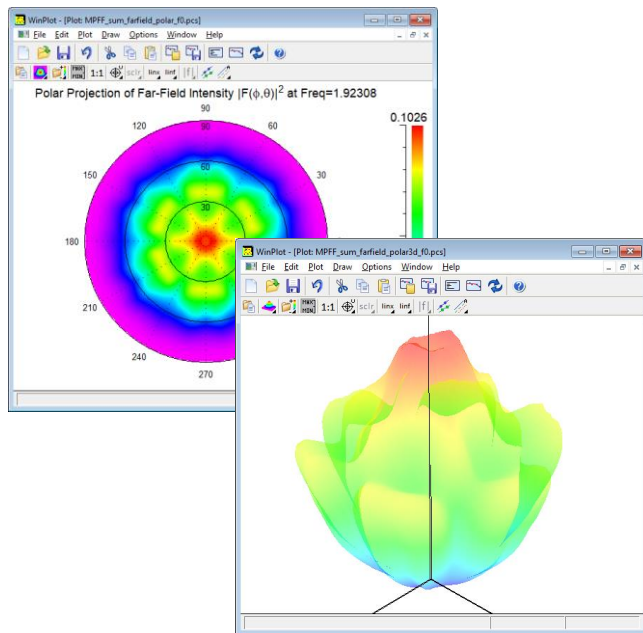
Waveguide combiners



Simulation and design of passive and active photonic devices

A focus on the LED Utility With RSoft Photonic Device Tool®

- LED is an incoherent light source, difficult to simulate
 - Dipoles at different locations polarized randomly and incoherently
- LED Utility is designated tool to calculate its extraction efficiency, chromaticity, far-field, luminance and radiance patterns
 - Based on FullWAVE FDTD with pre- & post-processing
 - Optical simulation only

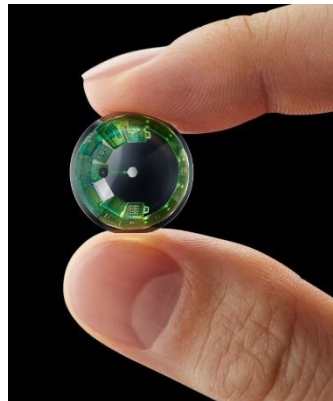
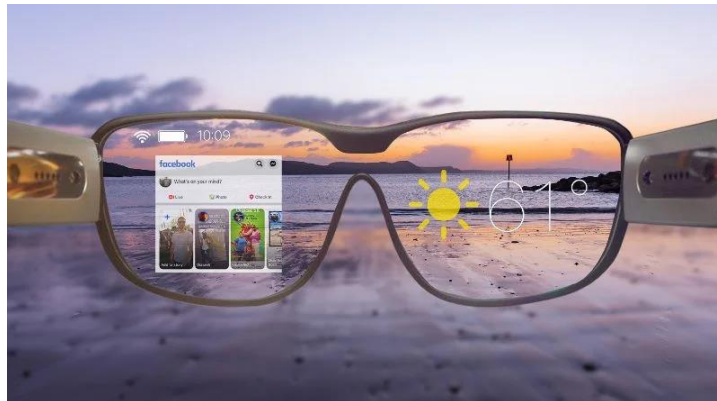
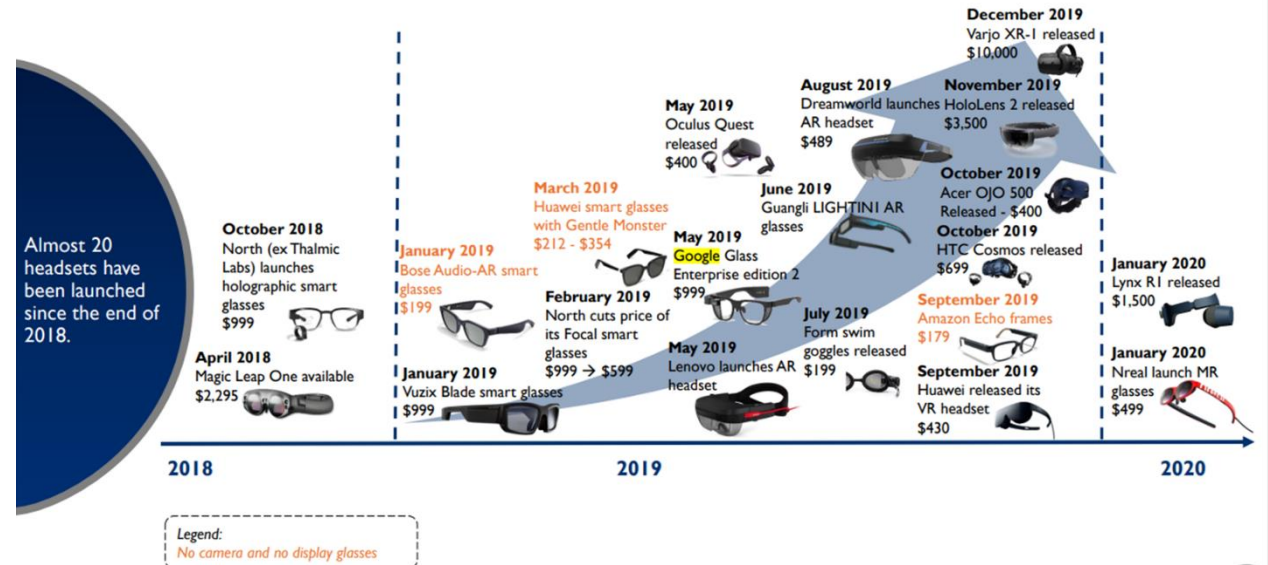


AR|VR|MR

→ An emerging application with cutting-edge challenges and system-level constraints

- AR/VR systems are a **collection of complex components**: displays using microLEDs, HOE/DOE, sensors for head tracking, eye tracking, gesture tracking
- There is still a long way to go despite **extraordinary investments** and many important industry players

WHAT'S NEW – PRODUCT LEVEL



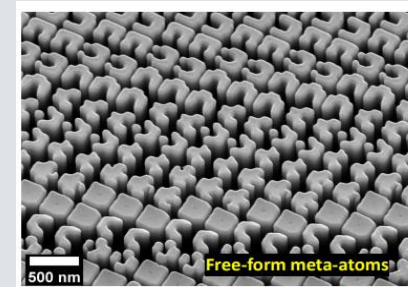
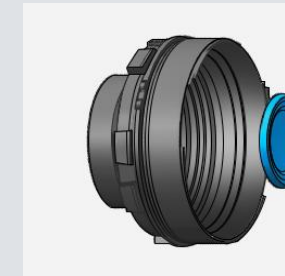
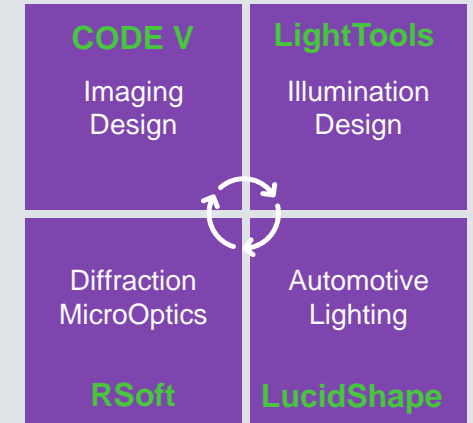
- According to IDTechEx, "Software is nearly there, hardware has many hurdles to overcome."
 - **Optics**: Bottleneck with combiner & compact camera optics
 - **Display**: Issues with resolution & full color
 - **Sensors**: Emerging technologies in eye tracking and time of flight cameras

How do we take AR|VR|MR systems to the next step?

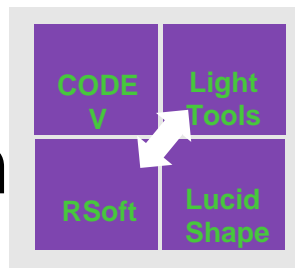
More **interoperability** across the optical design tools for multi-level simulations

More **design to manufacturing** comprehensive simulations

More **system-level** simulations



Design AR|VR|MR Systems Using Multiscale Simulation

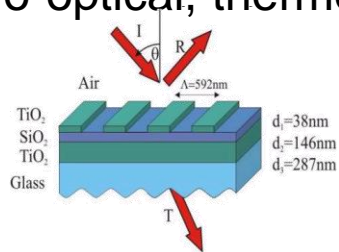


→ Interoperability between RSoft and LightTools



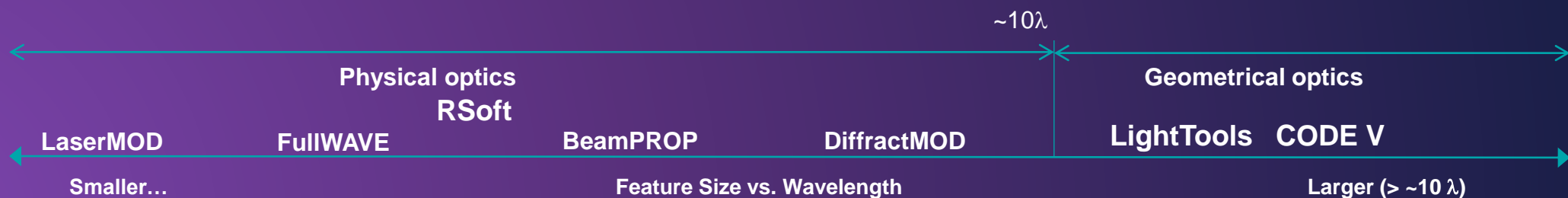
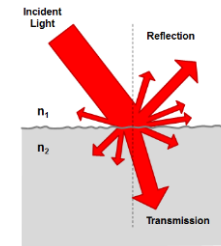
RSoft Component Tools

- Based on physical optics
- Maxwell's equations, etc
- Small photonics devices
- Wave propagation and multi-physics
- Diffraction, polarization, nonlinearity, electro-optical, thermo-optics, etc.



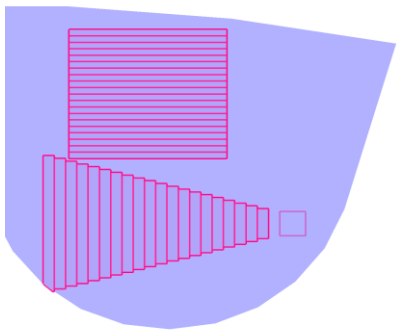
LightTools

- Based on geometrical optics
- Snell's law, etc.
- Large bulk optical system
- Ray tracing and beam propagation
- Reflection, refraction, Ideal diffraction



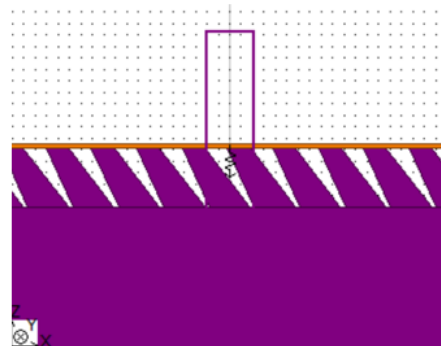
Our Design and Simulation Workflow for Waveguide AR Glasses

1 Specification & Layout



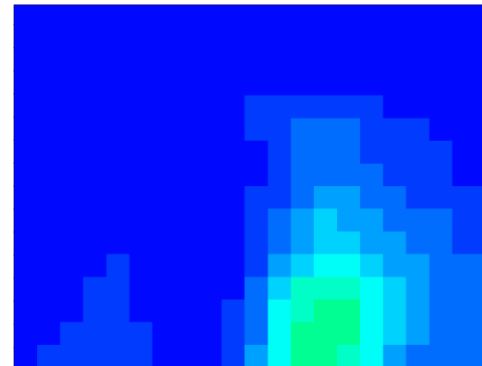
Determine spec. and layout base on the requirements

2 Grating Design



RSoft DiffractMOD/
RSoft FullWAVE
along with MOST
Optimizer

3 System Performance



LightTools simulation
and analysis with
RSoft BSDF

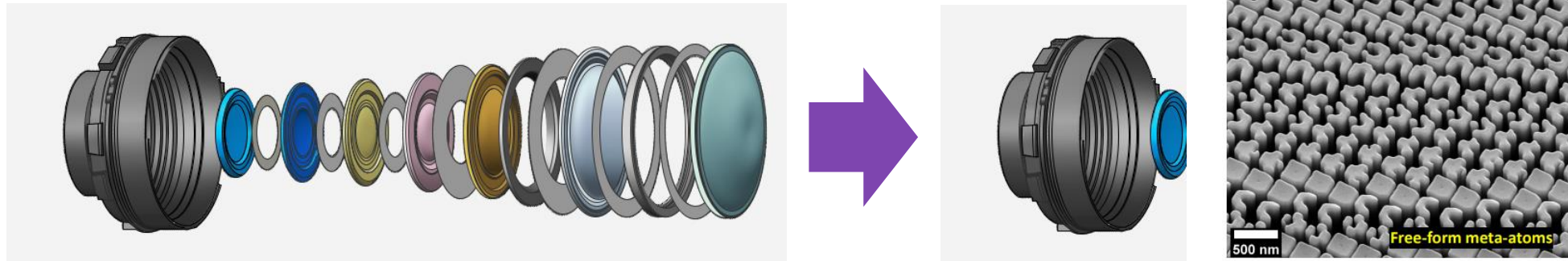
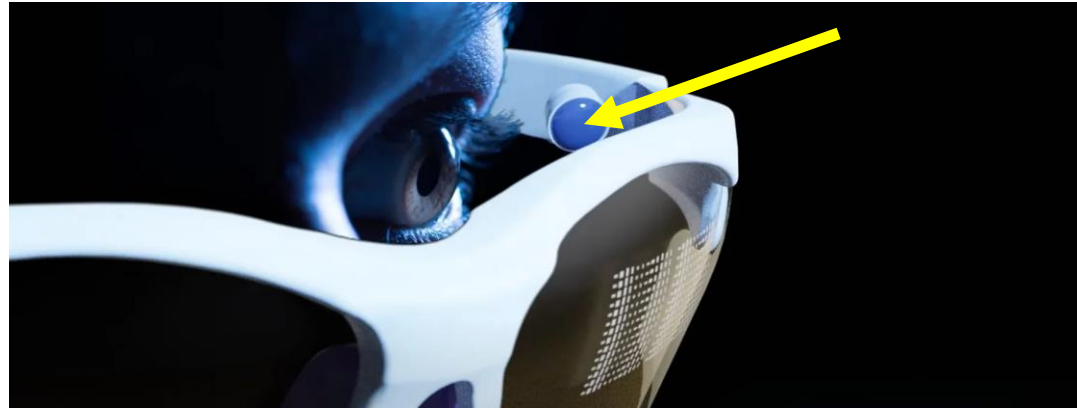
4 System Optimization



LightTools optimize
the parameters
including RSoft BSDF

Efficient Design of Complex Optical Elements: Meta Lens

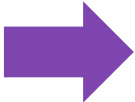
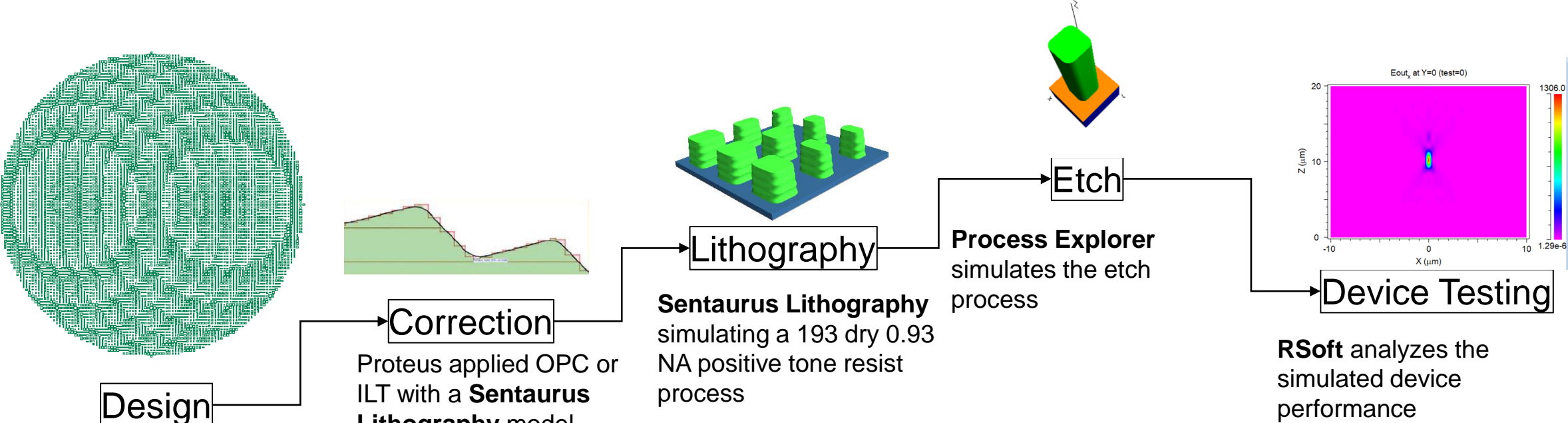
A compact flat lens useful in imaging systems, such as AR goggles



Meta lens – a flat lens made from sub wavelength components that primarily works with phase properties to focus light

Design Through Manufacturing Simulation

Simulation flow quantifies manufacturing impact on device performance



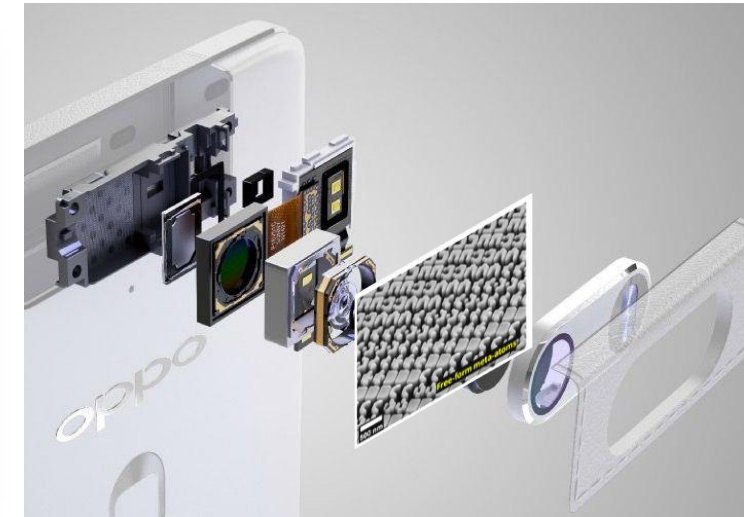
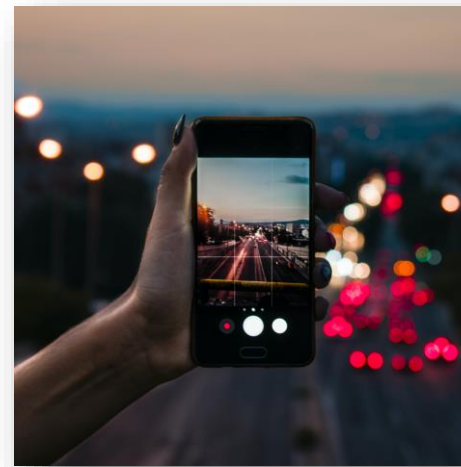
Metalenses are subject to patterning effects such as shape, shifted size, sidewall angle and pillar size

Why Do We Need System-Level Simulations?

The Example of Cameras: what makes a great image?

Analog Photography → Digital Photography

Computational Photography

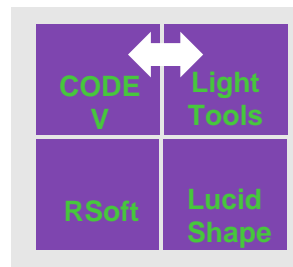


iPhone 3G to 14 Pro MAX



2007

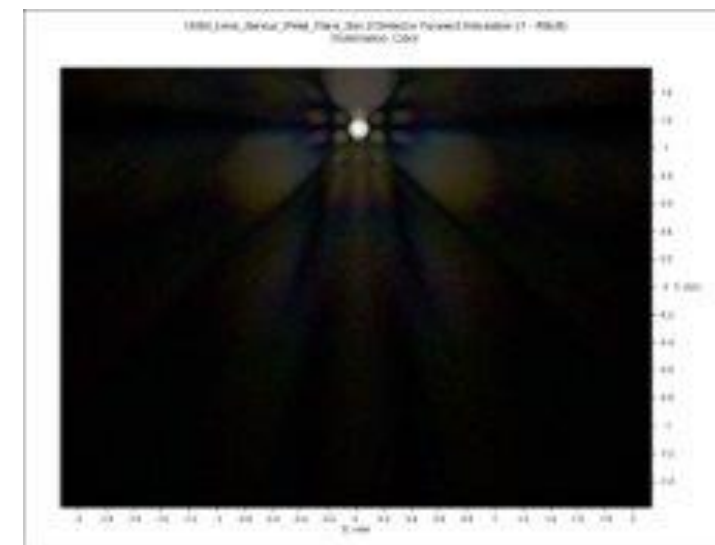
2022



Co-Simulate the Image Quality

→ Setting the interoperability stage for ultra-small and smart cameras

- Image simulation can help us understand optical performance
- Use CODE V
 - Design the lens to meet optical performance requirements
 - Perform a ghost analysis to look for particularly difficult surface pairs
 - Export to LightTools for mount design and flare analysis
- Use LightTools
 - Import the lens file from CODE V
 - Design the lens mount
 - Assign the optical properties to the surfaces of the mount, lens and detector
 - Insert a source
 - Run multiple Monte-Carlo simulations to analyze flare and ghost images
- **Using CODE V IMS analysis can understand image quality**
- **LightTools stray light simulation can check ghost image from lens and flare caused by mechanism and sensor**



Key Takeaways

- **AR|VR|MR needs a paradigm shift**
 - In designing the components/systems
 - Through more Collaborative Simulation Flows
 - Which enable cross-design and cross-optimization
- **Synopsys has the most comprehensive portfolio to design, optimize and test from end-to-end AR|VR|MR systems**
 - 3DIC and AI specialized IP for advanced embedded chips
 - Our optical platform for multi-scale simulations
 - Leverage simulations to accelerate time to market and increase yields
 - Beyond optics, go at the system-level with more visualization



Thank You

Questions ... ?

