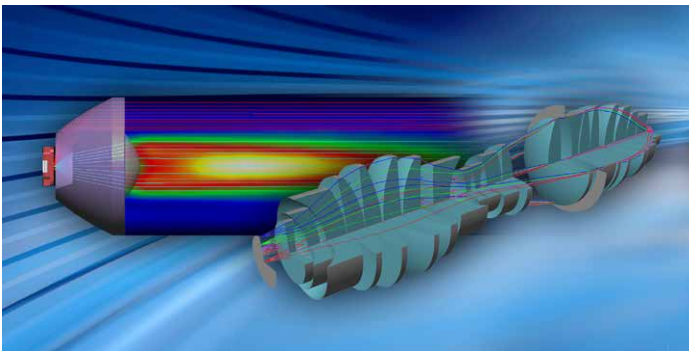


Optical Design and Engineering Services

Expert, Cost-Effective Solutions from Concept to Completion

Overview

Next-generation head-mounted display designed and patented by our engineers



Synopsys' Optical Solutions Group, formerly Optical Research Associates (ORA®), is a leader in the optics industry as an independent supplier of optical systems design services, with more than 4,800 completed projects in imaging, illumination and optical systems engineering since ORA was founded in 1963. The group is also one of the world's leading developers of optical design and analysis tools, with CODE V® imaging design software, LightTools® illumination design software, LucidShape® products for automotive lighting design, and RSoft™ products for photonic and optical communication design.

Our optical design team provides expert, imaginative and cost-effective solutions across the entire spectrum of optics. This includes emerging and maturing technologies for government, commercial and consumer products, including breakthrough designs for compact disk player optics, LED taillights, holographic heads-up displays and precision illumination systems. We are knowledgeable of and compliant with ITAR regulations.

Our team has won many awards in the field of optical design, such as the prestigious NASA Public Service Group Achievement Award in recognition of our engineering contributions to space exploration missions. Members of our team have been awarded 132 patents in the field of optical design.

We Protect Your Confidentiality and Intellectual Property

We will execute non-disclosure agreements and you retain all rights to any designs developed under your contract. This can give you a significant competitive advantage.

We Work as Integral Team Players in Your Development Process

We can tailor design services to work seamlessly with your organization. Our optical design experience can augment your own group's expertise or act as an extension to your in-house optical design team. In either case, we are adept at working effectively over a wide range of operational scenarios.

A Motivated Team of Optical Design and Analysis Experts Poised to Work with You

Visit our web site, <https://www.synopsys.com/optical-solutions.html>, to learn more about the breadth and depth of our experience, including technical publications, patents and resumes.

Our Range of Services

Imaging Design

- Develop systems that optically transfer images to a wide variety of detectors, including the eye, CMOS sensors/CCDs, print and film media, and photoresists.
- Industry applications encompass the full spectrum from the extreme UV to beyond the infrared, even extending to acoustic imaging.



Imaging design: mobile phone camera lens

Illumination Design

- Develop illumination systems that use virtually any source—from LEDs to bulbs to electrodeless lamps—and deliver light to its intended location.
- Industry applications include general lighting, roadway lighting, automotive interior and exterior lighting, machine vision, medical/biotech, solar energy, entertainment and displays.



Illumination design: LED sources

Systems Design

- Develop the interdisciplinary aspects of imaging- and illumination-based designs, including error budgets, cost modeling and independent assessments and design reviews.
- Industry applications include electro-optical systems design, thermo-optics, opto-mechanics, aero-optics and materials science.



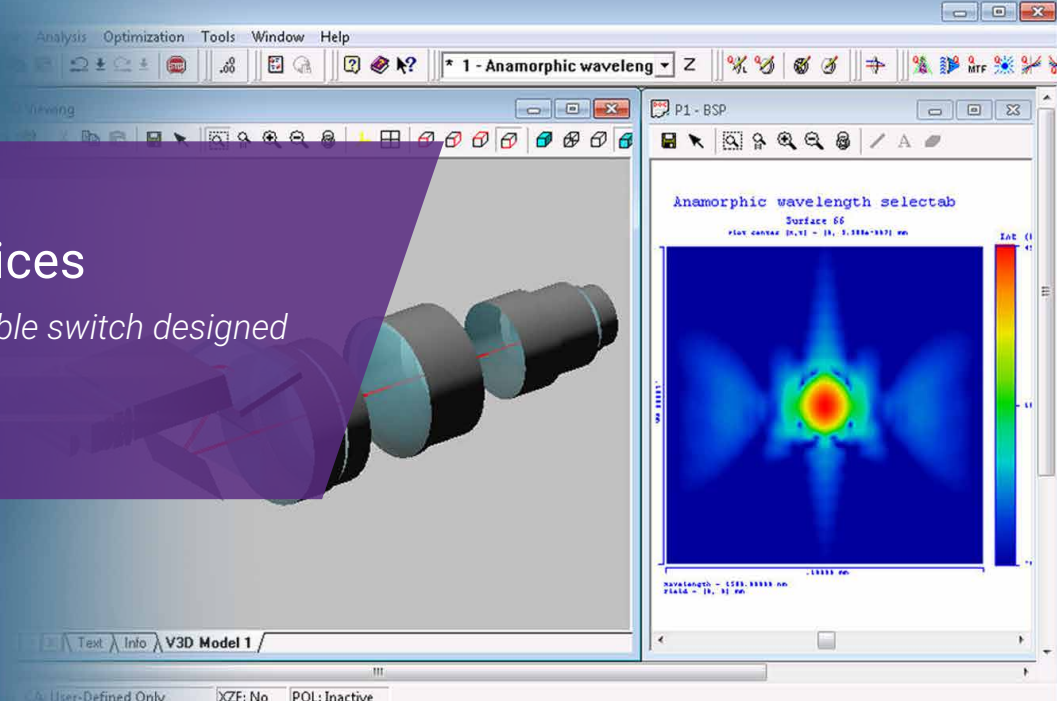
Systems design: opto-mechanics

Contact Us for a Project Proposal

Our engineers understand that today's competitive environment means you must achieve high performance and quick time to market. At your request and at no cost or obligation, we are ready to offer you a statement of work listing the tasks we propose to perform, a table of specifications that will govern the design, a firm fixed-price cost quotation and a delivery schedule. Let us review your requirements so we can illustrate how we can assist you. To get started, call us at 626-795-9101 or send an email to optics@synopsys.com.

Imaging Design Services

Anamorphic wavelength selectable switch designed and patented by our engineers



Looking for an Optical Design Expert?

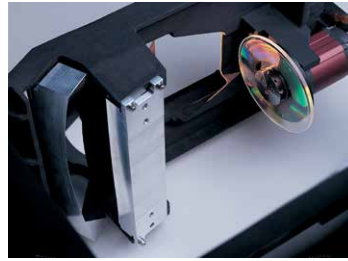
Our imaging optical designers have mastered practically every form of optical challenge. We have a breadth of project experience ranging from conceptual design through fabrication, assembly and optical testing. This broad experience base enables us to devise effective solutions to meet your needs.

Our team's optical applications expertise is wide ranging—from designing endoscopes and telescopes to developing optical components for children's toys and technical dive masks. Other applications include:

- Cell phone cameras
- Laser scanners
- Medical imaging systems
- Military optics
- Advanced lithography and inspection
- Digital imaging
- Zoom lenses
- Spectrometers
- Telecommunications
- Binary and other diffractive optics



Optical components that are part of a single optical system designed by our engineers (reproduced with permission of the University of California, Lawrence Livermore National Laboratory; developed under the auspices of the U.S. Department of Energy)



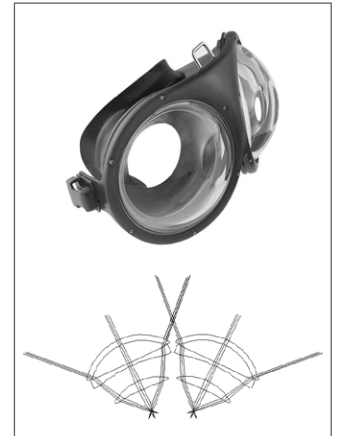
Holographic scanner designed by our engineers and produced by Holographix for high quality, large format color printing



Wide-angle lightning imaging lens designed by our engineers and fabricated by Kaiser Electro-Optics, Inc. for NASA (photo courtesy of Kaiser Electro-Optics, Inc.)



Wide-angle lens similar to many proprietary systems designed by our engineers



Wide-field, unity magnification dive mask designed by our engineers

Design for Cost Effective Prototype and Manufacture

Our engineers share a single vision and a common goal: to meet the challenges of virtually any optical design problem with world-class, cost-effective solutions and to follow these solutions through to hardware implementation. Our comprehensive approach includes collaborating with you to achieve your quality, performance, packaging, weight, schedule and budget goals.

We provide you with optical system designs that work—the first time. Our design expertise, coupled with an understanding of fabrication processes and careful tolerance analysis, ensure that our solutions will perform as predicted. Using the superior engineering capabilities of CODE V, the industry-leading optical design software, we develop accurate designs quickly and efficiently.

If You Need Help Selecting a Fabricator

Because our product is your success, we can proactively help you identify the best fabricators for your system and work with you to communicate your needs. In considering fabricators for your project, we match your needs for fabrication and assembly tolerances to the capabilities of fabricators we know well. By providing you with a list of qualified fabricators, we put you in a position to negotiate a competitive price and the quality you require.



Illumination Design Services

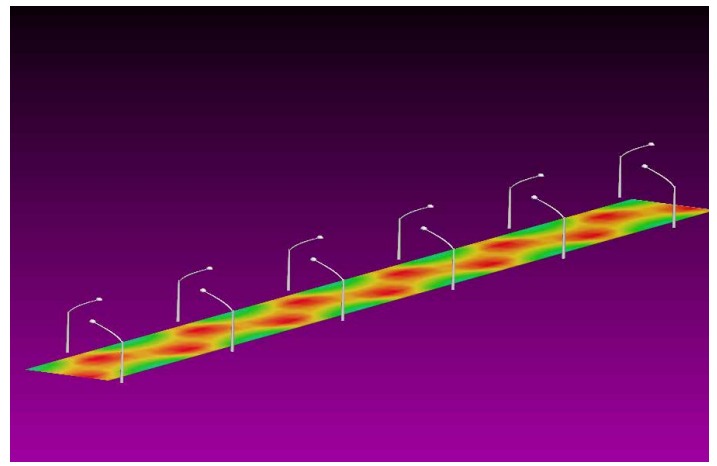
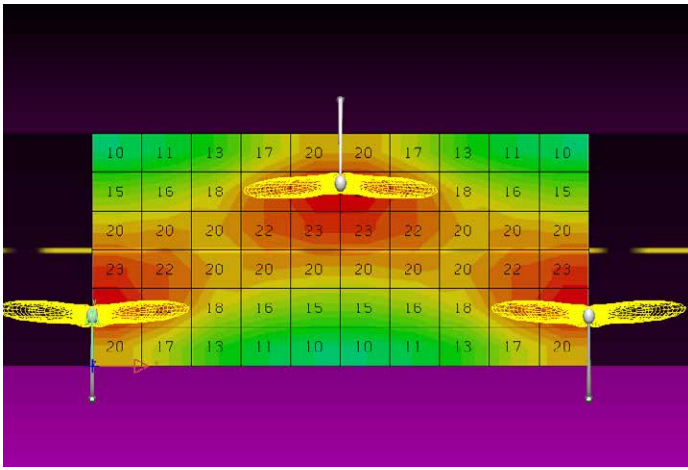
We can help you move your illumination design concept to market quickly while meeting your cost and manufacturing goals

Looking for an Illumination Expert?

Or do you just need to complement your existing team? Either way, we employ some of the most talented luminaire and illumination systems designers in the world. Whether you need LED street lights, LED lamps to replace conventional bulbs, aircraft lighting, backlights for LCDs, illuminators for scientific and industrial instruments, solar collectors, projection displays or automotive lighting, we have the required tools and experience.

Based on your package size and cost constraints, we create the best possible design that optimizes the function and quality of your illumination system's performance, including:

- Efficiency
- Uniformity
- Intensity
- Illuminance and irradiance
- Luminance and radiance
- Signal-to-noise ratio
- Contrast
- Color and lit appearance



LED street lighting design and analysis completed in LightTools

We have experience with a wide variety of sources including LED, high-intensity discharge, tungsten, fluorescent and even electrodeless lamps. We have designed illumination systems with production unit costs ranging from \$0.10 to \$500,000. Whether your system needs reflectors, light pipes, Fresnel lenses, lens arrays, flutes, prisms, diffusers or just about any other optical element, we have the expertise to develop or improve your product's lighting performance.

Do you need guidance on how to get your illumination system parts made, specified or checked? Our engineers have a broad background of experience that includes both mature and state-of-the-art production techniques and quality assurance metrology.

Trying to Decrease Design Cycle Time?

Let us introduce you to software prototypes. Our engineers use LightTools, the industry-leading software tool developed for illumination design, as well as LucidShape products for automotive lighting design. Our goal is to create a computer model of your system that is sufficiently accurate to eliminate the need for most of the time-consuming prototype process. Optimizing your system using LightTools and LucidShape is significantly more cost effective than multiple hardware prototypes and can cut months out of your design schedule. LightTools and LucidShape support CAD import and export of most popular mechanical CAD formats. Our designs can be integrated directly into your mechanical models or we can read and analyze your designs.



Automotive lighting



Medical lighting



LED lamps



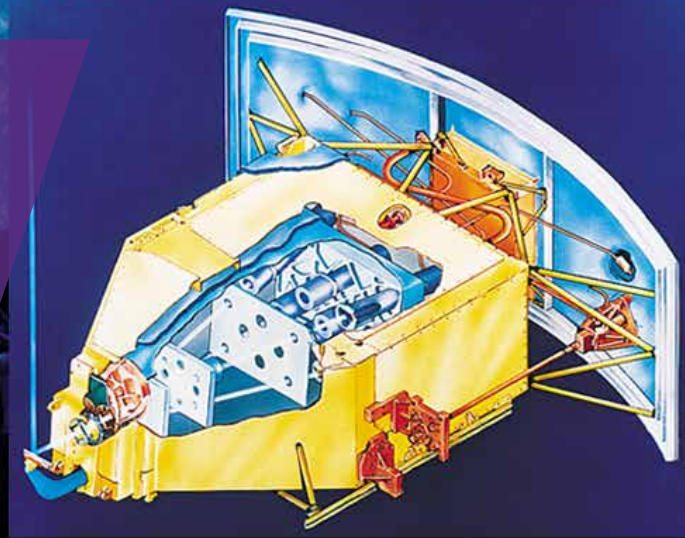
Backlit displays



Aviation and beacon lighting

System Design Services

Our engineers played a key role in establishing the prescription against which the Hubble Space Telescope's second Wide Field and Planetary Camera was built, as well as in supporting the interdisciplinary design, manufacturing and test effort



If Your Design Involves More Than Optics

We know electro-optical systems design, thermo-optics, opto-mechanics and materials science. From design conceptualization through flight hardware delivery, we'll ask the right questions and formulate answers that lead to cost-effective solutions. We have the right people, tools and methods to make sure your system works in the real world, from underwater to outer space and from cryogenic to hundreds of degrees Celsius.

We Know the Ropes

We can work with you at any stage in your project. We know which government-sponsored advanced optical technologies make sense for a commercial product. We know the best commercial practices to apply to bring government hardware online quickly and in a cost-conscious way. Our work can help engineers and project managers better assess the cost and cost-effectiveness of the specific baseline mix of hardware proposed.

If You Can't Afford Surprises

We can help quantify performance versus schedule risk and identify any showstoppers early in the design process. We provide selected quality guidance and proactive, independent technical assessments, analyses and recommendations based on our interdisciplinary know-how and experience. We can help you relieve a tolerance burden or manage risks effectively before they become hardware problems. The result: overall program cost reductions and successful systems delivery.

To Learn More

For more information about our optical engineering services and to request a detailed project proposal at no cost or obligation, please contact Synopsys' Optical Solutions Group at (626) 795-9101, visit <https://www.synopsys.com/optical-solutions.html>, or send an email to optics@synopsys.com.