

## Ansys SPEOS: Illuminating the Possibilities

Today's optical engineering challenge is to deliver extreme innovation quickly — while keeping costs low and reliability high. In demanding applications in the automotive, aerospace and general lighting segments, there is little time or budget for repetitive physical testing and prototypes. Instead, lighting design and verification must take place in a virtual engineering space that supports risk-taking, speed and accuracy — so there are no surprises when designs go into production. The solution is Ansys SPEOS. Offered by global simulation leader Ansys, SPEOS enables optical engineers to fine-tune critical factors such as propagation, reflection, visibility and legibility, while also identifying problems such as glare and hot spots. In a broad range of applications, SPEOS cuts significant time and expense from the design cycle, while supporting the high degree of innovation needed to support advanced applications such as head-up displays and autonomous vehicle sensors. Ready to shine a spotlight on your new opportunities for profitability and market leadership? Then meet Ansys SPEOS.

Optical engineers in the automotive, aerospace and general lighting segments face significant light-related challenges today. These categories are driven by product innovation, which means engineering teams are under constant pressure to arrive at the latest and greatest design feature — but, at the same time, they must also guarantee complete reliability for mission-critical applications. They must work quickly to meet customers' aggressive launch schedules, with limited funds and low staffing numbers. While this situation seems impossible, there is an answer to optical challenges: simulation via Ansys SPEOS. Backed by the proven capabilities and deep experience of Ansys, SPEOS enables optical engineers to work quickly, efficiently and affordably in a risk-free virtual design space that supports extreme innovation. Optical engineers can ask what-if questions and test their out-of-the-box ideas without the time and costs involved in physical prototype builds. As autonomy, artificial intelligence (AI) and other advanced technologies continue to reshape many optical products and their applications, Ansys SPEOS equips optical engineers with an equally advanced simulation solution.

### **/ In the Spotlight: The Critical Challenges Facing Optical Engineers**

Nearly every product is being reimagined today, with new functionality and designs that drive consumer demand. The worldwide lighting industry certainly feels market pressures to innovate and take product performance to a new level. In particular, the automotive, aerospace and general lighting segments are placing emphasis on game-changing products that will redefine the lighting category.

The burden of arriving at these extreme product innovations falls on optical engineers. Not only must they deliver ongoing innovations, but they must work quickly, to support their customers' product launch cycles. Their designs must operate with remarkable reliability, the first time and every time, to support mission-critical product applications. And they must do all this with shrinking staff numbers and other resources.

What makes this situation even more challenging? There is a lot of attention being paid to optical design today, for two major reasons:

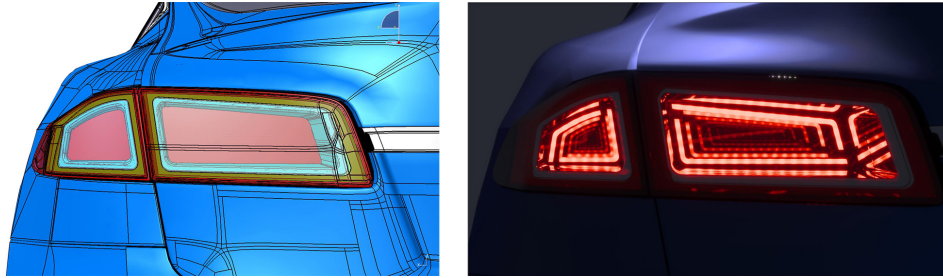
- 1. Optics technology supports emerging new areas like sensors, AI and autonomy.** Driverless cars, remotely controlled drones, head-up displays and other futuristic product designs rely heavily on optical engineers for their success. In these applications, optics components not only have to deliver innovative performance, but they also must be easy to read under a variety of conditions and enable easy control and adjustment by human operators.
- 2. Lighting design influences the purchasing decision for many consumer products.** As an important component of product design, lighting affects the emotional responses that influence consumer shopping behavior. Light has an impact on the perceived quality of the product and enables engineers to create a brand's signature as a critical element of the product design. Lighting can make products successful or lead to their failure.

But, while optical innovation and the right look-and-feel are key, they can't hold back the larger product launch schedule of OEMs who are racing to market with the latest and greatest design. In this environment, optical engineers' old ways of working — characterized by guesswork and repetitive physical testing — will no longer be sufficient. A new approach is needed.

## / Optical Simulation Is Not Just a Vision, It's a Reality

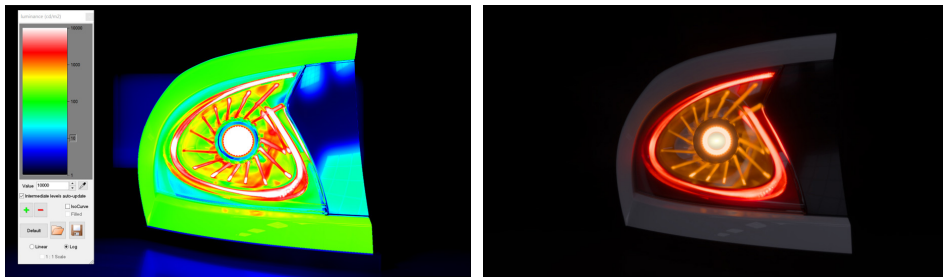
The clear answer is optical simulation. By designing, engineering and verifying their lighting systems in a risk-free virtual design space, optical engineers can do more with fewer resources. They can work faster. They can minimize development costs.

Even more important in today's fast-paced, increasingly digital world, simulation supports an extremely high level of innovation. By relying on a safe, affordable virtual design space, optical engineers can test new ideas along the path to final product designs.



From the CAD model to the real product, via SPEOS simulation

What kinds of innovations can be supported by simulation? The possibilities are endless, but some great examples are new applications for LEDs, increased levels of optical energy efficiency, better lighting appearance and illumination, improved sensing and smart functionality such as on/off controls based on motion detection.



SPEOS simulation of a rear lamp, showing false color on the left, on the right

All of these capabilities are absolutely critical to helping the general engineering community introduce successful autonomous cars, drones and other forward-looking product designs.

## / SPEOS: An Industry-Leading Solution, Offered by an Industry Leader

If these simulation capabilities sound too futuristic to be true, rest assured that they are here today. SPEOS is a powerful, proven solution that helps optical engineers design new features, optimize material selections and other characteristics, measure results, test product safety and comply with strict industry regulations. For example, optical simulations via SPEOS can help ensure that drivers can see and read the information on a car's control panel in any lighting condition, or ensure that the sensor on an autonomous drone is properly interpreting light phenomena such as glare.

By enabling a fast, inexpensive and accurate live preview of real-world performance, SPEOS cuts significant time and costs out of the product development cycle, reduces the need for physical prototypes and tests, and increases the engineering team's confidence in its customer promises. Simply put, SPEOS eliminates surprises once optical components have been placed in actual customer installations. In test after test, SPEOS simulations have been shown to accurately predict real-world product performance for optical systems.



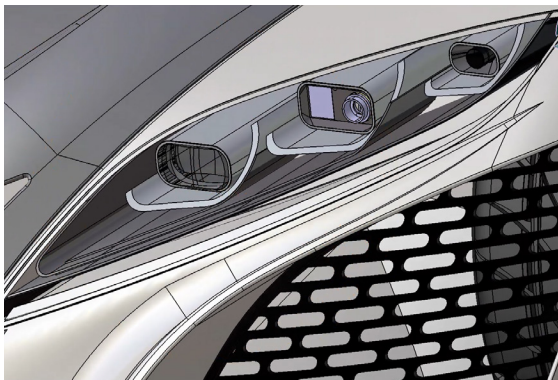
A versatile solution, SPEOS can be applied in a wide range of lighting applications, from cockpits and command centers to smart phones, computer screens and retail stores. Engineers can determine how displays and screens will appear in bright sunlight, the amount of illumination or the colors produced by artificial lighting, the best positioning for optical sensors and other crucial performance parameters. They can view their design innovations from every angle and under every ambient lighting condition, making iterative improvements quickly and easily until the product is fully optimized.

No other simulation solution can match the wide-ranging capabilities of SPEOS to support optical product development, including the truly groundbreaking ability of SPEOS to replicate human vision (see sidebar, “An Eye Toward Accuracy: SPEOS and Its Replication of Human Vision”).

A key advantage for optical engineers is that SPEOS is backed by Ansys, an acknowledged leader in engineering simulation for 50 years. With years of experience and thousands of customer success stories, Ansys can help SPEOS users adopt best practices and leverage the full capabilities of this solution.

Over the years, SPEOS has become the “gold standard” in optics simulation. In fact, many original equipment manufacturers (OEMs) require that their Tier 1 suppliers use SPEOS to verify the performance of their optics designs in a virtual design environment. In addition, SPEOS has been assessed by the International Commission on Illumination (CIE) against the CIE 171:2006 test cases, which assess the accuracy of lighting simulation software. CIE has determined that Ansys SPEOS Engine Simulation 2019 R2 accurately simulates light transport in a physically correct way.

SPEOS integrates easily with other Ansys software, including Ansys optiSLang for early-stage design of experiments and design optimization, and Ansys VRXPERIENCE for dynamic virtual reality studies. This integration can be valuable in developing, for example, sensors that are mounted on a vehicle (see sidebar, “Sensing the Possibilities: SPEOS and Autonomous Vehicles”). These integrated technologies can also help engineers perform real-time visualizations of glare and reflection within a cabin or cockpit, in order to ensure the visual comfort and safety of human operators. SPEOS can also be easily combined with thermal and mechanical simulation to anticipate, for instance, the thermal impact on the optical performance of a system.



Example of a combined headlamp/lidar/camera system, created with SPEOS

But SPEOS also functions as a standalone product, on a standalone platform, within the Ansys multiphysics environment. The platform is also CAD-agnostic, enabling a wide range of engineering teams to install and integrate SPEOS within their own technology environments.

In addition, SPEOS improves collaboration among industry partners by offering encryption functions that embed optical properties and secure intellectual property (IP). This means that engineers can freely share their optical system designs with customers, vendors and other partners.

## / An Eye Toward Accuracy: SPEOS and Its Replication of Human Vision



SPEOS enables organizations to see their final product as the end user will see it.

For decades, optical engineers have relied on CAD tools to develop innovative optics such as control panels and displays. One of the most important considerations is the development of a visual signature, visual impact and aesthetics that are pleasing to the eye, easy to read and simple to understand. Historically, engineers had to build a physical prototype to be able to answer the question, “What will this look like to the human eye?”

Today, SPEOS makes it possible to answer this question in a virtual design space, by replicating human vision under a wide spectrum of environmental conditions and ambient lighting levels. This revolutionary capability – enabled by a proprietary algorithm – is unmatched in the global lighting industry. It has already saved SPEOS customers significant time and costs by predicting the readability of displays and other optics at a very early stage of design.

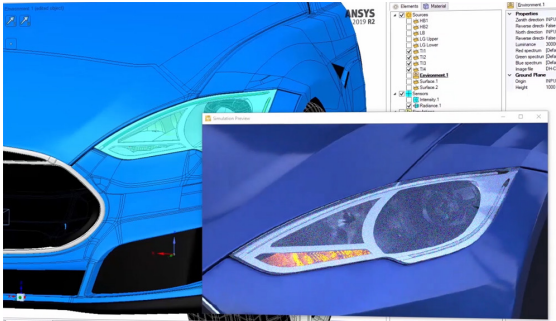
Development teams can develop a look-and-feel that is in keeping with their company’s visual signature, while also meeting tough safety standards. Best of all, optical engineers can “see” their designs at the very earliest stages of development, without having to rely on human subjects and costly, time-consuming display prototypes.

## / A Spectrum of Benefits

Reflecting 50 years of simulation experience, as well as 30 years of specialized lighting expertise, SPEOS was designed with the real-world needs of optical engineers in mind. It offers a spectrum of practical benefits that set the stage for product leadership in the automotive, aerospace and general lighting segments. These benefits are described below.

### Delivering Reliable Product Performance

SPEOS is a complete solution, covering design through user experience, that includes smart algorithms to achieve the desired optical performance target on the first test – eliminating human error and reducing manual work. SPEOS also offers a unique feature called SPEOS Live Preview that depicts the proposed lighting design under real-world conditions. Optical engineers can easily adjust the design in this simulated environment until it meets their expectations. And, because factors such as materials selection and lens type are critical in determining performance, SPEOS incorporates a robust library that enables engineers to test a variety of possibilities and arrive at an optimized overall design for a given application (see sidebar, “Robust Libraries Support the Best Possible Design”).



A Live Preview feature in Ansys SPEOS enables optical engineers to see exactly what their finished products will look like in real-world installations.

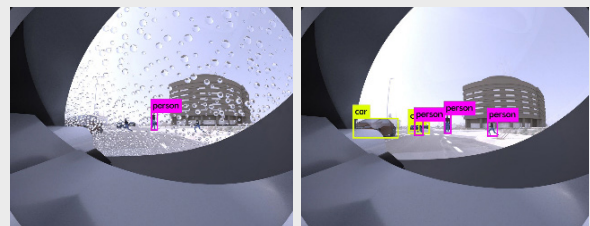
### Supporting Extreme Product Innovation

The high costs of prototypes and physical testing may make executives reluctant to invest in extremely innovative product features, where the risk of design failure may be high. SPEOS allows product developers to quickly test their groundbreaking concepts in a risk-free, virtual design space. Ideas can be discarded or targeted for future investment, depending on early simulation results. SPEOS simulations can be shared with internal decision makers or potential customers, providing a graphic demonstration of proposed product features or design trade-offs. By combining SPEOS with VRXPERIENCE, a dynamic virtual reality simulation tool from Ansys, optical engineers can even validate their designs in context, like “road testing” their designs mounted on a moving vehicle. SPEOS gives optical engineers an entirely new level of design freedom, enabling them to explore groundbreaking product innovations.

### Accelerating Time-to-Market

Making design iterations in a traditional product development environment is time-consuming, as engineers make adjustments, measure the results and change the parameters manually. Even more time-consuming is building and testing physical prototypes. SPEOS automates many tasks, supports fast and easy design iteration, and allows products to be quickly tested in a virtual environment. Not only does SPEOS streamline and accelerate end-to-end product development, but it creates a closed loop where simulation feedback informs the earliest stages of design – creating a cycle of continuous improvement. Time-to-market is drastically reduced, without sacrificing innovation, quality or reliability. Combined with high-performance computing (HPC) resources, SPEOS delivers results quicker, with an unprecedented level of accuracy.

## / Sensing the Possibilities: SPEOS and Autonomous Vehicles

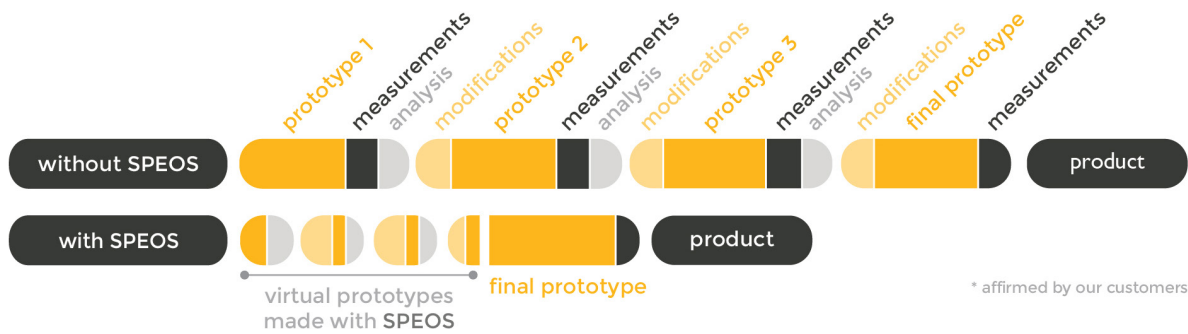


SPEOS-generated visibility comparison of the camera system in similar weather conditions. The anti-rain coating applied to the outer lens in picture 2 shows that, in case of rain, the full visibility of the sensor will be ensured.

One of the key challenges in commercializing vehicles equipped with advanced driver assistance systems (ADAS) is ensuring that they accurately sense, and respond to, the surrounding physical environment. They must be able to distinguish road signs, cars, pedestrians and other physical objects with an uncompromising degree of accuracy. Even more challenging, they must distinguish optical phenomena such as reflection and glare from real physical objects.

Enter Ansys SPEOS. SPEOS is designed to simulate the real-world performance of sensors in a risk-free virtual environment, where their safe performance can be verified well before they are ever mounted on an autonomous vehicle. Optical engineers can replicate real-world sensor performance under a range of lighting and weather conditions to make sure readings are accurate in every foreseeable situation. They can define the right position, the right orientation and the sensor's optical characteristics at an extremely granular level of detail.

While SPEOS offers static simulation capabilities that are crucial to effective sensor development, this powerful solution can be combined with Ansys VRXPERIENCE to simulate dynamic driving scenarios as well. This virtual-reality tool integrates easily with SPEOS to test and optimize sensor performance as a car or drone moves through physical space. This unique capability is only available from Ansys, a leader in simulation for more than five decades.



### Maximizing Profits via Reduced Engineering Costs

Manufacturers of automotive, aerospace and general lighting products are under pressure from consumers to offer innovative features and functionality – but at the lowest possible cost. This, in turn, places pressure on optics suppliers to keep their component prices low. SPEOS maximizes staff productivity, resulting in human resources cost savings. SPEOS also minimizes the cost of design rework, since changes are easily made, in seconds, in a virtual design space. Costly late-stage redesign work is avoided, because any issues are detected at a very early stage of development. Over-engineering and excessive quality control work, which can prove very costly, are also eliminated.

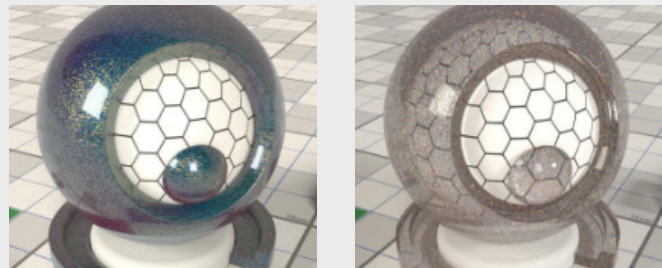
### Amplifying Human Resources

By automating many tasks associated with materials specification, propagation analysis, optical measurement and other design concerns, SPEOS eliminates manual work and makes the entire product development team more productive. SPEOS offers another productivity boost in the form of GPU-based simulation previews and renderings. These previews make optical simulations an interactive part of the design process. They also quickly inform engineers if a design is moving in the right direction, which reduces iteration and decision-making time. As the design team becomes more efficient, members can devote their time to more value-added, strategic work.

### Achieving Regulatory Compliance

Regulatory requirements for optics are stringent in the automotive, aerospace and general lighting categories – and with good reason. Often, human safety depends on the ability of optics to reveal, sense or respond to danger. Fortunately, SPEOS makes it easier, and faster, to achieve compliance by verifying performance under a broad range of operating scenarios. An easy-to-use library of standards can help ensure compliance with common industry regulations and guidelines. Leveraging SPEOS for preliminary verification can drastically reduce the number of physical prototypes and testing. As just one example, combining SPEOS with VRXPERIENCE to create a dynamic flying experience can replace the thousands of miles of actual flight testing needed to verify optical sensors mounted on drones.

## / Robust Libraries Support the Best Possible Design



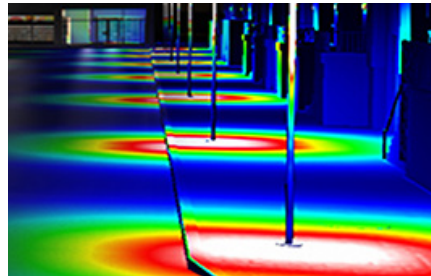
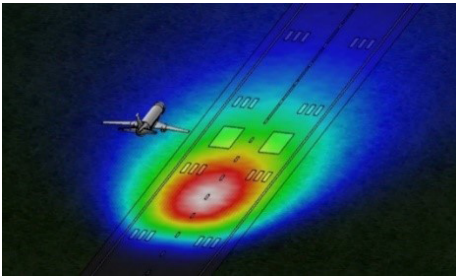
Optical engineers can use SPEOS to test different geometries, surface finishes and materials to ensure the right performance and aesthetic characteristics for their finished designs.

In designing customer solutions, optical engineers face myriad choices every day, including materials selection, light source type and lens characteristics. To make it easier and faster for engineers to make these essential decisions, SPEOS includes an extensive library with over 4,500 options in lights, materials and optical tools.

By referencing this online library, optical engineers can accurately simulate their finished product, making changes along the way that optimize performance. The SPEOS online library includes:

- **Materials**, used to create virtually any surface, texture or color. A dedicated optical measurement device captures material properties so engineers can easily manage predefined material samples virtually, enabling multiple color and trim options and variations.
- **Light sources** such as ready-to-use LEDs, fluorescents, incandescent and HID bulbs, and OLEDs.
- **Cameras and lenses** that reflect the latest optical technologies, enabling the creation of any optical system with a few mouse clicks.
- **Automotive standards** that help verify the compliance of virtual product designs with official SAE or ECE regulations and standards.
- **Predefined optical tools**, including sensor designs, common environments and typical photometric or color measurement tools.

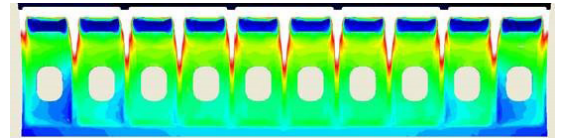
Assembled by Ansys industry experts, this robust collection of commonly used optical design information includes all the recent innovations that may inspire creativity.



Illumination maps in false colors demonstrate the performance measurement of any illumination system.

## / Bringing Product Leadership to Light

Achieving optical product leadership in the automotive, aerospace and general lighting segments is an incredibly complex task. Product development teams must balance the need for extreme innovation and quick turnaround with their own financial and strategic goals. They need to act quickly and constantly introduce new features, without sacrificing reliability or safety.



SPEOS simulation of a plane interior in false color

Just as today's optics represent very advanced technologies, there is an advanced technology solution available to help optical engineering teams master this complicated market environment. SPEOS has been developed by a team of industry experts specifically to help optical engineers master their short- and long-term challenges. By replacing manual labor, guesswork and human error with speed, automation and accuracy, SPEOS can drive innovation and product leadership.

By leveraging SPEOS to make strategic trade-offs that combine cost-effectiveness, performance, quality and aesthetics, companies can achieve a significant strategic advantage.

Ready to start exploring the benefits of Ansys SPEOS – and gaining an edge over competitors? Contact Ansys at 844.462.6797 or visit [www.ansys.com/products/optical](http://www.ansys.com/products/optical) for more information.

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