+44 (0)1494 777 100 sales@resolveoptics.com

Welcome to the Spring 2025 edition of 'Lens Innovation' – a twice yearly eNewsletter from **Resolve Optics Ltd**. Each issue of Lens Innovation contains features written to keep you informed about the latest technological developments, applications advances and breaking news in the optical design and manufacture industry.

Please do not hesitate to **contact us** if you would like to comment on a particular feature or ask further questions. We welcome your feedback.

Mark Pontin – *Managing Director*

INFORMATION GUIDELINES:

Wide angle lenses – advantages, disadvantages and applications

Wide-angle lenses are in demand in factory automation applications where vision cameras need to pull in data from a wide field of view. They are also used in medical imaging and life science research but notably they are in demand because of the trend of using 360° images to show the surroundings in high resolution. This could be used on you family vehicle or more often on military vehicles where it might be an advantage not to have window.

For all these applications – customer demand is for wide angle lenses with as near to zero distortion as possible allowing images to easily be stitch together.

Traditionally wide angles lead to distortion, depending on how you calculate the distortion you will typically be looking at between 5 to 15%. The lens will also require a very large front clear aperture. Both the distortion and the large diameter would render the design unsuitable for 360° applications.

There is a solution, but it comes with its own drawbacks. It is possible to use moulded aspherical wide angle lens elements to achieve <1% distortion. A new design we are investigating would be like a lens in a smart phone. By using moulded glass and plastic aspheric elements the overall size of the design can be kept small. The main downside of this approach is that custom moulded aspherical elements are only economically viable if you are producing larger numbers of lenses. This is due to the cost of the moulds. A technical limitation for some applications is the very short back register distance and the steep ray angles required to achieve the low distortion which can create issues with the angle of light rays' incident on the sensor.

Resolve Optics is currently investigating how lower volume wide angle lens applications can benefit from moulded aspheric elements.

Register here to be kept informed of our progress.

VIEWPOINT:

Mitigating the risk of optical failure on deployment.

Because of the risk of exposure to vibration, shock and wide temperature changes in many industrial, military and spaceborne applications – careful selection of lenses that will not fail on deployment is critical.

The cost of launching optical payloads into space is considerable. Likewise, reliability in military hardware and industrial optical inspection systems is paramount.

It is critical that all failure risk factors are considered during both the optical and mechanical aspects of the lens design process. In this way we can be confident that the lens will remain operational when exposed to these conditions.

Ruggedisation to prevent changes in focus from shock and vibration is often enabled by simplifying the lens design and reenforcing the mechanics of the optical system. Likewise for monitoring applications prone to temperature fluctuations, it is important to design lens systems that are insensitive to thermal change in the surrounding environment. Developing an athermalized optical design, is especially critical because temperature changes can cause the materials in a lens to expand and contract at different rates. If this is not carefully considered in your optical design, then a lens will lose focus as the temperature changes.

To validate the performance of lenses prior to deployment – Resolve Optics has invested in advanced vibration/shock test equipment so that lenses and optical systems can be fully qualified before being shipped to the customer.

This vibration / shock testing service not only provides piece of mind that Resolve Optics lenses will not fail upon deployment but can also save customers considerable time and money by removing the need to use third party testing services. Our MPA101-

L215M vibratory shaker coupled with a DTC Venzo 880 controller is capable of testing payloads up to 20kg and is certified and calibrated to ISO standards.

Learn more: **Click here.**

TECHNOLOGY FORUM

What are the trade-offs when specifying an HD or UHD lens?

Vision and imaging systems typically comprise a camera, imaging sensor and lens working together to provide a working solution. For them to work optimally, all the components must be matched properly. The earlier in the process of designing a vision or imaging system you choose your optics the better.

From a vision or imaging system perspective the main difference between UHD and HD is the pixel count: High Definition (HD) usually refers to 1280×720 pixels, while Ultra High Definition (UHD) means 3840×2160 pixels. This means that UHD offers approximately nine times more pixels than HD. Consequently, the key reason for specifying a UHD vision or imaging system is that the higher resolution delivers enhanced clarity and detail plus superior performance on large displays. However, UHD lenses and related UHD technologies are more expensive than their HD counterparts and not always required on smaller displays.

When specifying a suitable optical lens for your vision or imaging application – resolution is best stated as the Nyquist of the sensor (Cycles) or in terms of MTF (Modular Transfer Function). By knowing the dimensions of the imaging sensor and its pixel pitch, we can ascertain what resolution is required from your lens to deliver optimal performance. It is important therefore not to specify a lens resolution that is greater than the Nyquist of the sensor as this just results in an optical design that is

more expensive due to the requirement for additional elements, exotic glass types and a more complex design.

Read white paper: **'Sensor resolution versus lens resolution.'**

DESIGN FOCUS:

How to specify a lens for defence applications

Optics increasingly play a crucial role in a wide variety of defence applications.

To deliver a robust and reliable optical system suitable for a defence application your specification should include sections detailing required optical, mechanical and environmental performance.

The optical specification should clearly define performance factors including the required field of view (FOV), f/#, working distance, resolution, sensor size and pixel pitch plus distortion and vignetting. An optical specification will often also detail any optical test reports that are required to be supplied with the qualification lenses.

Lenses used in defence applications are typically designed to meet military standards (e.g. MIL SPEC), often requiring increased durability and resistance to harsh environmental conditions.

The mechanical specification for a defence application should state the available space envelope, Motorisation requirements (if any), Method of focus required, Register distance, lens camera interface, Preferred construction materials and coatings, grounding points for static drain and preferred mounting arrangement on camera / sensor / instrument.

An environmental specification should cover all aspects of required vibration and shock testing during both the qualification and production phase of creating the new lens /

optical system. This specification should also consider the temperature extremes the lens will be exposed to plus required ingress protection (IP standards) to ensure it is protected from water, dust, and other environmental factors.

Read Interview: 'Designing and Proving Optics for Military Applications'.

PROJECT REPORT:

A motorised zoom lens for operating in high radiation environments.

With an aim to provide nuclear plant operators with higher resolution colour images, many radiation resistant camera manufacturers are working to introduce a new generation of CCD cameras.

In 2024, a leading supplier of radiation hardened products to the nuclear industry selected Resolve Optics to develop a non-browning lens optimised for its new range of state-of-the-art radiation hardened digital cameras. Specified for long term operation in nuclear plants areas subject to high radiation levels up to 1MGy the client required the motorised lens to be optimised for colour vision technology and designed to last where other optics fail.

Drawing upon over two decades of experience of working with manufacturers serving the nuclear industry – Resolve Optics developed the Model 357 10x non-browning zoom lens range. This unique zoom lens delivers clear sharp images free of the strong yellow tint that is typically a limiting issue for colour sensors used in environments subject to higher levels of radiation.

Working closely with the customer – Resolve Optics developed a new 1/4″ format version of its 10x non-browning zoom lens matched to the rad hard camera sensor and able to operate over extended periods of time in very high radiation environments.

This development means the Model 357 10x non browning zoom lens is now available in 1/4″, 1/3″ and 2/3″ formats. Each of these lenses is available both motorised and non-

motorised covering the monitoring, maintenance, and investigation needs of most nuclear customers.

Click here to learn more.

BREAKING NEWS

Designing optimised optics for scientific applications.

In a recent exclusive interview with IEN Europe – Rob Watkinson discusses the advantages of bespoke lenses for scientific applications. In addition to describing some 'cool' custom optics for space research he details how our experience and expertise has enabled development of market leading instruments and imaging systems for the forensic, healthcare and high-speed imaging sectors.

To read interview in full click here.

A warm welcome to the Model 414 Non-Browning lens.

Optimized for use with two-thirds-inch format radiation tolerant cameras our new 16mm focal length Model 414 fixed focus non browning lens delivers high image resolution (f/2.8) and minimal geometric distortion from 400 – 750 nm.

To learn more click here.

Application optimized zoom lenses.

If you need a zoom lens with HD or Ultra-HD resolution, performance in a specific wavelength range, manual or motorised operation or a design to fit in a specific space envelope then watch this informative video.

Click here to watch video.

THE LAST WORD:

4k video livestream from the International Space Station.

UK-based space video specialists – Sen, recently launched its new Ultra High Definition (4K) livestream of the Earth and space. Sen's livestream provides the public with pioneering live Ultra High-Definition views of Earth and is the world' first commercial livestream from space, providing the public with live views of the earth taken from the international space station.

The latest 4K video cameras deployed by Sen onto the ISS use a selection of high-performance lenses from Resolve Optics to give them a range of different GSD (ground sampling distance) from 50 to 250 metres. This lens selection allows the Sen video cameras to capture both very wide shots of the entire Earth along with much more detailed shots of urban, industrial and remote geographical features. The supplied lenses were specifically designed for deployment into space using ruggedised mounting and non-browning (radiation resistant) glass to prevent failure on deployment and to ensure they can survive years of exposure to cosmic radiation.

Charles Black, founder and CEO of Sen said "We chose to partner with Resolve Optics to ensure our optics are specifically manufactured to perform optimally in the space environment. They custom design each lens to meet our very specific requirements for

capturing different perspectives of Earth and the International Space Station from different cameras. The team at Resolve Optics have proven many times that they have the expertise and experience to manufacture space grade optics that meet our very precise requirements to enable our video cameras to produce the highest quality views from space."

Watch the live streaming now.

Printable version (pdf)

OFFICE HOURS
Monday to Thursday: 8.00 – 5.30
Friday: Closed (See contact page for details)