



Welcome to the Spring 2018 edition of 'Lens Innovation' – a periodic eNewsletter from Resolve Optics Ltd. Each issue of Lens Innovation is designed to keep you informed about the latest technological developments, applications advances and breaking news in the optical design and manufacture industry.

If a particular feature interests you do not hesitate to contact us or follow the link for further information. We welcome your feedback.

Mark Pontin (Managing Director)

INFORMATION GUIDELINES:

Key Considerations When Selecting A Lens for Machine Vision



Given the diverse range of sensor formats and different resolution available in machine vision cameras, the number of lens options is vast.

One of the most common mistakes is that an engineer / scientist will often select a camera and a sensor before choosing a lens. This could lead to a situation where there isn't an optimised lens available for the application.

Remember all machine vision systems require production of an image of sufficient quality to enable the required measurements to be made. The critical determinant of image quality will be your choice of lens or lens combination. In a machine vision system, your choice of lens can also impact other factors including measurement accuracy, achievable speed, and the reproducibility and reliability of the downstream analysis.

A typical machine vision lens selection process should involve identifying your application needs and agreeing the key specifications to achieve this. These parameters include field of view, resolution (or size of the smallest detail or part to see or identify), working distance / range and depth of field (the height of the objects under inspection). Once these four key specifications are known, it is much easier to select an optimised lens and camera.

There is a direct relationship between the most suitable lens and the sensor used in the camera. Knowing the sensor size, select a lens that is able to illuminate the complete sensor area in order to avoid shading and vignetting. Your chosen lens also has to be able also to resolve the sensor pixel size. The better the optical resolution of your lens, the better detailed machine vision analysis can be achieved.

Standard resolution lenses (MTF 70 to 90 lp/mm ; low distortion and vignetting) are the most widely used lens type for machine vision sensors with a resolution of less 1 megapixel. High resolution lenses (MTF > 120 lp/mm and very low distortion) offer improved imaging performance compared to standard lenses and are particularly well suited to cameras with a small pixel size.

This short feature was intended to give you an overview of the many considerations when looking to develop an optimised inspection solution using machine vision.

For further information and expert assistance in selecting the optimal lens / lens system for your machine vision application please [click here](#).

VIEWPOINT:

How Modern Communication Tools Are Enabling Faster OEM Lens Design and Development.

Can you remember how business was done just a few decades ago. There was no email, Internet, mobile marketing, teleconference systems or smartphones. Now communications are



instantaneous, huge amounts of information move through email and the Internet and powerful tools are in the hands of owners and employees. Innovations in technology have improved operations at companies of all sizes and helped turn small local businesses into global businesses.

Collaborating with partners and customers in other countries is no longer a problem with modern communication technologies. Resolve Optics has invested in VOIP teleconference systems to conduct interactive meetings with our partners and customers. These systems enable us to share files and desktops. This ensures that we are all looking at the same document, specification or 3D model. When used properly VOIP teleconferencing can be almost as good as a face to face meeting, and of course saves the time spent and inherent cost of international travelling.

With projects that are in the design stage we regularly provide customer with updated 3D models (SolidWorks) so they can check how their new bespoke lens will interface correctly with their camera or application.

To ensure projects keep to schedule we use all the aforementioned tools, plus of course email communication and even face to face progress meetings. It really depends on what the customer requires.

We would be most interested to hear about your preferences for discussing or managing the design and manufacture of a new optimized bespoke lens or optical system for your product.

TECHNOLOGY FORUM:

Key Criteria of Lens Systems for the Nuclear Industry

An interview with IEN Europe Magazine.

The trend in the Nuclear industry is to require higher and higher resolution images so that more detail can be seen remotely. Being highly regulated and very safety conscious, changes in the Nuclear industry happen very slowly. Mark Pontin, Managing Director of Resolve Optics, describes the company's non-browning lens developments to cope with the demands of the Nuclear industry.



WHAT ARE THE KEY CRITERIA THAT A LENS SYSTEM HAS TO SATISFY IN ORDER TO MEET THE NEEDS OF THE NUCLEAR INDUSTRY?

The Nuclear Industry requires that the lenses it uses are Non-Browning and are able to maintain a usable image up to a maximum allowed radiation dosage. All Resolve Optics lenses are qualified to withstand 10^8 (100 million) Rads over an extended period of time. The term 'Non-Browning' is used to describe an optical lens that does not significantly change colour when exposed to radiation. Standard glasses will rapidly turn brown or grey when exposed to radiation which will cause a transmitted image to become dark and unusable.

CAN YOU DESCRIBE SOME RECENT ADVANCES MADE BY RESOLVE OPTICS IN THE AREA OF LENS TECHNOLOGY FOR THE NUCLEAR INDUSTRY?

The Nuclear industry has increasingly been adopting CMOS colour sensors in place of the traditionally used tube cameras which produce a monochrome image. This move towards colour images necessitated that Resolve Optics develops a new generation of non-browning lenses. As standard radiation resistant optical materials are very yellow most non-browning lenses produce images with a yellow tint. The new Model 357 range of non-browning lens from

Resolve Optics minimises the amount of yellow tint in the image.

PLEASE DESCRIBE SOME OF THE MAIN AREAS IN A NUCLEAR PLANT THAT ARE BENEFITING FROM RADIATION RESISTANT LENS TECHNOLOGY?

In a nuclear power station – radiation tolerant cameras are used to monitor all areas of the plant including the reactor containment area, nuclear fuel storage facilities and decommissioning areas. Even if these cameras are in areas that are not exposed to high radiation they will be required to be radiation resistant in case of an emergency. Other typical use of non-browning lenses includes rooms used to store crucial equipment and for inspection of pipes in water cooling facilities surrounding the reactor. Nuclear reprocessing plants also use non-browning lenses and radiation tolerant cameras to monitor the reprocessing and vitrification of nuclear waste.

CAN YOU TELL US ABOUT ONE OF YOUR MOST INTERESTING APPLICATIONS THAT YOU HAVE HELPED SOLVE FOR A NUCLEAR INDUSTRY CUSTOMER?

Because of the security sensitive nature of almost all nuclear installations, I am not really at liberty to reveal specific customer details. However, I can say that the new generation Model 357 non-browning lenses for use with colour CMOS camera was developed initially as a bespoke lens product for a nuclear systems integrator.

RESOLVE OPTICS HAS DEVELOPED A RANGE OF RADIATION RESISTANT LENSES FOR USE IN THE NUCLEAR INDUSTRY. WHAT OTHER APPLICATIONS OUTSIDE THIS INDUSTRY CAN BENEFIT FROM THESE PARTICULAR TYPES OF LENS?

Space is another major application that has widespread need of non-browning lenses. The higher the orbit of a satellite or spacecraft the greater the levels of radiation that onboard cameras, sensors and instrumentation containing optics is subject to. Space applications are very demanding as the last thing you would want is to get your optical system into space only to find it does not work as expected or your image quickly deteriorates as a critical lens darkens. Therefore, Resolve Optics non-browning lenses for space applications are designed to withstand the harsh environment of that unforgiving environment.

Increasingly Resolve Optics non-browning lenses are also being used in medical applications. In medical research – Resolve Optics radiation resistant lenses form targeting elements in synchrotron radiation therapy machines and also in commercial x-ray instrumentation.

WHAT DO YOU SEE AS FUTURE POSSIBLE DEVELOPMENTS OF LENS TECHNOLOGY FOR THE NUCLEAR INDUSTRY?

The trend in the Nuclear industry is to require higher and higher resolution images so that more detail can be seen remotely. Being highly regulated and very safety conscious, changes in the Nuclear industry happen very slowly. Consequently, Resolve Optics has some time to translate the knowledge it gained from developing HD and ultra HD resolution lenses for other industries into a new generation of radiation resistant high resolution lenses.



For further information on radiation resistant lenses [click here](#).

PRODUCT FOCUS:

Bespoke Infrared Lenses

To realise the full potential of recent development in Infrared (IR) camera, sensor and instrument technology, the need for very high performance, high-resolution or large format IR lenses and lens systems that meet the exact needs of that device is critical.



Driven by the lure of cost savings it is natural to try and include 'off-the-shelf' infrared lenses and lens systems in the design of your products. However, adopting an 'off-the-shelf' strategy necessitates accepting risks including loss of competitive edge through compromised performance and having little control over security of supply compared to an optimized bespoke OEM design.

Over the last 25 years Resolve Optics Ltd. has successfully developed many innovative, high performance OEM lenses for customers seeking to source no-compromise IR components for their thermal camera, sensor or instrument system. Drawing upon an experienced team of optical designers, Resolve Optics Ltd. can quickly gain an understanding of the basic physics of the technology associated with each customer's product enabling a novel, optimised and affordable solution to be proposed.

For further information or to discuss a project that may benefit from a bespoke fixed focus or zoom lens or lens system optimised to operate in the infrared (IR) region (1-14 microns) please [click here](#).

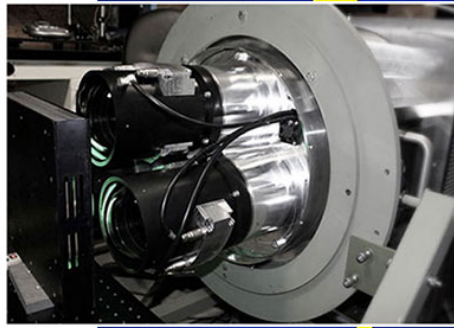
PROJECT NEWS:

In this feature we share with you how Resolve Optics specialist lenses and lens systems have helped organisations solve problems and enhance their competitive edge.

EU award to help develop ultra large format surveillance system

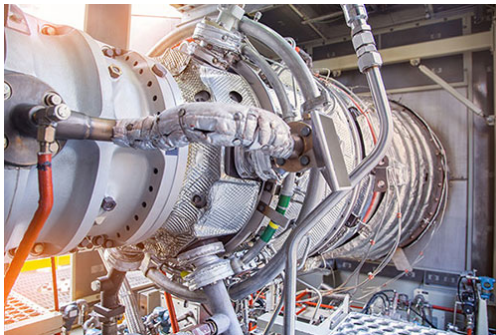
Resolve Optics Ltd in conjunction with IMAO SAS (Limoges, France) has received a Euro 1.68 million Horizon 2020 award to expedite the development of a 1GPixel resolution ultra-large format aerial surveillance camera. Using ultra large format, low distortion lenses custom designed by Resolve Optics, IMAO was able to create a prototype aerial surveillance camera. Its patented design, which associates three optical chambers, a matrix of sensors and 3 ultra large format lenses, represents a disruptive development in the field of aerial data acquisition. The prototype 660Mpixel camera produces high quality images two to three times larger than the standard image size generated by other large format cameras on the market. As a consequence, not only are less images required for geographic data mapping but also these images require less processing time saving operators time and money. Using the Horizon 2020 funding, the Resolve Optics / IMAO consortium aim to further improve the 660Mpixel resolution of the prototype camera to reach 1Gpixel by 2020. With this ultra-high resolution, large format

capability, less aerial surveillance flights will be required to create better quality images for Google maps, construction sites and other mapping and surveillance projects.



For further information of the Resolve Optics / IMAO Horizon 2020 project [click here](#).

Developing an endoscope system capable of high temperature / pressure inspection within a gas turbine engine



Today, gas turbines are one of the most widely-used power generating technologies. Gas turbines are a type of internal combustion engine in which burning of an air-fuel mixture produces hot gases that spin a turbine to produce power. It is the production of hot gas during fuel combustion, not the fuel itself that gives gas turbines the name. Gas turbines can use a variety of fuels, including natural gas,

fuel oils, and synthetic fuels.

Resolve Optics has developed a high temperature Short Wavelength Infrared (SWIR) endoscopic viewing system to enable inspection of the blades in a gas turbine while in operation. To enable inspection during gas turbine operation, required that the SWIR endoscope had to operate up to 950°C at the tip with 150PSI pressure and be able to withstand severe vibration.

To overcome the negative effects of high temperature and pressure – Resolve Optics created a novel design which allowed introduction of cool air at high pressure at the mid-section of the endoscope. This innovation enabled the prism at



the tip of the endoscope to be cooled to < 200°C and the positive pressure to provide enough airflow to keep the prism clean. In addition, to stop the endoscope transmitting heat from its tip to the connected camera – special heat breaks were designed into the body so that the camera end of the endoscope was kept below 50°C.

One of the most challenging aspects of the SWIR endoscope design was to ensure that the glass elements were securely retained. If the elements or clamp rings were to become loose the levels of vibration would quickly generate enough glass and metal powder debris to obscure the image. This problem was overcome by utilising spring retainers made from carefully selected materials with an expansion rate that would cancel out the differences in expansion between the glass and the metal housing.

For further information on bespoke optical systems able to withstand challenging operating environments (temperature, pressure or vibration) please [click here](#).

HOT OFF THE PRESS

In this feature we share with you the latest news from Resolve Optics.

Join the Resolve Optics Social Media Community

The Social Media hub on the Resolve Optics website is here to provide followers with a taste of the distinct personality of our lens design and manufacture business. We are keen to hear your opinions, learn about lenses and lens systems that will assist you in your work and of course try to answer your questions. If you are an engineer, designer or scientist interested in optics and looking for the latest buzz.



Why not become a follower to our [LinkedIn](#), [Facebook](#), [Google+](#), [Twitter](#) and [Instagram](#) feeds today. For every new qualifying follower registering before 30th April 2018, Resolve Optics will make a £1 donation to charity.

To visit the Resolve Optics social media archive, [click here](#).

Evolving Customer Data Protection



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To view our data protection policy in full – [click here](#).

Nuclear 10x Zoom Lens Data Sheet

Resolve Optics has published a new data sheet for its Model 357 Wide Angle Adapter. Using specialist non-browning glasses the Model 357 is able to produce clear sharp images free of the strong yellow tint that has traditionally been a limiting issue when using radiation resistant

lenses on colour sensors. The Model 357 HD 10x zoom lens has been designed to operate in environments subject to high level radiation, such as nuclear fuel handling, reactor active zones and nuclear waste storage plants. The non-browning glass used in the Model 357 is proven to withstand long-term exposure to radiation up to a dose of 100,000,000 rads and temperatures to 55 °C without discoloration. Operating at f/2, the Model 357 provides high image resolution and minimum geometric distortion from 400 to 770 nm, and can image objects from 800 mm to infinity without using add-on adapters. When focused at infinity, the lens achieves high image resolution on axis at full aperture throughout the zoom range without refocusing.



[Click here to request further information.](#)

THE LAST WORD:

In this feature we share with you topical news and resources published in the global media about the world of photonics and imaging.

News Item 1: Photonics-based research to test limits of quantum theory

Scientists from three UK universities and five others from across Europe are to test one of the fundamental laws of physics as part of a major Europe-wide project awarded €4.4 million in funding. The experts from Queen's, Belfast, Southampton and UCL (London) have formed a consortium with the universities of Aarhus, Delft, Trieste and INFN (Italy), OAW (Austria) and the UK company M Squared, to test the limits of one of the core principles of quantum mechanics.

Further Information: <http://optics.org/news/9/1/19>

News Item 2: How to Avoid Choosing the Wrong Power/Energy Sensor

Sensors are critical for accurate laser measurement, yet are often selected based on the wrong criteria. Choosing solely on the measurable power range or aperture size is typical but insufficient. In this webinar, the presenter focuses on key factors in the selection process, including beam diameter, beam density values, cooling requirements, and exposure duration.

Further Information: www.laserfocusworld.com/webcasts/2018/03/how-to-avoid-choosing-the-wrong-power-energy-sensor.html
