

Renishaw incremental encoders enhance the stability and efficiency of lens testing



Customer:

UMA Technology Inc

Industry:

Precision manufacturing

Challenge:

To find a precision optical encoder for UMA's DSC-E1 series, designed for small lens mass production-line testing.

Solution:

The RGH22 optical encoder system with self-adhesive RGS-20 scale significantly reduces test cycle time.

Background

The smartphone has become increasingly ubiquitous in recent years with significant penetration throughout the world. The global smartphone market topped 1 billion shipments for the first time in 2013, and is expected to reach 1.2 billion in 2014.

Smartphone cameras have become indispensable tools. People are now accustomed to them as part of daily life – shooting and then sharing with friends and family. Lens quality is more important now than ever, due to the ever-increasing number of megapixels found in today's digital phone cameras. Frequently, the resolution of digital photos is actually limited by the camera's lens - and not by the resolution of the detector itself. Major smartphone manufacturers are now in a race to enhance their camera capabilities in order to attract new customers. Taiwan's UMA Technology Inc (UMA) develops optical testing equipment for industry to provide accurate, rapid and reliable lens error detection schemes.



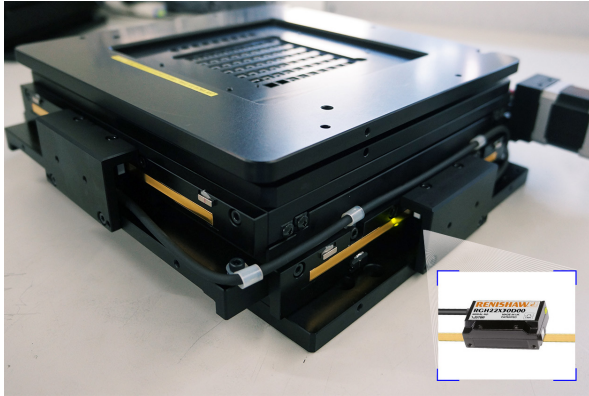
Taiwan's UMA Technology Inc develops optical lens testing equipment to ensure smartphone camera quality



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UMA (Taiwan)



Mobile platform using the RGH22 series optical encoder system controls the XY position of the lenses under test

Lens inspection

Lens testing equipment is used to ensure image quality. The optical quality of lenses is measured using a uniformly illuminated ISO 12233 chart standard – projected directly on to an imaging sensor by the lens. This test pattern is an image evaluation tool for determining the resolving power, limiting resolution and modulation transfer function (MTF) of electronic still-picture cameras. Different lenses project differing image qualities such that high-quality lenses closely reproduce the chart standard, whereas poor quality lenses do not. Renishaw has supplied the optical encoder components required by UMA's DSC-E1 series, designed for small lens mass production line testing.

The general test process starts with the precise placement of a lens tray on the DSC-E1 series' mobile platform; the candidate lens is then lined up with the standard chart and the imaging sensor beneath. Each lens test examines 9 - 25 different image regions such that the total time taken for each lens is less than 3 seconds. The platform moves with high speed back and forth, in both X and Y directions, and accuracy depends on high-quality closed-loop feedback information provided by an optical encoder on each axis. Mr. Sentry Lee, UMA senior project manager, says: "The mobile platform is one of the core components of the testing equipment; it has a decisive influence on test results and uses two stepper motors with a screw drive system. Renishaw's RGH22 optical encoder system with self-adhesive RGS-20 scale

High accuracy, high precision mobile platform

Mr. Lee explains the importance of the accuracy of the mobile platform: "The size of a smartphone camera lens and the requirement of imaging multiple points across the detector frame mean that the acceptable deviation in the optical path between the source and imaging sensor is very small. Errors in lens positioning could cause good lenses to be mistaken for bad and, thus, reduce overall yield and increase our production costs." Test repeatability is equally important, having a direct impact on the finished product yield. A benchmark is established to determine if the lens is qualified. UMA want the highest yield possible and minimal scrap as a result of testing errors, leading to the general requirement for

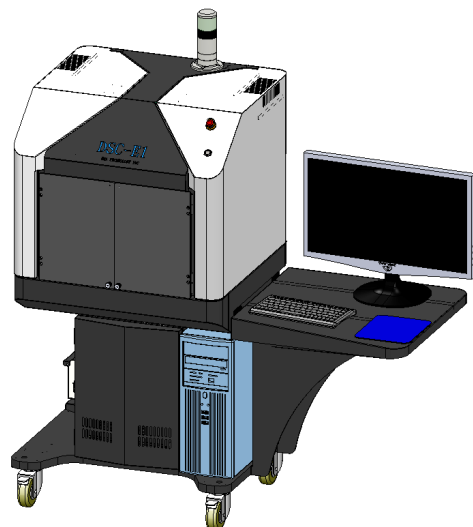
a detection error rate of $\pm 3\%$. Mr Lee adds: "Prior to redesign, the linear stage on the equipment was driven by only stepper motors, offering an unsatisfactory level of repeatability. Installation of Renishaw's RGH22 encoder system has enhanced resolution to $0.1\ \mu\text{m}$, which improves our product competitiveness."

The scale of a typical encoder, attached in some way to the machine structure, is the basis for measurement performance of the system. In general, the thermal expansion of the scale will not match that of the supporting substrate, which is often made of a different material. Choosing granite confers its various benefits including significantly lower thermal expansion. Conventional scales then lead to measurement uncertainty over temperature – a problem completely eliminated by using the Renishaw RGS-20 self-adhesive tape scale, which is essentially a gold-faced steel strip of $6 \times 0.1\ \text{mm}$ cross-section. This is mastered to the substrate and expands precisely with it, ensuring the elimination of hysteresis for completely predictable metrology as well as easy installation without the need for fixing holes.

High speed detection

Speed is another important factor in the industry's assessment of equipment performance. Mr. Lee explains: "There is a gap between the edge of the lens and the insert on the tray. The original system had to readjust position until the lens, light source and image sensor were aligned, which often took several attempts. Consequently, enhancing process efficiency was a big challenge for us. Renishaw's high-performance encoder allows our latest system to locate the correct position at once, reducing processing time significantly."

Mr. Lee adds: "Benefiting from the explosive growth in smartphones and mobile devices, our potential market has grown 20 times. We must enhance our equipment speed to maintain our leading position in order to seize these opportunities. Renishaw's encoders are well known in the market and, when compared with other brands, have the best cost-performance ratio. We have no reason to choose others."



UMA DSC-E1 series designed for the mass production line testing of small lenses

First-class delivery and service

Renishaw is committed to providing professional and technical solutions and a first-class service to meet the needs of world-wide customers across all industries. It continues to support UMA in the development of new products for enhancing production efficiency. "As a core component supplier, Renishaw offers excellent after-sales service, quick response and fast delivery. We don't have to worry about our supply, so we can allocate more resources for new product development," concludes Mr Lee.

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