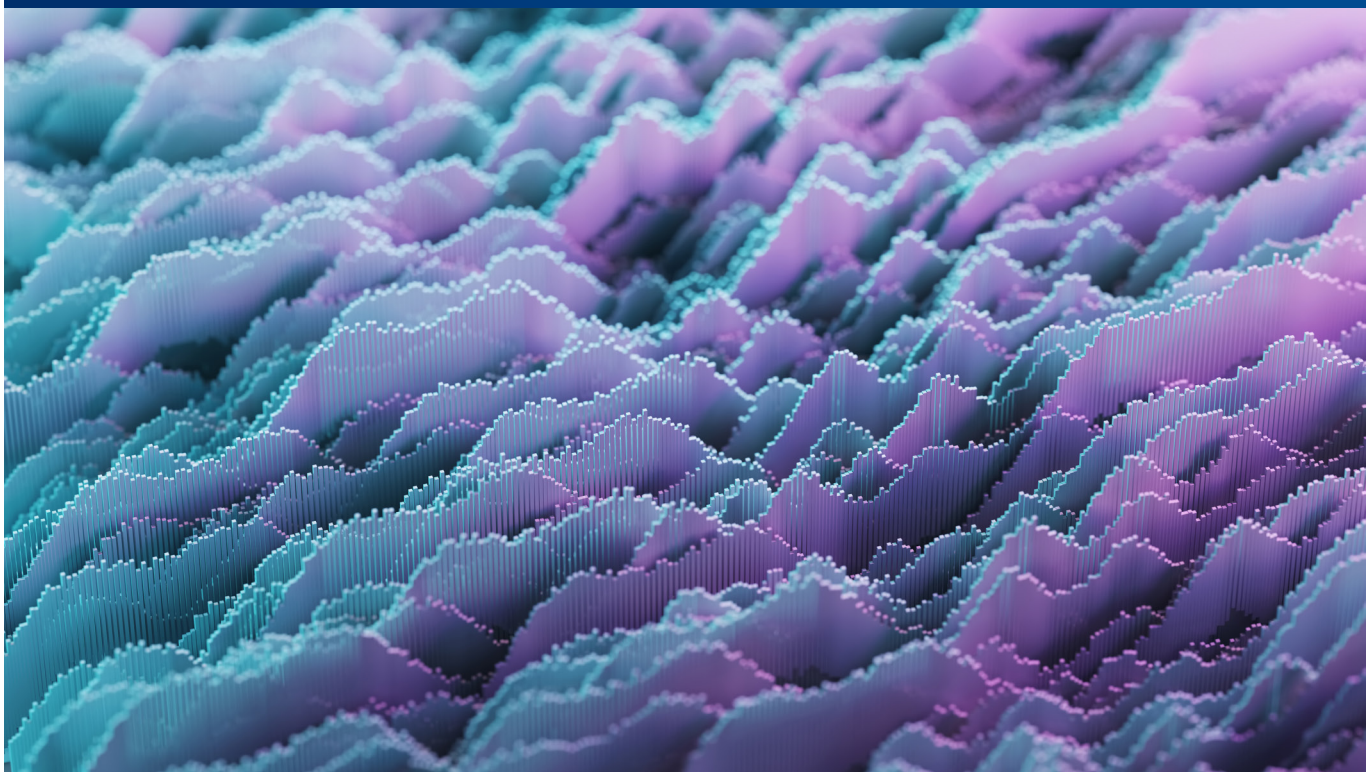
NPL
National Physical Laboratory

Metrology helps maintain six-fold turnover growth at Queensgate Instruments

Queensgate Instruments, a brand of Prior Scientific Instruments Limited, has been a pioneer in the field of nanopositioning for over 45 years. It specialises in high-speed, high-precision nanopositioning systems and nanodisplacement sensors. Partnering with National Physical Laboratory (NPL), through the Analysis for Innovators (A4I) programme, Queensgate accessed the expertise needed to meet increasing customer demand for higher accuracy.

Nanopositioning refers to the technology and techniques used to precisely control the position of objects at the nanometre scale (10-9 m). Regular laboratory and testing equipment is simply not precise enough for such small movements. Nanopositioning uses advanced equipment to move objects just a few nanometres at a time.

Nanopositioning is required so support many critical industries including semiconductors, healthcare, aerospace and astronomy as well as supporting many areas of applied research such as quantum device fabrication, photonics and instrumentation for synchrotron beamlines. Two examples of applications of nanopositioning and nanoscale displacement sensing are: enabling scientists to spot overstrain in something as large as a robotic arm on the International Space Station; and tracking the movement of microscopic cells in pharmaceutical research.



Challenge

Queensgate's work at the forefront of nanopositioning innovation has made it a leader in the global market for custom and OEM nanotechnology products – including nanosensors, nanopositioning devices, control electronics and software.

To maintain its competitive edge and meet the increasing customer demand for higher precision, Queensgate needs to keep improving how well its products work, especially in areas like adjusting tiny movements in multiple directions, fixing uneven performance, and making systems that move more smoothly and accurately.

Solution

Queensgate partnered with the National Physical Laboratory (NPL) through the Analysis for Innovators (A4I) programme to address these three key challenges: correcting spatial and linearity errors, improving parallel kinematic technology, and validating product performance claims.

The A4I programme gave Queensgate access to NPL's full range of expertise, technology, and advanced testing facilities. NPL's team identified errors, measured and characterised them in their dimensional nanometrology laboratory, and developed the necessary algorithms to correct them. Since Queensgate lacked in-house mathematical expertise, they relied on NPL's data science capabilities to create these algorithms. Once the corrections were integrated into Queensgate's products, NPL rigorously tested the updated systems to validate the enhanced accuracy, ensuring the improvements were robust and reliable. Having worked with NPL before, Queensgate trusted their expertise and state-of-the-art equipment for traceable validation.

"Using our equipment in NPL's laboratories we have been able to generate a whole wealth of data that Queensgate cannot get with their own facilities," explained Andrew Yacoot, a Principal Scientist at NPL. He added, "our mathematical lead scientist on the project worked on similar problems at a much larger scale so they were able to bring a tremendous wealth of experience applying mathematical solutions to complex positioning problems, benefitting both NPL and Queensgate."

Impact

Resolving these challenges was essential for Queensgate to maintain its market leadership in the highly competitive field of nanopositioning, especially for demanding applications, and maintain its outstanding growth trajectory through improvements to its existing products.

"Queensgate has grown its annual turnover six-fold since we were acquired five years ago and this work has been fundamental to maintaining that growth over the past two years," explains Craig Goodman, Product Manager at Queensgate.

"NPL applied its nanometrology expertise and deep data science knowledge to help measure and compensate for minute errors that affect product accuracy. We fully expect these improvements to help increase sales of Queensgate products. Over the next 24 months, sales of products that utilise these improvements could easily account for 25 to 50% of our revenue and I would hope to see total revenue grow by more than 50% in the same period."

The project also unlocked new opportunities from the parallel kinematic algorithms created in partnership with NPL. These have been used to produce the largest nanopositioning stage the

company has ever manufactured, a key piece of instrumentation supporting the manufacture of micro-LEDs, which are essential for the development of virtual reality and augmented reality screens and the next generation of smartwatches and smartphones. "The value from this A4I project is directly feeding into the emergence and application of these exciting new technologies and their future use by millions of people around the world," says Goodman. "Without collaborative innovation through the A4I programme this critical enabling product would not have been possible. We are expecting to see millions of pounds of financial return from this one technology alone in the coming years."

Whilst the project is already delivering direct benefits to Queensgate, it could have a much larger influence on hundreds of businesses in the months and years ahead according to Yacoot. "The advancements we have achieved in nanopositioning could have a significant positive impact on the wider industry, influencing future technological developments in related fields. There are long term opportunities for this work to have a bearing on products and services from multiple sectors. For example, we expect these innovations to set new industry standards for semiconductor manufacturing and VR/AR technologies in the future."

The project's impact is so significant it is even being felt at a local level, beyond the company gate. The factory that manufactures Queensgate's products is based in Devon in an area that is economically-deprived, and it provides high-skilled job opportunities to the local population. The collaboration with NPL has created growth opportunities that will sustain and expand high-skilled jobs in Devon for at least the next 18 months.

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