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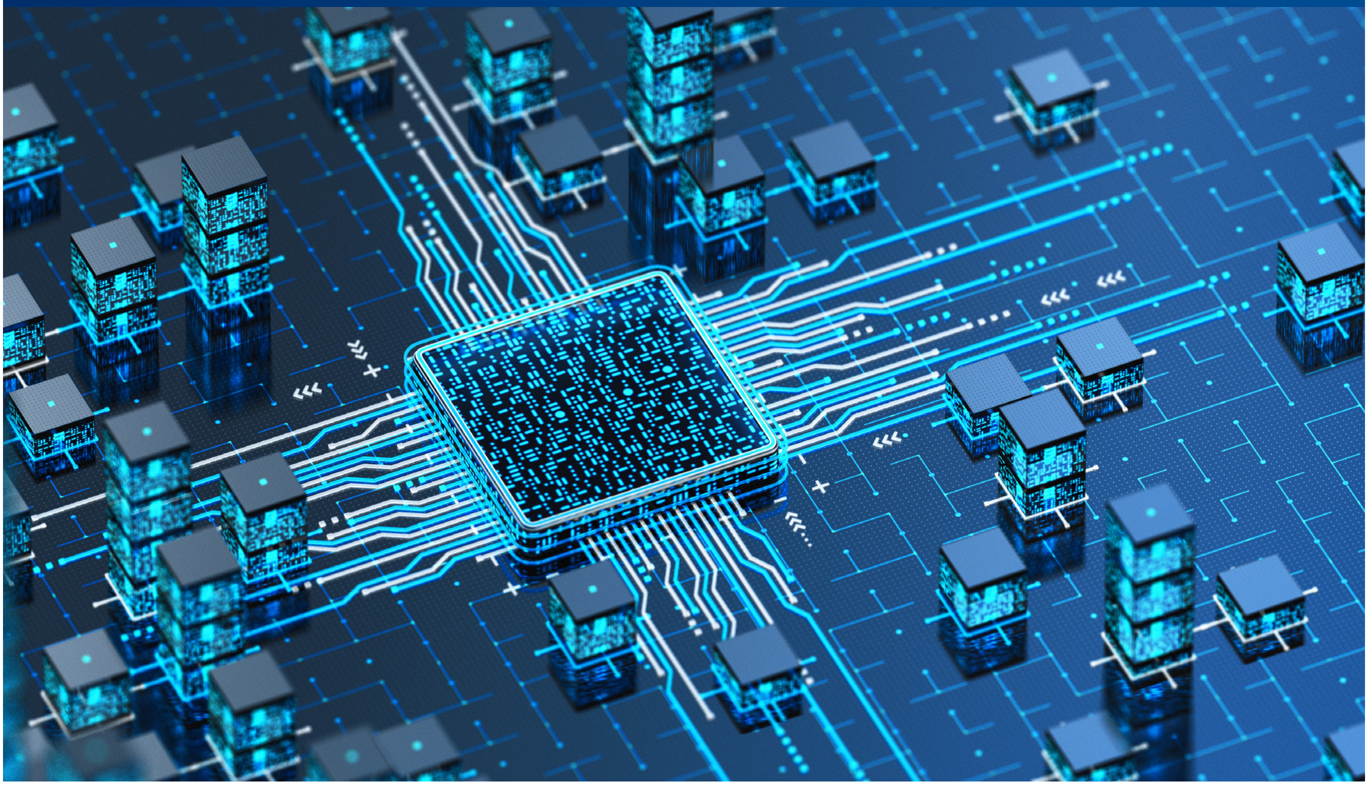
Anemos seeks lucrative opportunities in the semiconductor market, after NPL validates nanometre-scale positional measurement device

Anemos Technology Limited has developed a compact sensor that precisely tracks its position in a 3D space – but it needed validation at the nanometre-scale to access precision markets like the semiconductor industry.

The company's Multi-axis Absolute Position Sensor, or MAPS, can be attached to precision instruments and machine tools – such as microscopes or computer numeric control (CNC) machines – to provide accurate measurement of their linear and angular motion, which can be used to correct positional errors in real time.

This could make MAPS highly valuable to industries requiring extreme manufacturing precision, such as semiconductors, advanced microscopy, and robotics, which currently rely on large, expensive laser-based systems to perform these time-consuming characterisation measurements.



The technology incorporates a camera in a small sensor head, which observes a 'map' - a glass reference scale with a proprietary printed pattern. Using advanced sub-pixel image processing algorithms, MAPS calculates the sensor's precise location in relation to the 'map', in three dimensions and three rotational axes – known as six degrees of freedom (6DoF).

"From the customer perspective," says Richard Aras, CEO of Anemos, "all you do is place the scale, attach the sensor to the thing you want to track, and MAPS tells you the position with nanometre precision, even as it moves around with complex, off-axis motion."

This combination of a camera as a sensor, and algorithms to determine position and correct for errors, allows positional measurements at a fraction of the size, cost, and setup time required by laser-based systems.

Challenge

Despite the technological advances made by Anemos, they still needed to validate MAPS' accuracy at the nanometre scale. "We really want to get this into high-end markets such as semiconductor manufacturing," says Aras. "It's an industry where ultra-high precision is non-negotiable, and we were pretty confident we could meet their exacting demands. But they wouldn't even look at us without highly credible validation data."

Measuring at such small scales is extremely challenging due to even the tiniest environmental and mechanical perturbations. "A small business like ours just didn't have the in-house facilities and expertise necessary for this level of validation," says Aras. "We need to know we've done it right, and we need independent validation data that customers and investors will trust, so it was imperative to partner with a world-class measurement institution like NPL".

Solution

Over three rounds of experiments, NPL performed positional measurements of a stage – a moving platform – using both MAPS and traceable optical interferometry measurement techniques, allowing them to compare the two.

"Since MAPS measures six dimensions simultaneously with one sensor, and NPL's systems measure each axis with a separate interferometer sensor, we also had to deploy sophisticated mathematical transformations to compare the datasets," says Andrew Yacoot, Principal Scientist at NPL, who led the project.

Each experiment provided deeper insights into improving the MAPS system's resolution and reliability. The last results showed that MAPS could indeed achieve sub-nanometre resolution in position and sub-microradian in angular measurements, and could mitigate common misalignment errors.

This collaborative activity was funded through two successful Analysis for Innovators (A4I) projects and a Measurement for Recovery (M4R) project.

Impact

"Thanks to learnings over the course of the experiments, we've been able to improve our system to the point that it is now 100 times better at positional measurements," says Aras. "At the same time, the NPL measurements have validated the MAPS system and showed it could achieve much higher precision than initially anticipated".

The work has been published in the Institute of Physics journal, Measurement Science and Technology, with the paper[1] concluding that MAPS capabilities and small size "bode well as a potential reference artefact not just for nano-scale metrology, but also in larger range CMM/CNC calibration, microscopy, AFM, robotics, and many other applications."

The results have helped spark conversations in new markets and have also been instrumental in securing additional funding rounds from investors.

Aras concludes, "The validation from NPL – backed by a peer reviewed paper – lends huge credibility to our portable, nanometre-accuracy positional measurement devices. Without this work, there's no way we would have had the confidence to approach high-precision industries like semiconductors. But now with solid data to back it up, we're confident in delivering real value in these markets, and we've already started conversations with some of the world's biggest semiconductor manufacturers".

[1] https://iopscience.iop.org/article/10.1088/1361-6501/ad5c92

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