

# Quantum Technology For Next-Generation Pnt

Quantum technology has the potential for enabling improved performance for position, navigation and timing (PNT) techniques. By combining classical technologies with quantum technologies, there are opportunities to develop systems which are more robust and less prone to error when operating in Global Navigation Satellite Systems (GNSS) denied environments.

The UK Hub for Quantum Enabled Position, Navigation & Timing (QEPNT) held a joint event with the Royal Institute of Navigation (RIN), on the 12<sup>th</sup> June at the Royal Society in London, bringing together over 90 delegates from the classical PNT community with the quantum industry and academia to discuss potential areas where quantum technology could provide value in next-generation applications.

The event was opened by Dr Ramsay Faragher, CEO of RIN and Professor Doug Paul, Principal Investigator of QEPNT, each highlighting the areas where quantum can support PNT.

A morning of case study presentations on applications in inertial navigation, atomic clocks and timing, and LIDAR systems included a discussion between QEPNT Deputy Principal Investigator, Dr Joe Cotter of Imperial College London and Chester Butterworth, Head of Strategy, Disruptive Capabilities & Technology at the Royal Navy, on their collaboration on a cutting-edge navigation system. The technology they have been trialling could help ships and submarines to navigate more accurately without the reliance on satellite-based navigation.

Mark Stevenson, Principal Scientist at Toshiba Europe Ltd gave an overview of working in partnership with Heriot-Watt University, and the Universities of Cambridge, Edinburgh and Glasgow and other industry partners, to develop novel range finding and 3D imaging systems which will be used for driver assistance and the autonomous vehicles of the future.



Rachel Maze (DSIT)



Rachel Maze, Head of Quantum Technologies Policy at the Department for Science, Innovation and Technology (DSIT) focused on the National Quantum Strategy Missions and the role the community has to play in contributing to the Government's mission for improved quantum navigation systems.

Roger McKinlay, Challenge Director – Quantum Technologies at UK Research and Innovation, also presented on the 'Contracts for Innovation' funding, where companies can apply for awards to accelerate the development and adoption of quantum sensors and quantum position, navigation, and timing products and services.

Roger said, "I'm delighted to see growing interest in what quantum technologies can contribute to position, navigation and timing."

The audience spent the afternoon in working groups discussing critical use cases and technical requirements for quantum in PNT. A wide variety of use cases were discussed across different domains, including resilient navigation of ships and aircraft, synchronised timing for telecoms and national grid networks, and single-photon LiDAR for robotics, underwater surveying, and urban canyons.

Technical requirements varied across domains and use cases, however generally a strong and resilient supply chain for components and talent were agreed as being vital across all systems.

Discussions between industry representatives and academics during the workshop and networking sessions were a key milestone in building relationships and potential collaborations for advancing quantum technology.

Sara Pellegrini, Imaging Communication and Academic Collaborations Manager at STMicroelectronics commented,



Roger McKinlay (Challenge Director Quantum Technologies, UKRI)

“The event was invaluable to learn more about PNT and how quantum can be the future to reduce UK’s reliance on satellites. The extent of our reliance on GPS in many applications is something we take for granted. Being aware of the situation and being part of a possible solution to make the UK more autonomous is key to safeguard our future”.

The event was the first of a series of industry and academic events organised by the QEPNT Hub to foster collaboration to deliver practical systems for resilient PNT applications. QEPNT will hold its next industry event ‘Quantum Technology for Innovation in Automotive Electronics’ on 18<sup>th</sup> September at ZF Automotive UK, Solihull.

<https://qepnt.org/>



## About QEPNT - Quantum Enabled Position, Navigation and Timing

Summary by Professor Douglas Paul, OBE, University of Glasgow and Principal Investigator of QEPNT Hub

Global Navigation Satellite Signals (GNSS) such as Global Positioning System (GPS) are essential to society to provide position, navigation and timing services for the operation of critical national infrastructure.

As well as helping us to find our way, GNSS underpins vital areas of the UK’s economy and national security. The aerospace, finance, maritime, agriculture and transport sectors are all dependent on reliable GNSS signals.

However, GNSS is vulnerable to attacks and jamming. Such widespread level of jamming events will affect critical national infrastructure in the near future. London Economics have estimated a £7.6 billion cost to the UK economy if GNSS is denied for a week; the US Government estimate a \$58.2 billion cost to the US economy for 30 days of GNSS denial; and the European Radio Navigation Plan estimates that €1.4 trillion (10% GDP) of the European economy would be affected by GNSS attack.

The UK Hub for Quantum Enabled Position, Navigation and Timing (QEPNT) has the vision to develop quantum and quantum-hybrid technologies that can resiliently operate without using satellites and maintain the integrity of the UK’s infrastructure.

The Hub aims to build a UK community from academia, industry and Government stakeholders to create technologies that will harness the power of quantum timing and position sensors to free us from our reliance on satellites.

QEPNT is one of five quantum hubs launched by UKRI Engineering and Physical Sciences Research Council (EPSRC), with a £106 million investment from EPSRC, the UKRI Biotechnology and Biological Sciences Research Council (BBSRC), UKRI Medical Research Council (MRC), and the National Institute for Health and Care Research (NIHR).

The Hub, funded as part of the UK National Quantum Technology Programme, is led by world-leading researchers from the Universities of Glasgow, Bristol, Cambridge, Edinburgh, Heriot-Watt, Imperial College London, Loughborough, Strathclyde, Queen’s University Belfast and the National Physical Laboratory.



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