SENSING USING QUANTUM OCT WITH AI

Informe

Información del proyecto

SEQUOIA

Identificador del acuerdo de subvención:
101070062

DOI
10.3030/101070062

Fecha de la firma de la CE
8 Septiembre 2022

Fecha de inicio
1 Noviembre 2022

Fecha de finalización
31 Octubre 2025

Financiado con arreglo a
Digital, Industry and Space

Coste total
€ 6 435 635,00

Aportación de la UE
€ 6 435 635,00

Inversión en las prioridades políticas de la Unión Europea

- Agenda digital: ●
- Aire puro: ○
- Inteligencia artificial: ○
- Acción por el clima: ○
- Biodiversidad: ○

Coordinado por
NKT PHOTONICS A/S
Denmark

Periodic Reporting for period 1 - SEQUOIA (SENSING USING QUANTUM OCT WITH AI)

Período documentado: 2022-11-01 hasta 2024-04-30

Resumen del contexto y de los objetivos generales del proyecto

Optical coherence tomography (OCT) is a key imaging technology, especially for ophthalmology, allowing non-contact high resolution 3D imaging which has helped to save the sight of millions of people across the world. OCT developed rapidly since its invention in 1991 but has stalled since reaching the practical axial resolution (z) limit of ~1 µm (>5 µm for most commercial systems). Quantum OCT (QOCT) offers a step change ×2 improvement in z together with greatly reduced dispersion. In addition, by controlling the orbital angular momentum (OAM) it is possible to protect the system from environmental noise and deliver improved edge definition, surface profile distinction and discrimination of chiral objects. SEQUOIA aims to deliver the highest resolution OCT system ever built, protected from noise by artificial intelligence (AI) based OAM control in a real-world application: retinal imaging.

• Underpinning the SEQUOIA approach is an ultra-stable, ultra-low noise comb source of unprecedented bandwidth (250-400 nm) which builds on NKT's world-leading all-normal dispersion (ANDi) supercontinuum (SC) sources and adds new PTB techniques for stabilisation and noise control to allow the stable generation of entangled photon pairs by spontaneous parametric down conversion (SPDC).

• AI-based algorithms from UPV will be used at TUD to program spatial light modulators (SLMs) to encode high purity high-dimensional OAM onto the QOCT beams to increase noise resilience and improve imaging quality.

• MPD will advance its state-of-the-art technology to deliver new single-photon avalanche diode (SPAD) arrays specifically tailored for quantum imaging, to perform photon coincidence correlation at an unprecedented rate.

• The current NOR world-leading classical OCT data acquisition and processing software will be extended to create the first ever QOCT software, which will also include OAM analysis.

• Theoretical work at NCU will develop the first mathematical models of noise in QOCT in order to optimise the parameters of the SPDC through numerical simulation.

• PTB will perform metrological characterisation of all relevant parameters of the subsystems and the SPDC source. At DTU the integrated QOCT set-up will be characterised to show the advantage over classical OCT.

• Retinal imaging, a vital real-world application (using stable test standards from WWU) will be performed, with automated AI-algorithms (UPV) to analyse the images and compare performance with classical OCT.

• In order to develop the longer-term exploitation of the technology, ARD will perform a detailed techno-economic analysis (TEA) and social life cycle analysis (S-LCA) to evaluate potential future markets and social impacts.

• VIV will coordinate an extensive dissemination and communication programme including a high-profile SEQUOIA Advisory Board (SAB) of quantum, OCT and clinical experts of international repute and with close interaction and coordination with the Quantum Flagship.

Trabajo realizado desde el comienzo del proyecto hasta el final del período abarcado por el informe y los principales resultados hasta la fecha

Progress in the project has been good in the first Period. For confidentiality reasons, some of the material cannot be made publicly available at this stage. However, some aspects are already published and in the public domain.

New durable retinal test samples for high resolution testing of imaging systems at WWU with UPV
https://doi.org/10.1117/12.3002538

Fundamental theoretical work on super-resolution in OCT systems at NCU
https://doi.org/10.1117/12.3005421
https://doi.org/10.1117/12.2668845

Some of the first investigations into the use of orbital angular momentum in QOCT at DTU
https://doi.org/10.1117/12.3000075
https://doi.org/10.1117/12.3000318

Avances que van más allá del estado de la técnica e impacto potencial esperado (incluida la repercusión socioeconómica y las implicaciones sociales más amplias del proyecto hasta la fecha)

Will be clarified at the end of the project.

Última actualización: 29 Julio 2024

Permalink: https://cordis.europa.eu/project/id/101070062/reporting/es