

Utilising quantum computing for breast cancer subtyping

STFC Hartree® Centre worked with Royal Brompton Harefield Hospitals, Imperial College London and IBM through the Hartree National Centre for Digital Innovation (HNCDI) using quantum computing to differentiate between breast cancer subtypes.

Challenge

The gold standard for diagnosing cancer is the histological assessment of tissue samples, which requires pathologists to examine tissues at a cellular and subcellular level. Machine learning is a powerful tool that has been used to automate this process by analysing digitised Whole Slide Images (WSI). WSI are extremely large digital images that contain complex biological information, meaning analysis of WSI requires significant computational resources. Accurate and rapid determination of cancer subtypes is needed for the prediction of patient prognosis, as well as identification of the most suitable treatment option for individuals. We worked with Royal Brompton and Harefield Hospitals, Imperial College London, Warwick University and IBM to explore their novel research project for a new method that aims to leverage the unique features of quantum computing to improve the speed and accuracy of computational pathology for subtyping cancer.

Approach

Building on previous research by Royal Brompton and Harefield Hospitals, Imperial College London and IBM, the collaborative team integrated quantum machine learning into an existing AI workflow which extracts data from WSI. They trained the quantum machine learning algorithm using pre-processed data, enabling the classification of breast cancer subtypes. This method demonstrated consistent accuracy compared to other AI models but was hindered by scalability issues. To overcome this challenge, the team developed a new theoretical methodology. This innovative approach enables the analysis of WSI while maintaining classification accuracy using 50% less datasets as well as fewer quantum resources, making the process approximately 25 times faster.

“Funding from the HNCDI program was key to developing this first step in quantum computational pathology and precision medicine.”

Jan-Lukas Robertus

Royal Brompton
Harefield Trust



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Benefits

Leveraging quantum computing to accurately classify cancerous cells has the potential to deliver improvement to current machine learning approaches for subtyping malignancies. The novel approaches developed during this collaboration present a significant paradigm shift in computational pathology, and will support the development of other quantum-enabled solutions for the diagnosis of cancer. This research represents a first step towards applied quantum computational pathology and precision medicine which will allow us to address a broad range of challenges in healthcare and quantum resource requirements.

At a glance

- Faster cancer subtyping using less data compared to previous computational pathology methods.
- Prospective advancements in cancer classification techniques and methodologies.
- Novel approaches that push the cutting edge of quantum computing research in healthcare.
- Potential to increase efficiency in the healthcare sector by speeding up and standardising cancer subtyping.

Who we are

The Hartree Centre was created by UK Government to help businesses and public sector organisations accelerate the adoption of high performance computing (HPC), big data analytics, artificial intelligence (AI) and quantum technologies. We play a key role in realising UK Government's Industrial Strategy by stimulating applied digital research and innovation, creating value for the organisations we work with and generating economic and societal impact for the UK. We are proud to be part of UK Research and Innovation.

What we do

- Boost productivity and innovation for industry
- Offer training and skills development
- Provide insights into future technologies
- Give tailored business development support
- Build bespoke small teams around your project

