NVIDIA, Rolls-Royce and Classiq Announce Quantum Computing Breakthrough for Computational Fluid Dynamics in Jet Engines

World's Largest Quantum Circuit for Industrial Simulation to Advance Development of Quantum Computing in Aerospace

ISC—NVIDIA, Rolls-Royce and Classiq, a quantum software company, today announced a quantum computing breakthrough aimed at bringing ever-increasing efficiency to jet engines.

Using NVIDIA's quantum computing platform, the companies have designed and simulated the world's largest quantum computing circuit for computational fluid dynamics (CFD) — a circuit that measures 10 million layers deep with 39 qubits. By using GPUs, Rolls-Royce is preparing for a quantum future despite the limitations of today's quantum computers, which only support circuits a few layers deep.

Rolls-Royce plans to use the new circuit on its journey to quantum advantage in CFD for modeling the performance of jet engine designs in simulations that use both classical and quantum computing methods.

Such breakthroughs are important to Rolls-Royce, a world leader in the aviation industry, in its work to build state-of-the-art jet engines that support the energy transition with more sustainable aviation.

"Designing jet engines, which are one of the most complicated devices on earth, is expensive and computationally challenging," said Ian Buck, vice president of hyperscale and HPC at NVIDIA. "NVIDIA's quantum computing platform gives Rolls-Royce a potential path to tackle these problems head-on while accelerating its research and future development of more efficient jet engines."

"Applying both classical and quantum computing methods directly to the challenge of designing jet engines will help us accelerate our processes and perform more sophisticated calculations," said Leigh Lapworth, computational science fellow at Rolls-Royce.

Rolls-Royce and its partner, Israel-based Classiq, designed the circuit using Classiq's synthesis engine and then simulated it using NVIDIA® A100 Tensor Core GPUs. The speed and scale of the process was made possible by NVIDIA cuQuantum, a software development kit that includes optimized libraries and tools to speed up quantum computing workflows.

NVIDIA Grace Hopper Accelerates Quantum Computing
NVIDIA offers a unified computing platform for speeding breakthroughs in quantum research and development across disciplines. The NVIDIA Grace Hopper Superchip, which combines the groundbreaking performance of NVIDIA Hopper™ architecture GPUs with the versatility of the NVIDIA Grace CPUs, is ideally designed for giant-scale quantum simulation workloads.

Additionally, its high-speed, low-latency NVIDIA NVLink®-C2C interconnect makes classical systems built with the superchip optimally suited to link to quantum processors, or QPUs. With a total 600GB of fast-accessible memory per node, Grace Hopper enables the quantum ecosystem to push these simulations to an even larger scale.

A strategic bridge to the quantum future, Grace Hopper powers DGX™ Quantum, the world's first GPU-accelerated quantum computing system combining quantum computing with state-of-the-art classical computing. NVIDIA also provides developers with NVIDIA CUDA® Quantum, a robust open-source programming model that links GPUs and QPUs.

NVIDIA's Quantum Ecosystem Expands
A vast array of the world's quantum computing research now runs on NVIDIA GPUs.

The Jülich Supercomputer Centre, one of Europe's largest facilities for quantum computing, also announced at ISC plans to build a quantum computing lab with NVIDIA, highlighting the growing importance of hybrid quantum-classical computing systems. The lab will also help developers advance the field of quantum computing with tools like CUDA Quantum.

Additionally, ORCA Computing is the latest QPU builder to integrate CUDA Quantum, combining its photonic quantum computer with GPUs for machine learning. TensorFlow Quantum and TorchQuantum — two popular quantum machine learning frameworks — now also integrate cuQuantum. The majority of the world's quantum computing software today supports GPU acceleration with the NVIDIA quantum platform.

Learn more about the NVIDIA quantum computing platform at ISC.

About NVIDIA
Since its founding in 1993, NVIDIA (NASDAQ: NVDA) has been a pioneer in accelerated computing. The company's invention of the GPU in 1999 sparked the growth of the PC gaming market, redefined computer graphics, ignited the era of modern AI and is fueling the creation of the industrial metaverse. NVIDIA is now a full-stack computing company with data-center-scale offerings that are reshaping industry. More information at https://nvidianews.nvidia.com/.

Certain statements in this press release including, but not limited to, statements as to: the benefits, impact, performance, features and availability of our products, collaborations, services, and technologies, including NVIDIA's quantum computing platform, NVIDIA GPUs including NVIDIA A100 Tensor Core GPUs, NVIDIA cuQuantum, NVIDIA Grace Hopper Superchips, NVIDIA Hopper architecture GPUs, NVIDIA Grace CPUs, NVIDIA NVLink-C2C interconnect, DGX Quantum and NVIDIA CUDA Quantum; our collaborations with Rolls-Royce, Classiq, Jülich Supercomputer Centre and ORCA Computing, and the benefits, impact, features and availability thereof; the expensive and computationally challenging nature of designing jet engines; a vast array of the world's quantum computing research now running on NVIDIA GPUs; and the majority of the world's quantum computing software today supporting GPU acceleration with the NVIDIA quantum platform are forward-looking statements that are subject to risks and uncertainties that could cause results to be materially different than expectations. Important factors that could cause actual results to differ materially include: global economic conditions; our reliance on third parties to manufacture, assemble, package and test our products; the impact of technological development and competition; development of new products and technologies or enhancements to our existing product and technologies; market acceptance of our products or our partners' products; design, manufacturing or software defects; changes in consumer preferences or demands; changes in industry standards and interfaces; unexpected loss of performance of our products or technologies when integrated into systems; as well as other factors detailed from time to time in the most recent reports NVIDIA files with the Securities and Exchange Commission, or SEC, including, but not limited to, its annual report on Form 10-K and quarterly reports on Form 10-Q. Copies of reports filed with the SEC are posted on the company's website and are available from NVIDIA without charge. These forward-looking statements are not guarantees of future performance and speak only as of the date hereof, and, except as required by law, NVIDIA disclaims any obligation to update these forward-looking statements to reflect future events or circumstances.

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