

Quantum Computing Research Activities & Experts in Iceland

Executive Summary

Quantum computing is one type of "Next Generation Computing" with new algorithms that scale better and offer new approaches to solve computing problems more energy-efficiently¹. Iceland performs several quantum computing research activities as part of the National Competence Center for Icelandic High-Performance Computing (HPC) and Artificial Intelligence (AI) in Iceland (IHPC NCC Iceland²). In addition, quantum computing expertise is also offered through the IHPC NCC Iceland within the European Digital Innovation Hub of Iceland (EDIH-IS³) by different experts from the University of Iceland (HI).

While quantum computing offers various approaches, Iceland's current activities and expertise focus on "quantum annealing" and its application in solving complex optimisation problems. A short introduction to quantum computing in general and quantum annealing, in particular, was given at the Icelandic UT Messan in 2020⁴. The IHPC NCC Iceland and HI collaborate in that context with the German Juelich Unified Infrastructure for Quantum Computing (JUNIQ)⁵ facility that hosts a D-Wave Quantum Annealer quantum computer. The research activities led to many publications by HI PhD students and professors in solving complex optimisation problems for AI methods, such as those required in application fields like remote sensing. Within the more extensive European network of EuroCC NCCs for HPC and AI across 33 countries⁶, Iceland is active in the "CASTIEL Quantum Working Group" and is being recognised as one European expert country. Iceland is also part of the international LUMI Supercomputer⁷ consortium that recently acquired a quantum computing module, and future research activities will also leverage this device.

On the national level, the IHPC NCC Iceland and HI have also successfully obtained two grants from RANNIS for summer students ("Nýsköpunarsjóður námsmanna") in the last two years. Also, several summer schools have been co-organized and performed by IHPC NCC Iceland in collaboration with the international "IEEE High-Performance and Disruptive Computing in Remote Sensing (HDCRS) Working Group"⁸. Finally, discussions with Icelandic companies (e.g., the Decode Genetics IT department) indicated an interest in observing quantum computing technologies for future use and the need for knowledge exchange.

Selected Icelandic Experts / Contacts

- Prof. Dr. – Ing. Morris Riedel, Full Professor, HI, Head of IHPC NCC Iceland: morris@hi.is
- Prof. Dr. – Ing. Gabriele Cavallaro, Associated Professor, HI: g.cavallaro@fz-juelich.de
- Dr. Heman Hemanadhan Myneni, PostDoc, HI: myneni@hi.is
- PhD Student Amer Delilbasic, HI & Juelich Supercomputing Centre: a.delilbasic@fz-juelich.de
- PhD Student Marcel Aach, HI & Juelich Supercomputing Centre: m.aach@fz-juelich.de

¹ The Scientific Case for Computing in Europe 2018-2026, Online: <https://prace-ri.eu/wp-content/uploads/2019/08/PRACEscientificCase.pdf>

² IHPC NCC Iceland Community, Online: <https://ihpc.is/community/>

³ EDIH-IS, Online: <https://edih.is/>

⁴ UT Messan 2020, Demystifying Quantum Computing, Online: <https://www.youtube.com/watch?v=EQGshhspn9A>

⁵ JUNIQ facility of the Juelich Supercomputing Centre, Online: <https://www.fz-juelich.de/en/ias/jsc/systems/quantum-computing/juniq-facility>

⁶ EuroCC2/CASTIEL NCCs for HPC and AI Network, Online: <https://www.eurocc-access.eu/>

⁷ LUMI Supercomputer Quantum Module LUMI-Q, Online: <https://lumi-supercomputer.eu/czechia-will-host-the-european-lumi-q-quantum-computer/>

⁸ HDCRS Summer School 2022, Online: <https://www.grss-ieee.org/community/groups-initiatives/high-performance-and-disruptive-computing-in-remote-sensing-hdcrs/hdcrs-summer-school-2022/>