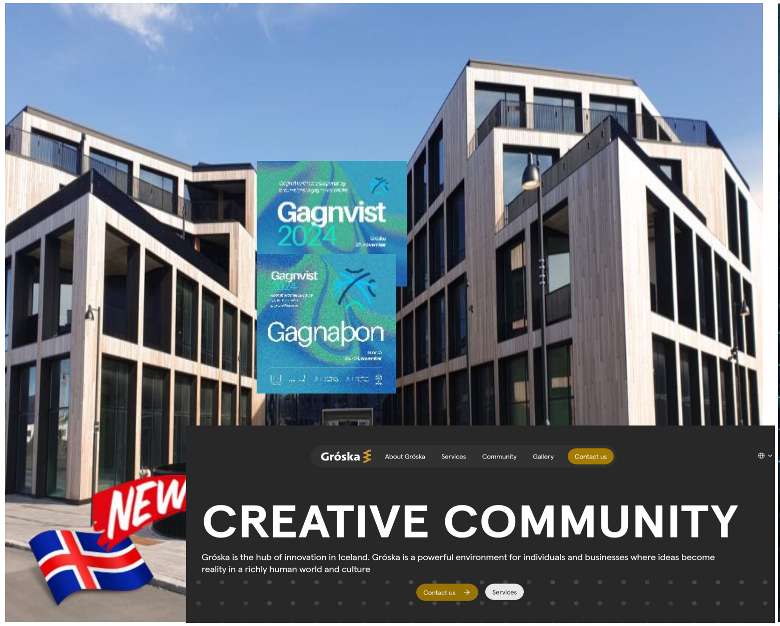


Icelandic National Competence Center (NCC) for HPC & AI – Quantum Computing Activities

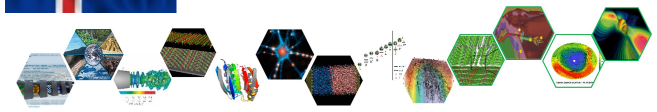
PROF. DR. – ING. MORRIS RIEDEL, SCHOOL OF ENGINEERING & NATURAL SCIENCES (SENS), UNIVERSITY OF ICELAND

MINISTRY APPOINTED EUROHPC JOINT UNDERTAKING GOVERNING BOARD MEMBER OF ICELAND

HEAD OF THE EUROCC2 NATIONAL COMPETENCE CENTER (NCC) FOR HPC & AI – ICELANDIC HPC (IHPC) COMMUNITY

4TH DECEMBER 2024, QUANTUM AUTUMN SCHOOL 2024 EVENT, STOCKHOLM, SWEDEN

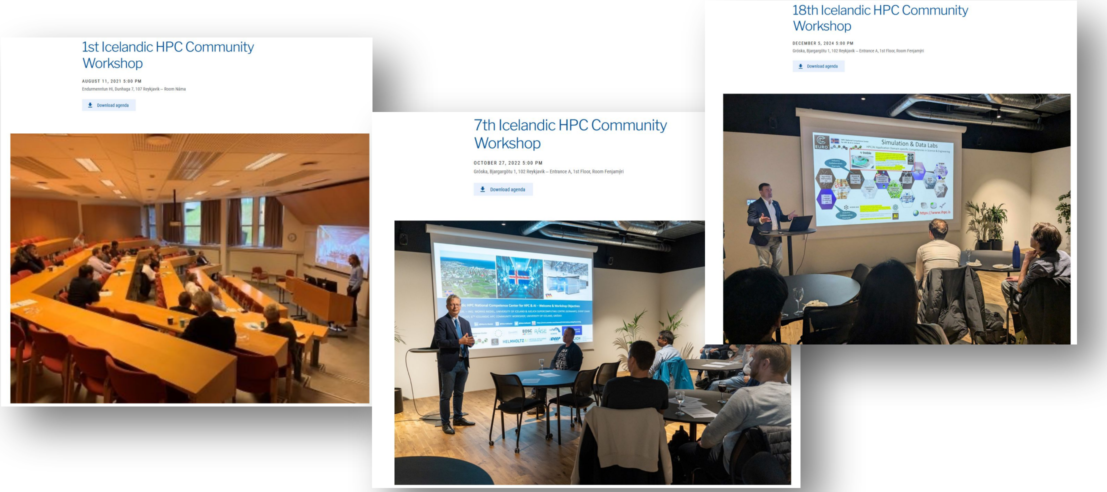
IHPC National Competence Center for HPC & AI in Iceland



EURO² · UNIVERSITY OF ICELAND · EUROPEAN DIGITAL INNOVATION HUB EDIH ICELAND · LUMI · TrustLLM · JÜLICH Forschungszentrum | JUNIQ QUANTUM USER FACILITY · EuroHPC Joint Undertaking · RAISE Center of Excellence · DEEP Projects · JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

NCC Iceland – Part of a Larger European Network of NCCs

https://www.ihpc.is



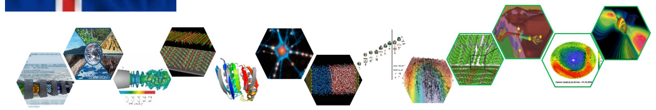
[1] IHPC.IS

[2] EuroHPC JU

[3] EuroCC Projects

[4] Digital Europe Programme

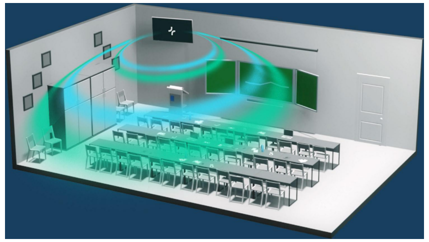
IHPC National Competence Center for HPC & AI in Iceland



NCC Iceland – Application Domain-Specific Simulation & Data Labs (SDLs)

[5] Treble

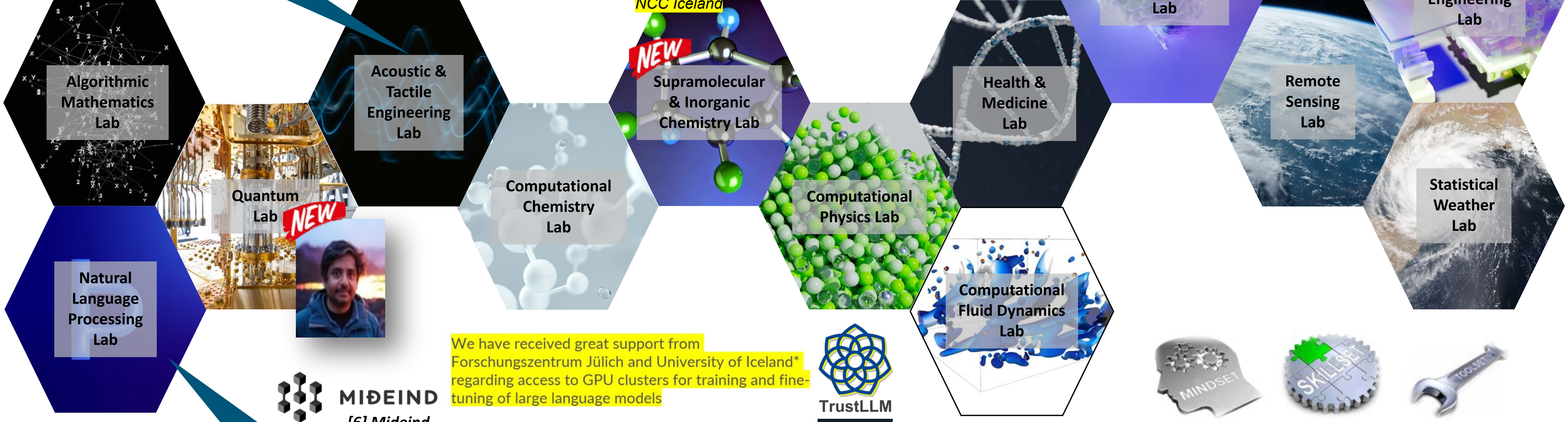
treble



With NCCs help we have been able to run our wave based acoustic simulations on GPU based HPC systems allowing us to run larger simulations than ever before and making it possible for Treble to verify the accuracy of our technology. We are grateful to have received HPC access through the NCC Iceland, including user support on technical environments, scalability, and configuration of the HPC systems. We are happy therefore to have contributed to one success story of the collaboration from Treble with NCC Iceland

EUROPEAN DIGITAL INNOVATION HUB
EDIH ICELAND

Industry Collaboration Example



MIÐEIND

[6] Mideind

We have received great support from Forschungszentrum Jülich and University of Iceland* regarding access to GPU clusters for training and fine-tuning of large language models

We are looking to contribute to European projects to support smaller languages in NLP and AI

** Many thanks to Prof. Dr. - Ing. Morris Riedel & his NCC team!*

TrustLLM

AI SWEDEN

Industry Collaboration Example

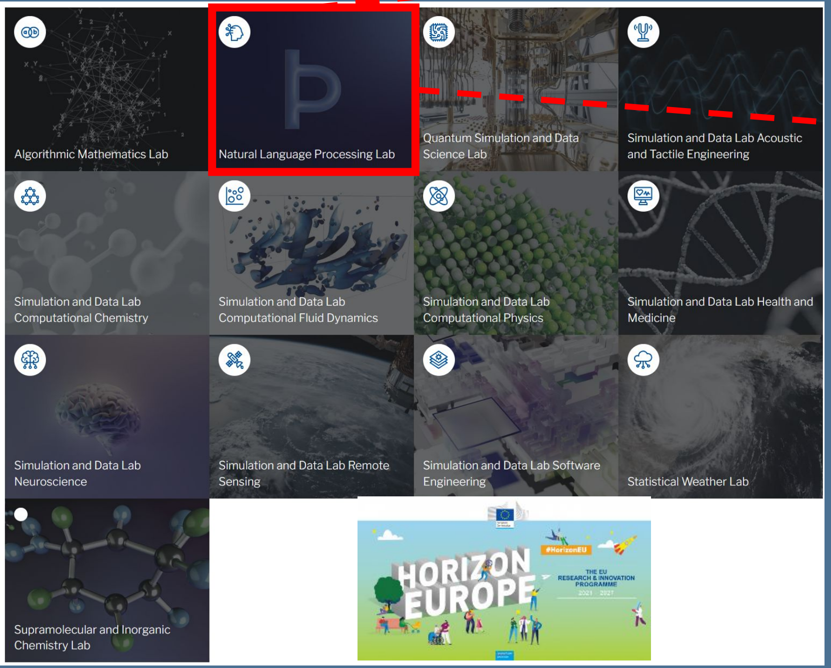
https://www.ihpc.is

Combining Scientific Domain-Specific Icelandic HPC/AI Competencies

TrustLLM

[7] TrustLLM

Icelandic is a low-resource language (i.e., less corpora to train AI/LLMs) – Google Translate & ChatGPT without 'innovative approaches' do not work very well



HEAD OF THE LAB

Prof. Dr. Hafsteinn Einarsson

Assistant Professor at Háskóli Íslands

Hafsteinn is an assistant professor at the School of Engineering and Natural Sciences of the University of Iceland. He received his Ph.D. in Computer Science from ETH in 2017. He has worked on applied ML solutions for startups and in the Icelandic banking sector. He is currently focused on natural language processing, interpretable ML methods and optimization problems.

Annika Simonsen

Ph.D. Student - University of Iceland

Annika is an Ph.D. student in artificial intelligence and language technology at the School of Engineering and Natural Sciences of the University of Iceland. She had an MSc in Applied Linguistics from the University of Edinburgh ('19) and an MA in Language Technology from the University of Iceland ('24). Her Ph.D. is part of the TrustLLM project, which is developing an open, trustworthy, and sustainable LLM initially targeting the Germanic languages. Annika's Ph.D. project revolves around the alignment of the neural network that will be developed in the TrustLLM project with a special focus on the low-resource languages.

Hans Erik Mathias Stenlund

Ph.D. Student - University of Iceland

Mathias is a Ph.D. student in the fields of language technology and high-performance computing at the School of Engineering and Natural Sciences of the University of Iceland. He is currently partaking in the European TrustLLM project that aims to create the next generation of trustworthy and open LLMs for the Germanic languages. In 2023, he earned his master's degree in language technology from Uppsala University, where he previously also earned his bachelor's degree in linguistics.

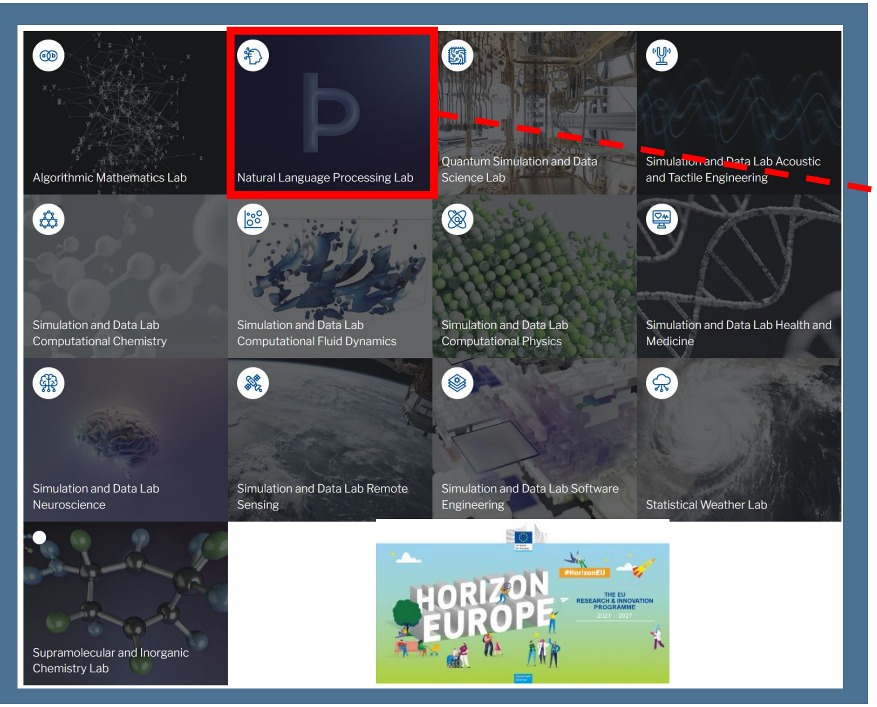
Vésteinn Snæbjarnarson

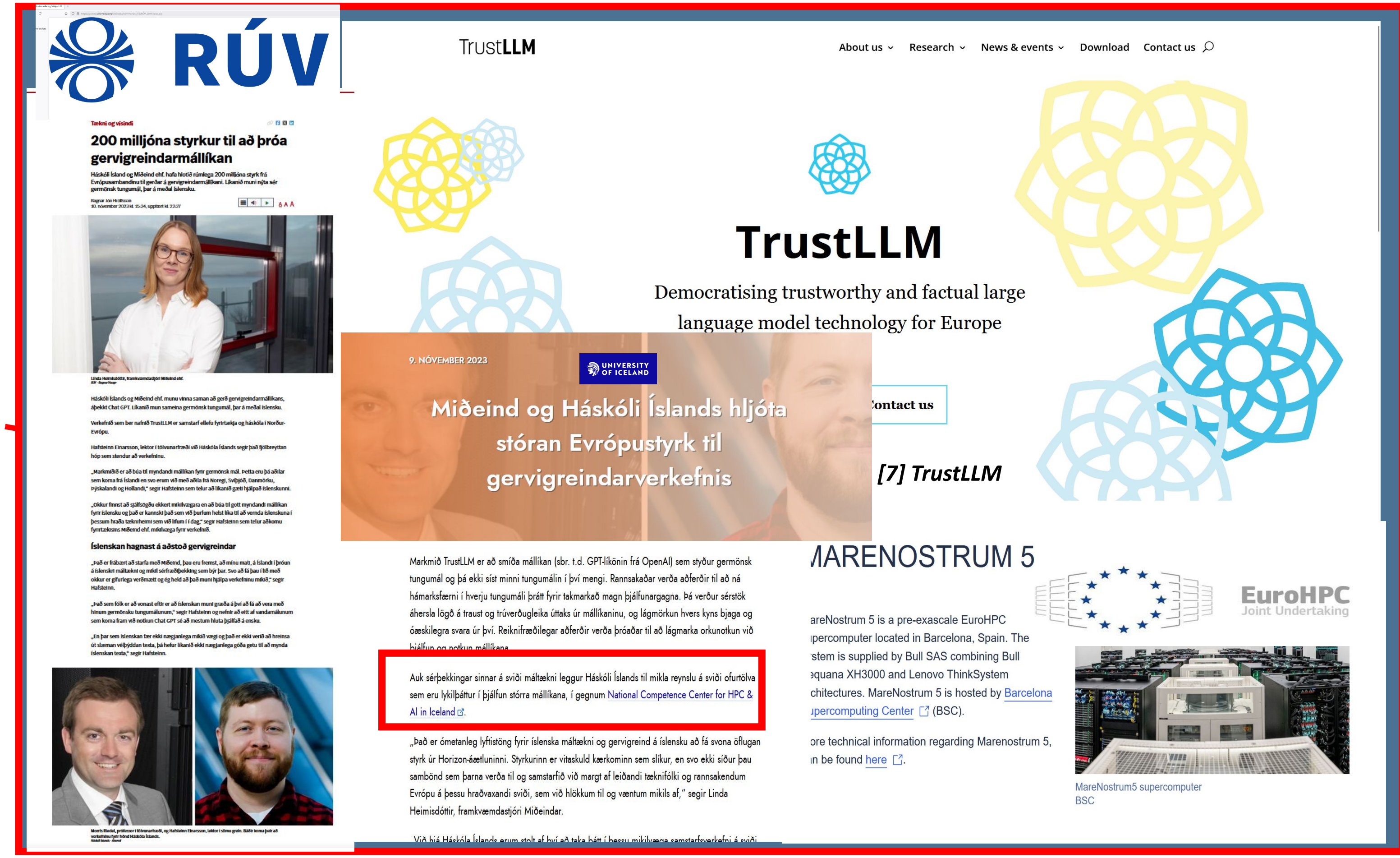
Ph.D. student at the University of Copenhagen

Vésteinn, a dedicated ELLIS PhD student at the Pioneer Centre for Artificial Intelligence, delves into the realms of natural language processing and computer vision. Based at the University of Copenhagen and advised by Serge Belongie, with co-advisory from Ryan Cotterell at ETH Zürich, he explores multimodal settings that combine methods for NLP and Computer Vision. His research pursuits also encompass compositionality of embedding spaces and generative models. Vésteinn's academic journey commenced with a BA in Philosophy and a BS in Mathematics from the University of Iceland, followed by an MS in Computer Science, where his thesis addressed Question Answering for Icelandic. He's also associated with Icelandic language technology company, Miðeind ehf. Currently, Vésteinn's work pivots around descriptive image captioning and fine-grained visual categorization.

Combining Scientific Domain-Specific Icelandic HPC/AI Competencies

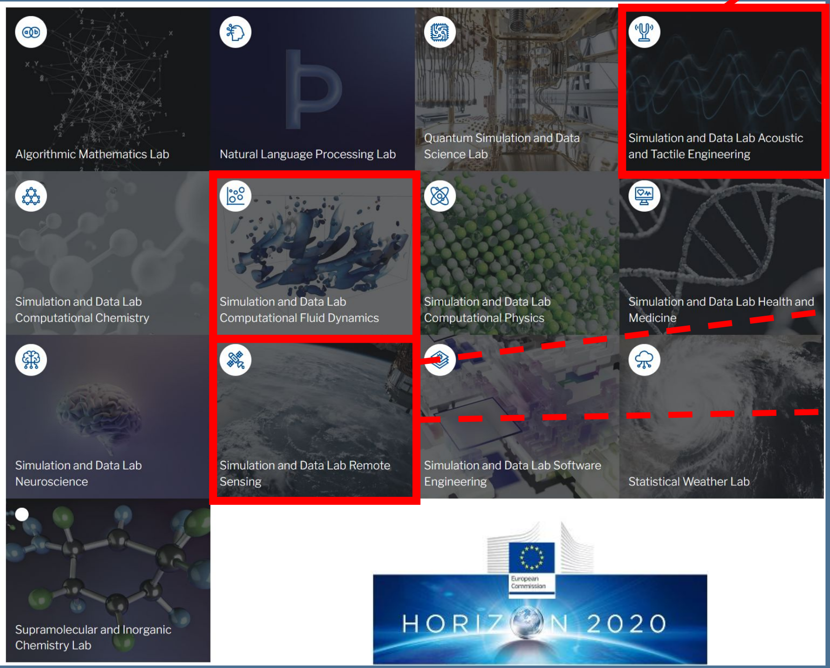
[7] TrustLLM

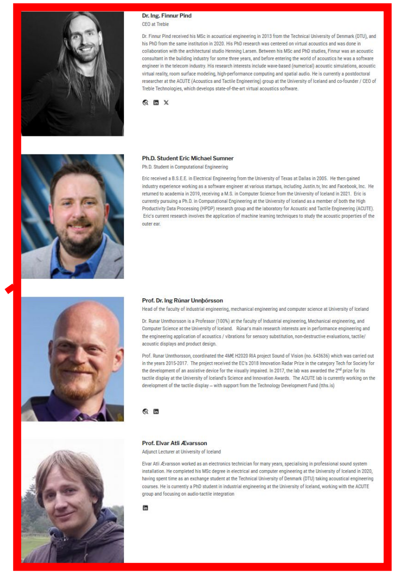


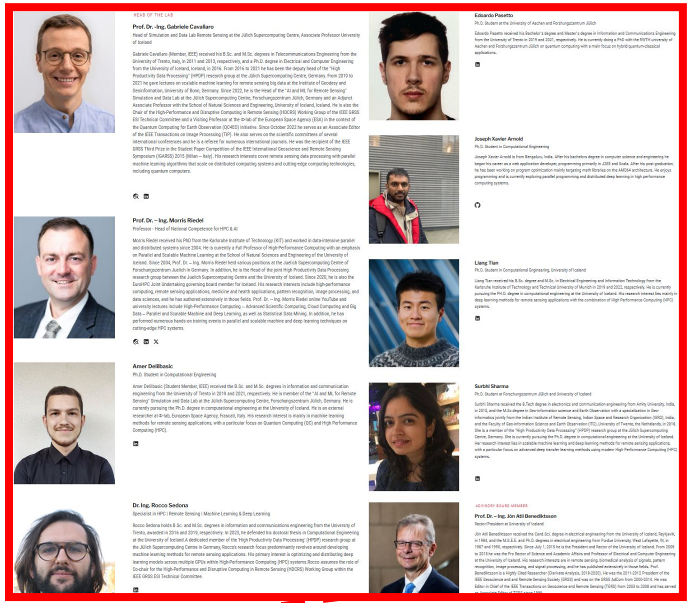


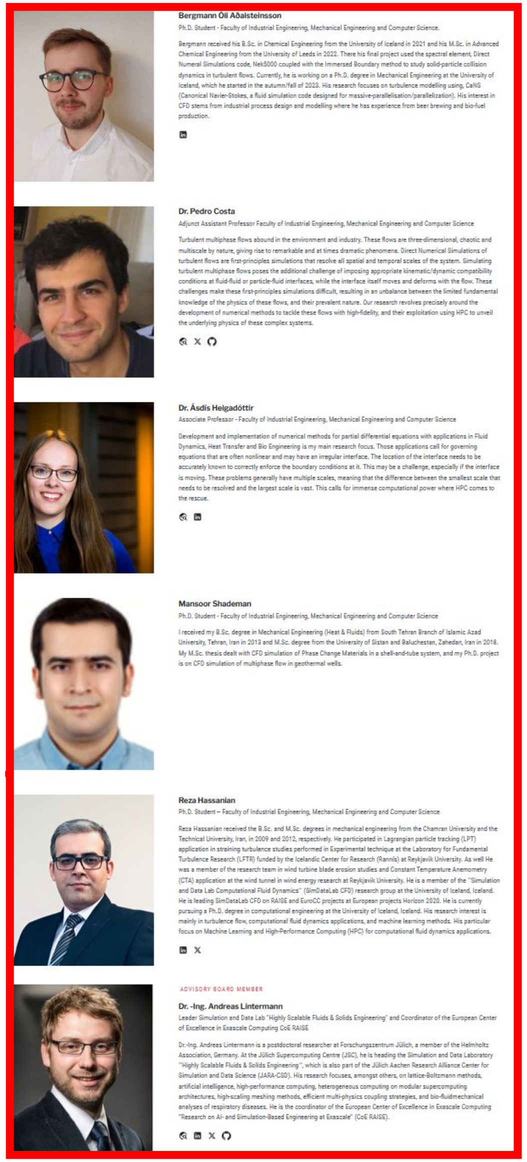
Combining Scientific Domain-Specific Icelandic HPC/AI Competencies

[8] CoE RAISE





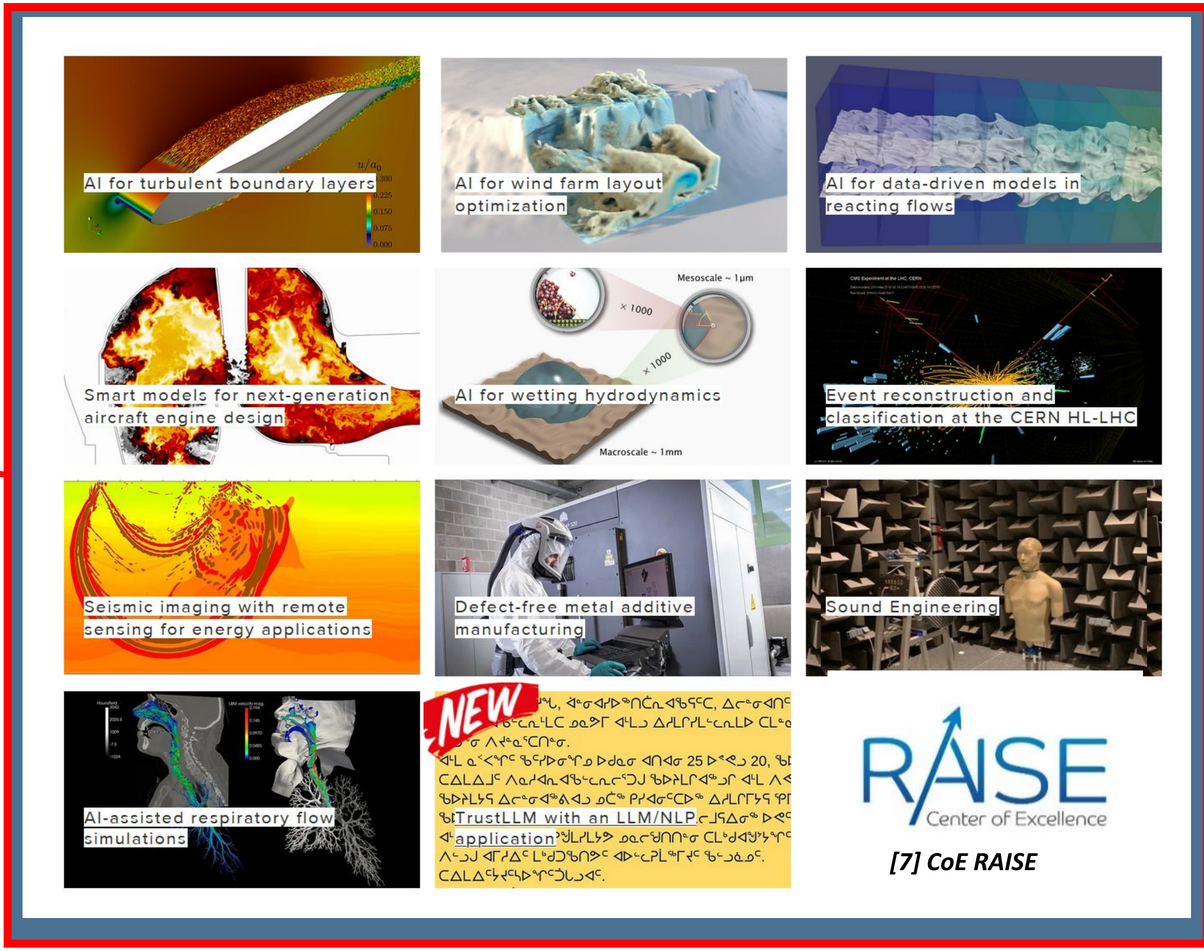




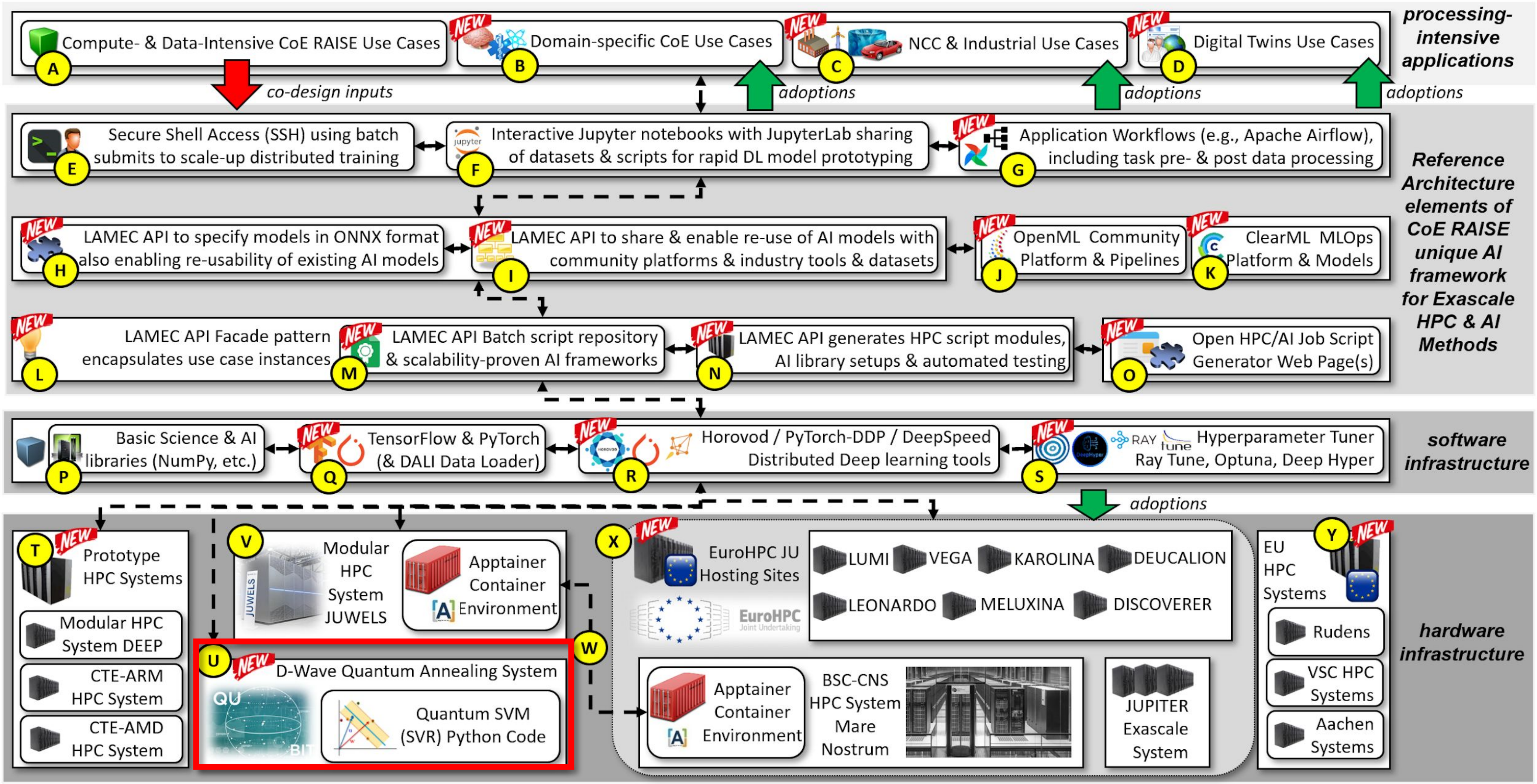
Combining Scientific Domain-Specific Icelandic HPC/AI Competencies

[8] CoE RAISE

[9] JUNIQ



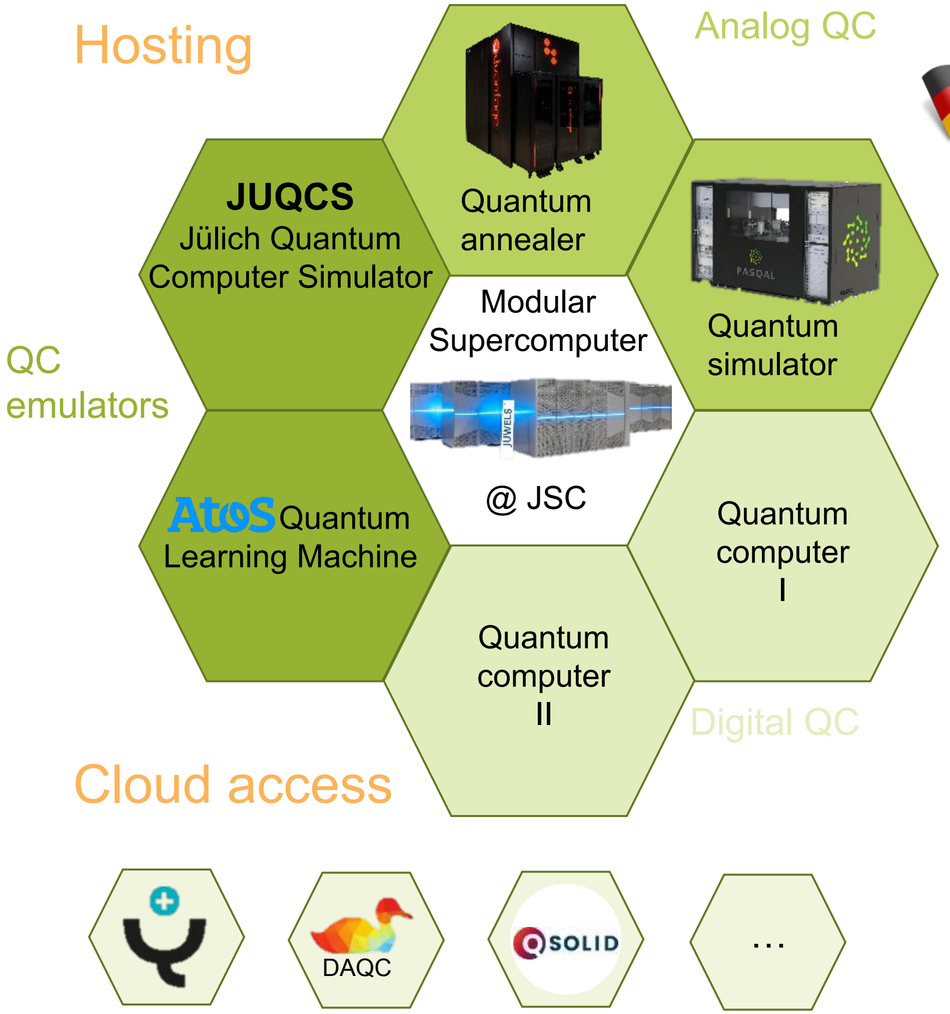
CoE RAISE Outcome – Unique AI Framework (UAIF) & Quantum Computing



[8] CoE RAISE

[10] M. Riedel & C. Barakat et al., "Enabling Hyperparameter-Tuning of AI Models for Healthcare using the CoE RAISE Unique AI Framework for HPC, 2023

Selected Quantum Computing Activities: Strong Icelandic–German Cooperation



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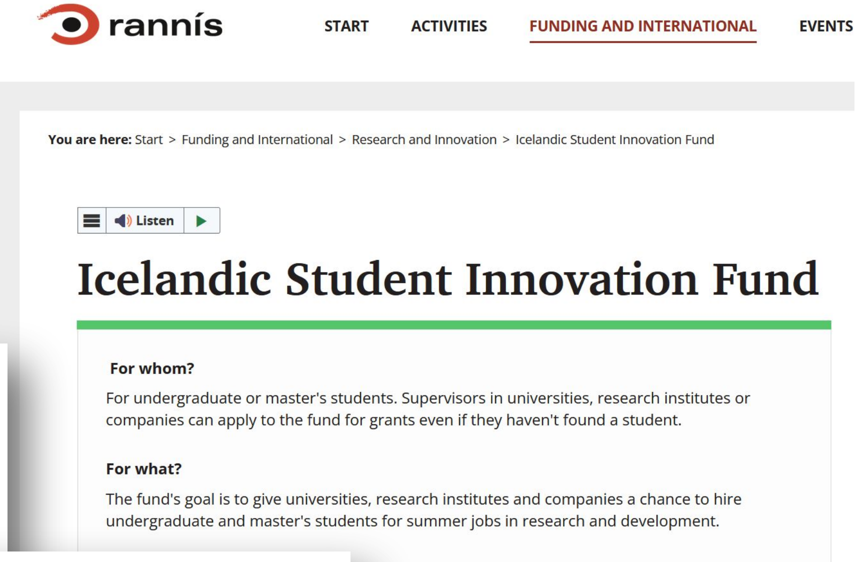
JÜLICH Forschungszentrum | JUNIQ QUANTUM USER FACILITY

[9] JUNIQ



rannís START ACTIVITIES FUNDING AND INTERNATIONAL EVENTS

You are here: Start > Funding and International > Research and Innovation > Icelandic Student Innovation Fund

Listen

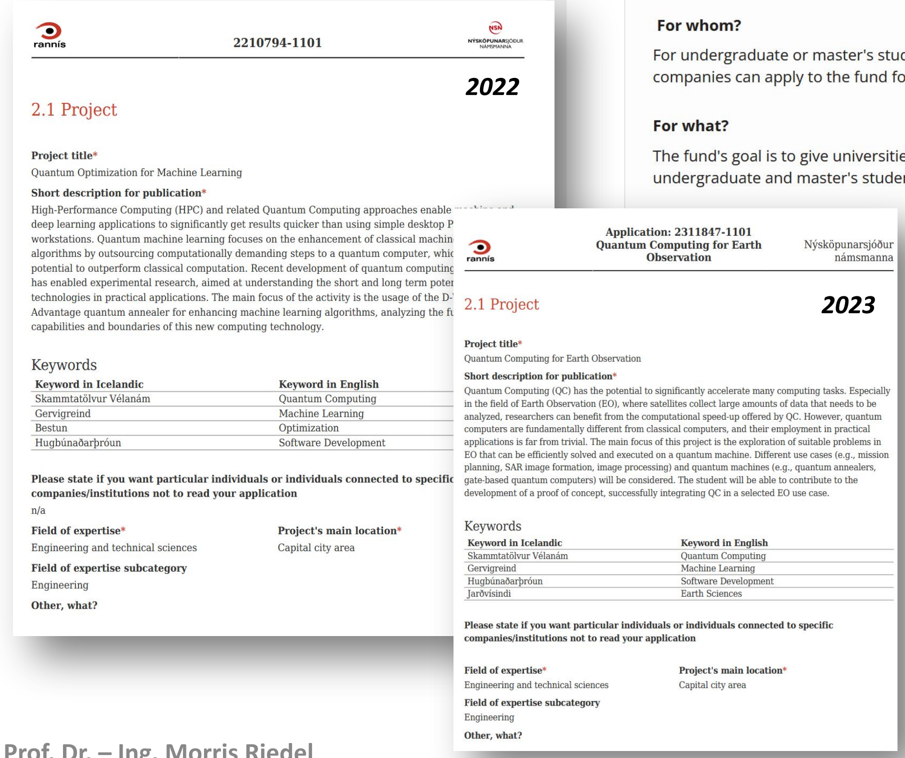
Icelandic Student Innovation Fund

For whom?

For undergraduate or master's students. Supervisors in universities, research institutes or companies can apply to the fund for grants even if they haven't found a student.

For what?

The fund's goal is to give universities, research institutes and companies a chance to hire undergraduate and master's students for summer jobs in research and development.



rannís 2210794-1101 NÝSKÖPUNARSJÓÐUR NÁMSMANNA

2022

2.1 Project

Project title*

Quantum Optimization for Machine Learning

Short description for publication*

High-Performance Computing (HPC) and related Quantum Computing approaches enable
deep learning applications to significantly get results quicker than using simple desktop P
workstations. Quantum machine learning focuses on the enhancement of classical machin
algorithms by outsourcing computationally demanding steps to a quantum computer, whic
potential to outperform classical computation. Recent development of quantum computing
has enabled experimental research, aimed at understanding the short and long term poter
technologies in practical applications. The main focus of the activity is the usage of the D-
Advantage quantum annealer for enhancing machine learning algorithms, analyzing the fu
capabilities and boundaries of this new computing technology.

Keywords

Keyword in Icelandic	Keyword in English
Skammtatölvur Vélanám	Quantum Computing
Gervigreind	Machine Learning
Bestun	Optimization
Hugbúnaðarþróun	Software Development

Please state if you want particular individuals or individuals connected to specific companies/institutions not to read your application

n/a

Field of expertise* Engineering and technical sciences

Project's main location* Capital city area

Field of expertise subcategory Engineering

Other, what?

rannís **Application: 2311847-1101 Quantum Computing for Earth Observation** Nýsköpunarsjóður námsmanna

2023

2.1 Project

Project title*

Quantum Computing for Earth Observation

Short description for publication*

Quantum Computing (QC) has the potential to significantly accelerate many computing tasks. Especially in the field of Earth Observation (EO), where satellites collect large amounts of data that needs to be analyzed, researchers can benefit from the computational speed-up offered by QC. However, quantum computers are fundamentally different from classical computers, and their employment in practical applications is far from trivial. The main focus of this project is the exploration of suitable problems in EO that can be efficiently solved and executed on a quantum machine. Different use cases (e.g., mission planning, SAR image formation, image processing) and quantum machines (e.g., quantum annealers, gate-based quantum computers) will be considered. The student will be able to contribute to the development of a proof of concept, successfully integrating QC in a selected EO use case.

Keywords

Keyword in Icelandic	Keyword in English
Skammtatölvur Vélanám	Quantum Computing
Gervigreind	Machine Learning
Hugbúnaðarþróun	Software Development
Jarðvísindi	Earth Sciences

Please state if you want particular individuals or individuals connected to specific companies/institutions not to read your application

Field of expertise* Engineering and technical sciences

Project's main location* Capital city area

Field of expertise subcategory Engineering

Other, what?

UNIVERSITY OF ICELAND

Selected Quantum Computing Activities: Using D-Wave Advantage system JUPSI

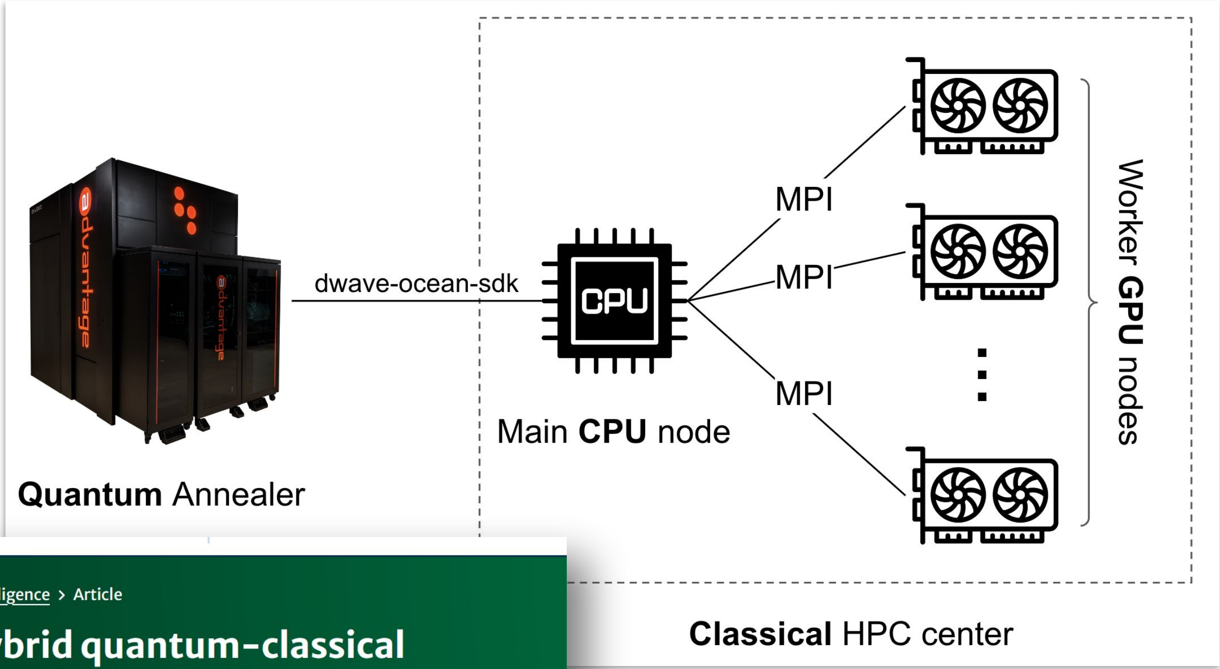
JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

JÜLICH Forschungszentrum | JUNIQ QUANTUM USER FACILITY

- Facts
  - First Quantum Annealer (QA) in Europe in operation at Jülich Supercomputing Centre
  - (also one of the largest with 5,617 qubits)
  - Number of qubits is large – yet the actual size of problems that can be computed is small (i.e., downsizing problems from earth observation)
  - Results can be improved in several use cases
  - 5 hours of additional compute time (10h total) on QA granted to CoE RAISE partners
- Interesting time-to-solution
  - Note that one run on this Quantum device usually requires only (milli–)seconds
  - E.g., compare runtime in machine learning optimisation with stochastic gradient descent

Selected Quantum Computing Activities: Hyperparameter Optimization (HPO)

- CoE RAISE Studies
  - Quantum Support Vector Regression (Q-SVR) with Swift Hyperband (HPO algorithm)
- Approach
  - Train several models with different hyperparameters until a certain threshold in time (i.e., 20 epochs) is reached on a classical HPC system
  - Transfer the (incomplete) learning curves of these models to a QA
  - Fit a Q-SVR to predict the performance for the rest of the epochs
  - Train the models with the best performance (according to the regression model) until completion on the classical HPC system



Home > Quantum Machine Intelligence > Article

Distributed hybrid quantum-classical performance prediction for hyperparameter optimization

Research Article | Open access | Published: 14 September 2024
Volume 6, article number 59, (2024) Cite this article

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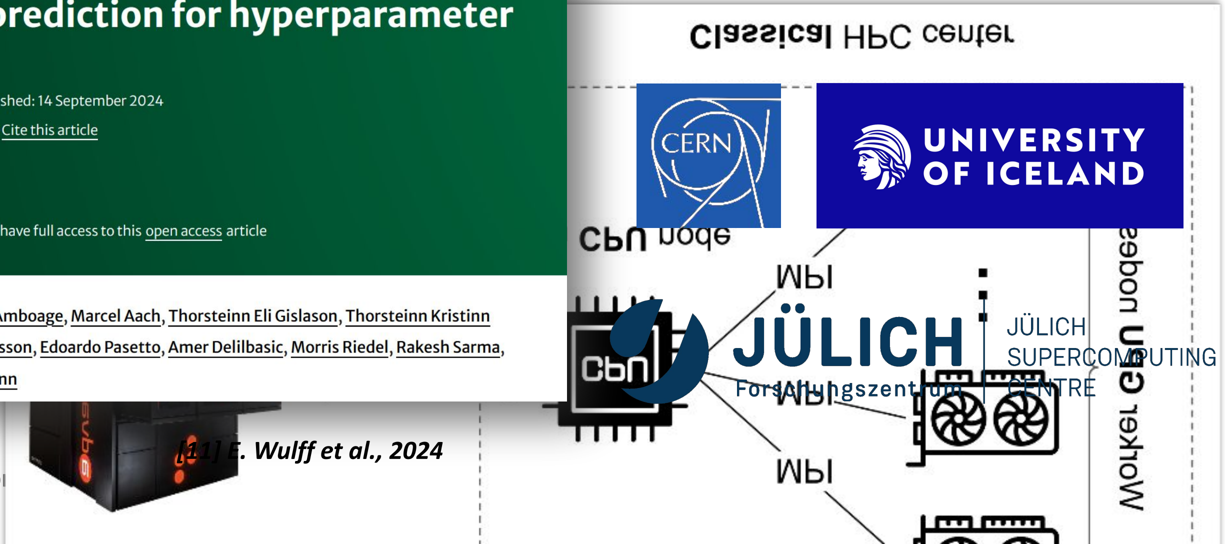
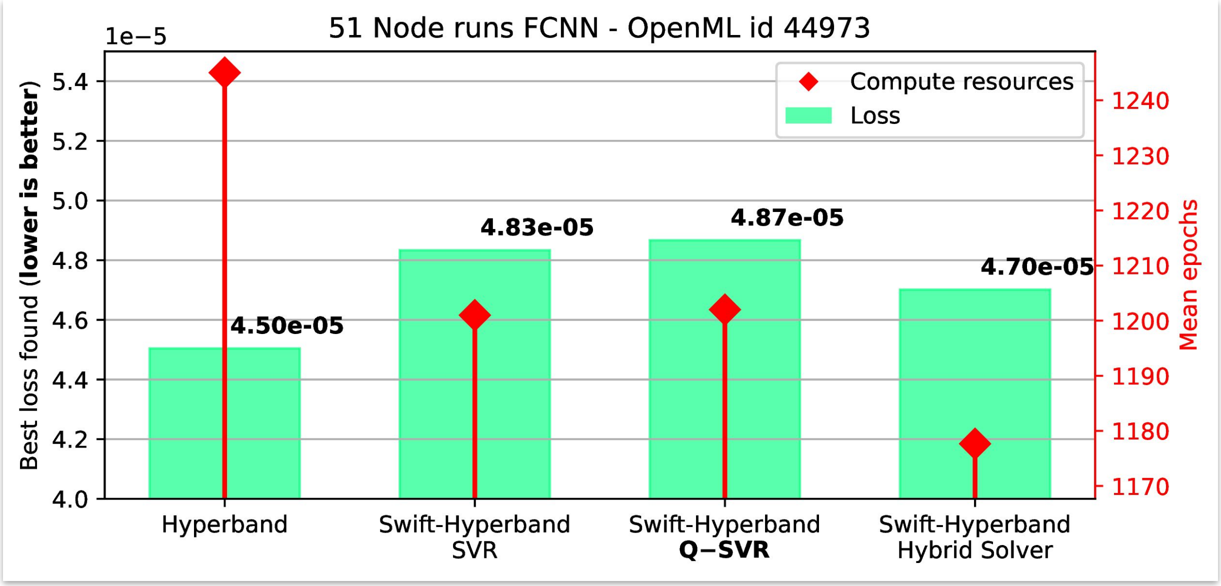
Eric Wulff, Juan Pablo Garcia Amboage, Marcel Aach, Thorsteinn Eli Gislason, Thorsteinn Kristinn Ingolfsson, Tomas Kristinn Ingolfsson, Edoardo Pasetto, Amer Delilbasic, Morris Riedel, Rakesh Sarma, Maria Girone & Andreas Lintermann



[11] E. Wulff et al., 2024

Selected Quantum Computing Activities: HPO Comparisons & Q-SVR Results

- Findings
  - Swift Hyberband provides similar target model performance as *default* Hyperband while consuming fewer computational resources (~ 9.4% for NN training on cifar-10)
  - QSVR consumes fewer epochs than the SVR for the NN cases (cifar-10 & TinyImageNet), but more for the other instances
  - Hybrid solver outperforms both SVR & QSVR-based Swift-Hyperband
  - Datasets from OpenML Curated Tabular Regression benchmark



Grid Stability dataset

[12] S. Fischer et al.

[11] E. Wulff et al., 2024

NCC Iceland – SDL Software Engineering – Quantum Computing Activities

RAISE Center of Excellence

[8] CoE RAISE

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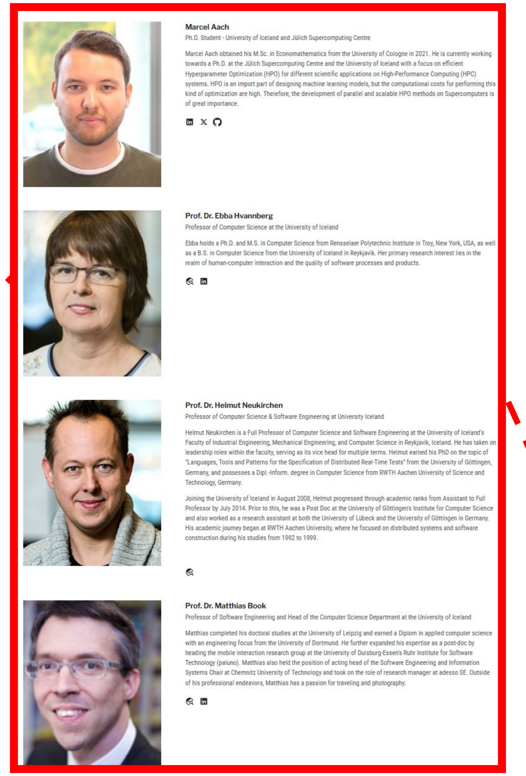
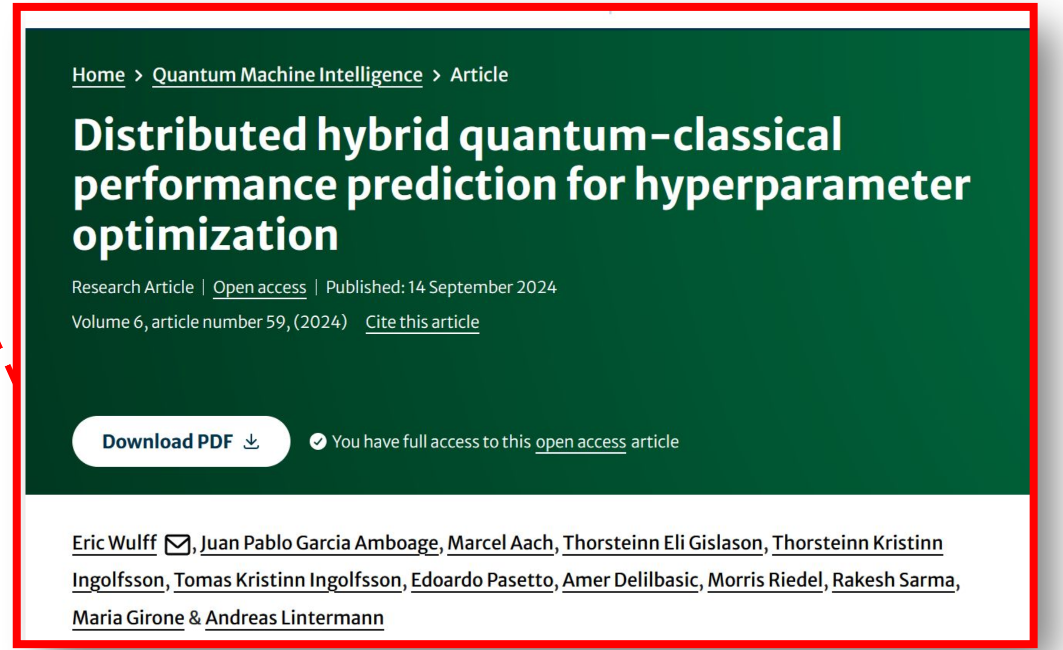
[9] JUNIQ

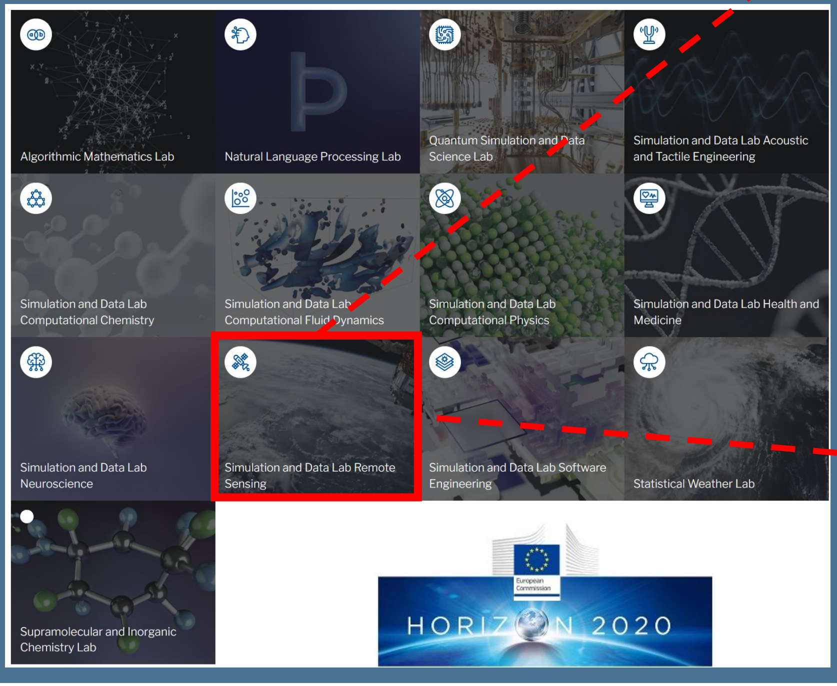


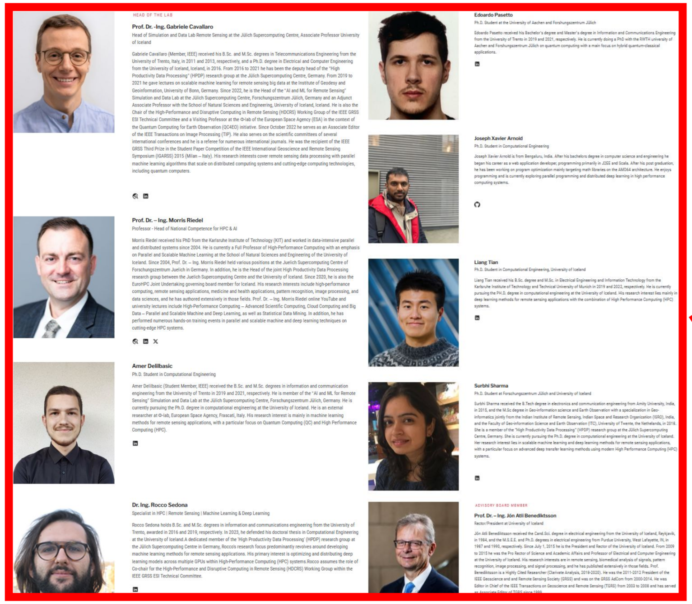


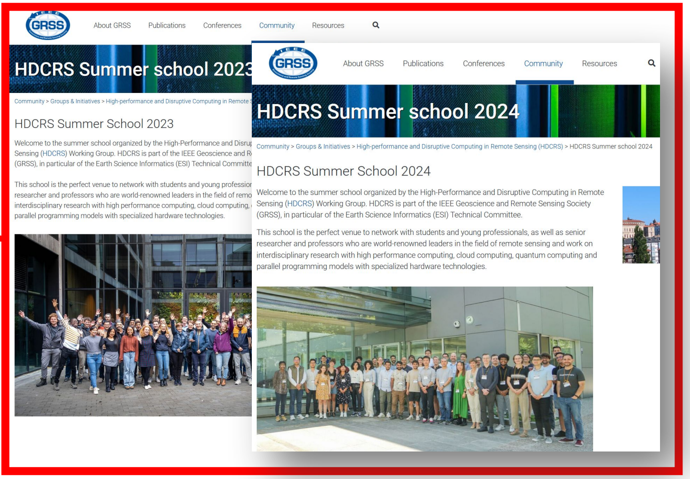
[11] E. Wulff et al., 2024

NCC Iceland – SDL Remote Sensing – Quantum Computing Activities (1)

[9] JUNIQ







[13] A. Delilbasic et al., 2024

1434 IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING, VOL. 17, 2024

A Single-Step Multiclass SVM Based on Quantum Annealing for Remote Sensing Data Classification

Amer Delilbasic, *Student Member, IEEE*, Bertrand Le Saux, *Senior Member, IEEE*, Morris Riedel, *Member, IEEE*, Kristel Michielsen, and Gabriele Cavallaro, *Senior Member, IEEE*

***Abstract*—In recent years, the development of quantum annealers has enabled experimental demonstrations and has increased research interest in applications of quantum annealing, such as in quantum machine learning and in particular for the popular quantum support vector machine (SVM). Several versions of the quantum SVM have been proposed, and quantum annealing has been shown to be effective in them. Extensions to multiclass problems have also been made, which consist of an ensemble of multiple binary classifiers. This article proposes a novel quantum SVM formulation for direct multiclass classification based on quantum annealing, called quantum multiclass SVM (QMSVM). The multiclass classification problem is formulated as a single quadratic unconstrained binary optimization problem solved with quantum annealing. The main objective of this article is to evaluate the feasibility, accuracy, and time performance of this approach. Experiments have been performed on the D-Wave Advantage quantum annealer for a classification problem on remote sensing data. Results indicate that, despite the memory demands of the quantum annealer, QMSVM can achieve an accuracy that is comparable to standard SVM methods, such as the one-versus-one (OVO), depending on the dataset (compared to OVO: 0.8663 versus 0.8598 on Toulouse, 0.8123 versus 0.8521 on Potsdam). More importantly, it scales much more efficiently with the number of training examples, resulting in nearly constant time (compared to OVO: 85.72 versus 248.02 s on Toulouse, 58.89 versus 580.17 s on Potsdam). This article shows an approach for bringing together classical and quantum computation, solving practical problems in remote sensing with current hardware.**

***Index Terms*—Classification, quantum annealing (QA), quantum computing (QC), remote sensing (RS), support vector machine (SVM).**

Manuscript received 25 August 2023; revised 4 November 2023; accepted 20 November 2023. Date of publication 28 November 2023; date of current version 14 December 2023. This work was supported in part by the German Federal Ministry of Education and Research and the Ministry of Culture and Science of the State of North Rhine-Westphalia through the project JUNIQ, in part by European Union's Horizon 2020 Research and Innovation Framework Program H2020-INFRAEDI-2019-1 through the Quantum Computing for Earth Observation initiative from the ESA Φ-lab and the Center of Excellence Research on AI- and Simulation-Based Engineering at Exascale under Grant 951733, and in part by the European High-Performance Computing Joint Undertaking and European Union/European Economic Area states through the EUROCC2 project under Grant 101101903. *(Corresponding author: Amer Delilbasic.)*

Amer Delilbasic is with the Jülich Supercomputing Centre, Forschungszentrum Jülich, 52428 Jülich, Germany, also with the University of Iceland,

NOMENCLATURE

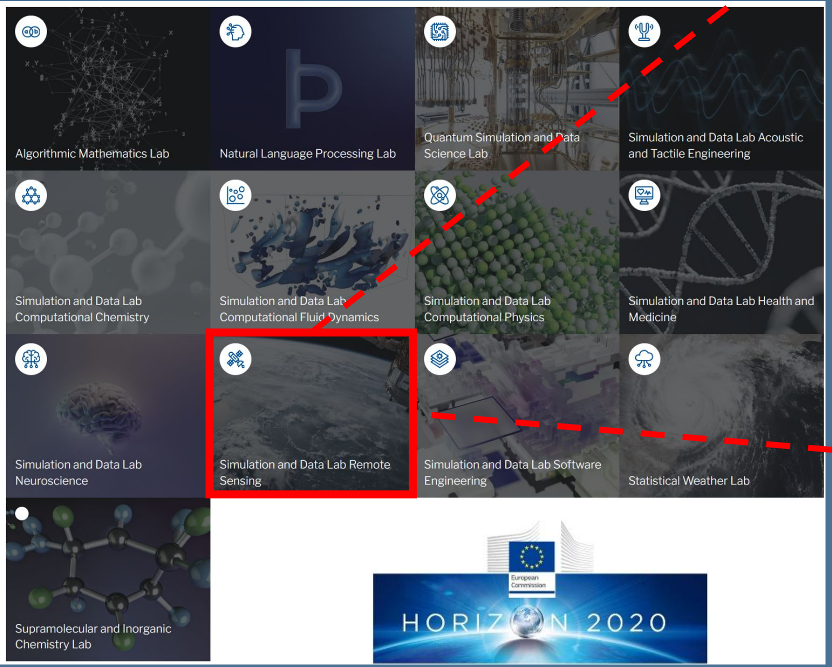
AQC	Adiabatic quantum computation.
BDSD	Band-dependent spatial detail.
CS	Crammer–Singer.
DAG	Directed acyclic graph.
DSM	Digital surface model.
EO	Earth observation.
ML	Machine learning.
OVA	One-versus-all.
OVO	One-versus-one.
QA	Quantum annealing.
QC	Quantum computing.
QML	Quantum machine learning.
QMSVM	Quantum multiclass support vector machine.
QSVM	Quantum support vector machine.
QUBO	Quadratic unconstrained binary optimization.
RS	Remote sensing.
SVM	Support vector machine.

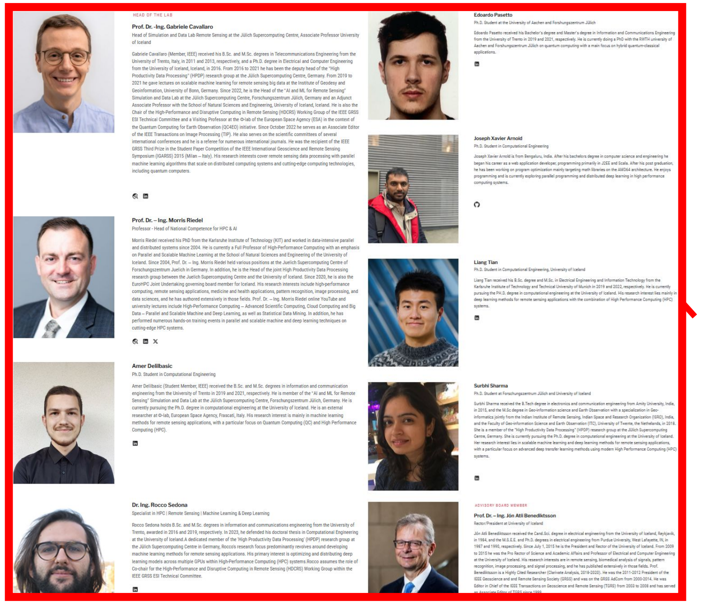
I. INTRODUCTION

IN THE context of EO [1], there is a growing availability of data acquired by heterogeneous RS sources . Many applications are currently benefitting from RS data, e.g., agriculture, green energy development, and urban monitoring. The devices and software for data processing have to match this trend in order to extract information from the collected data in a timely manner.

NCC Iceland – SDL Remote Sensing – Quantum Computing Activities (2)

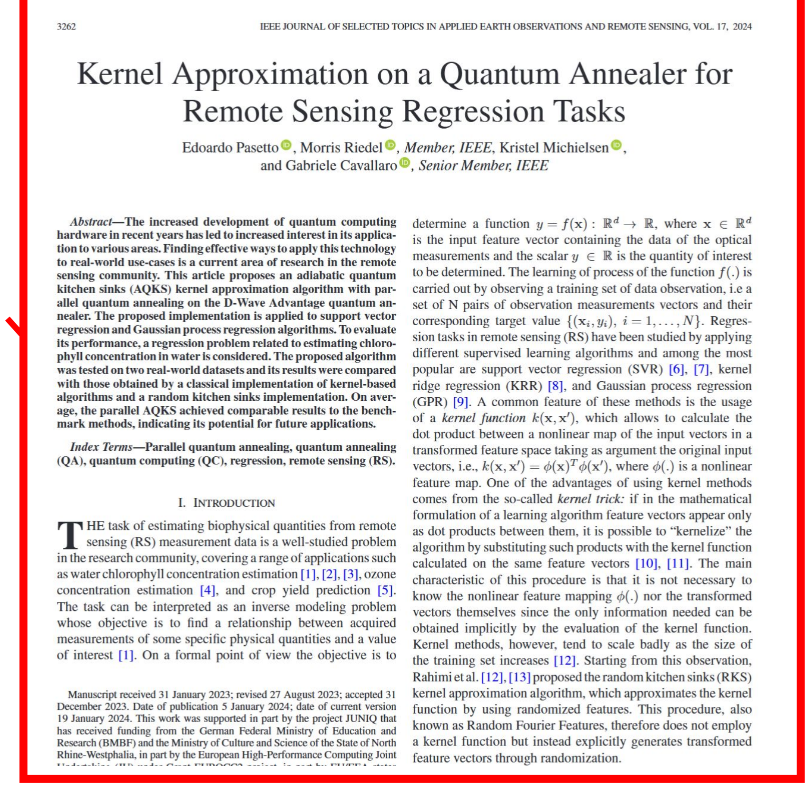
[9] JUNIQ





[15] QC4EO Study

[14] E. Passeto et al., 2024



3262 IEEE JOURNAL OF SELECTED TOPICS IN APPLIED EARTH OBSERVATIONS AND REMOTE SENSING, VOL. 17, 2024

Kernel Approximation on a Quantum Annealer for Remote Sensing Regression Tasks

Edoardo Pasetto, Morris Riedel, *Member, IEEE*, Kristel Michielsen, and Gabriele Cavallaro, *Senior Member, IEEE*

Abstract—**The increased development of quantum computing hardware in recent years has led to increased interest in its application to various areas. Finding effective ways to apply this technology to real-world use-cases is a current area of research in the remote sensing community. This article proposes an adiabatic quantum kitchen sinks (AQKS) kernel approximation algorithm with parallel quantum annealing on the D-Wave Advantage quantum annealer. The proposed implementation is applied to support vector regression and Gaussian process regression algorithms. To evaluate its performance, a regression problem related to estimating chlorophyll concentration in water is considered. The proposed algorithm was tested on two real-world datasets and its results were compared with those obtained by a classical implementation of kernel-based algorithms and a random kitchen sinks implementation. On average, the parallel AQKS achieved comparable results to the benchmark methods, indicating its potential for future applications.**

Index Terms—**Parallel quantum annealing, quantum annealing (QA), quantum computing (QC), regression, remote sensing (RS).**

I. Introduction

The task of estimating biophysical quantities from remote sensing (RS) measurement data is a well-studied problem in the research community, covering a range of applications such as water chlorophyll concentration estimation [1], [2], [3], ozone concentration estimation [4], and crop yield prediction [5]. The task can be interpreted as an inverse modeling problem whose objective is to find a relationship between acquired measurements of some specific physical quantities and a value of interest [1]. On a formal point of view the objective is to determine a function $y = f(\mathbf{x}) : \mathbb{R}^d \rightarrow \mathbb{R}$, where $\mathbf{x} \in \mathbb{R}^d$ is the input feature vector containing the data of the optical measurements and the scalar $y \in \mathbb{R}$ is the quantity of interest to be determined. The learning of process of the function $f(.)$ is carried out by observing a training set of data observation, i.e a set of N pairs of observation measurements vectors and their corresponding target value $\{(\mathbf{x}_i, y_i), i = 1, \ldots, N\}$. Regression tasks in remote sensing (RS) have been studied by applying different supervised learning algorithms and among the most popular are support vector regression (SVR) [6], [7], kernel ridge regression (KRR) [8], and Gaussian process regression (GPR) [9]. A common feature of these methods is the usage of a *kernel function* $k(\mathbf{x}, \mathbf{x}')$, which allows to calculate the dot product between a nonlinear map of the input vectors in a transformed feature space taking as argument the original input vectors, i.e., $k(\mathbf{x}, \mathbf{x}') = \phi(\mathbf{x})^T \phi(\mathbf{x}')$, where $\phi(.)$ is a nonlinear feature map. One of the advantages of using kernel methods comes from the so-called *kernel trick:* if in the mathematical formulation of a learning algorithm feature vectors appear only as dot products between them, it is possible to "kernelize" the algorithm by substituting such products with the kernel function calculated on the same feature vectors [10], [11]. The main characteristic of this procedure is that it is not necessary to know the nonlinear feature mapping $\phi(.)$ nor the transformed vectors themselves since the only information needed can be obtained implicitly by the evaluation of the kernel function. Kernel methods, however, tend to scale badly as the size of the training set increases [12]. Starting from this observation, Rahimi et al. [12], [13] proposed the random kitchen sinks (RKS) kernel approximation algorithm, which approximates the kernel function by using randomized features. This procedure, also known as Random Fourier Features, therefore does not employ a kernel function but instead explicitly generates transformed feature vectors through randomization.

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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-efficiently[1]. 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 Iceland[2]). In addition, quantum computing expertise is also offered through the IHPC NCC Iceland within the European Digital Innovation Hub of Iceland (EDIH-IS[3]) 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 2020[4]. 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 countries[6], 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 Supercomputer[7] 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

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[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/

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Very happy to share that we've received a 100-qubit quantum computer from Pasqal, a world leader in neutral atoms quantum computing technology. The new quantum computer is part of the EuroHPC Joint Undertaking (EuroHPC JU) project HPCQS_EU, an initiative aiming to advance the integration of quantum systems with the European supercomputing infrastructure. The Pasqal device will be coupled with the JURECA DC supercomputer at JSC and will also expand the resources at our quantum computing user facility, JUNIQ. We are pleased to enable European researchers using hybrid classical-quantum resources to solve complex challenges. Read more in our Press Release: https://lnkd.in/ev8j2aTq

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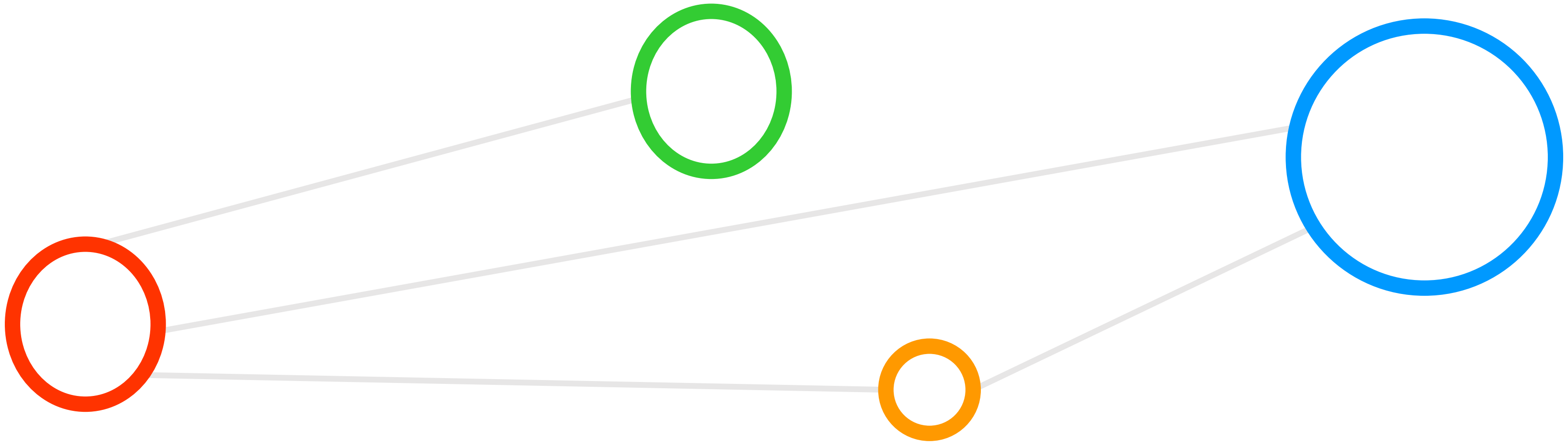
2 December 2024

Pasqal's 100-qubit quantum computer has arrived in Jülich, Germany

The Jülich Supercomputing Centre (JSC) at Forschungszentrum Jülich received a 100-qubit quantum computer from Pasqal in mid-November. Pasqal is a world leader in neutral atoms quantum computing technology. The new quantum computer is part of the EuroHPC JU project HPCQS and will be coupled with the JURECA DC supercomputer at JSC. This will enable European researchers to use hybrid classical-quantum resources to solve complex challenges.

[16] Press release

Selected References



Selected References (1)

- [1] Icelandic HPC (IHPC) National Competence Center for High-Performance Computing (HPC) & Artificial Intelligence (AI), Online: https://www.ihpc.is/
- [2] EuroHPC Joint Undertaking (JU), Online: https://eurohpc-ju.europa.eu/
- [3] EuroCC Projects, Online: https://www.eurocc-access.eu/
- [4] Digital Europe Programme, Online: https://digital-strategy.ec.europa.eu/en/activities/digital-programme
- [5] SME Treble Technologies, Online: https://www.treble.tech/
- [6] SME Mideind, Online: https://miðeind.is/is
- [7] TrustLLM, Online: https://trustllm.eu/
- [8] European Center of Excellence Research on AI- and Simulation-Based Engineering at Exascale (CoE RAISE), Online: https://www.coe-raise.eu/
- [9] Juelich UNified Infrastructure for Quantum computing (JUNIQ), Online: https://www.fz-juelich.de/en/ias/jsc/systems/quantum-computing/juniq-facility/juniq
- [10] M. Riedel and C. Barakat et al., "Enabling Hyperparameter-Tuning of AI Models for Healthcare using the CoE RAISE Unique AI Framework for HPC," 2023 46th, MIPRO ICT and Electronics Convention (MIPRO), Opatija, Croatia, 2023, pp. 435-440, Online: https://doi.org/10.23919/MIPRO57284.2023.10159755

Selected References (2)

- [11] Wulff, E., Garcia Amboage, J.P., Aach, M. et al. Distributed hybrid quantum-classical performance prediction for hyperparameter optimization. Quantum Mach. Intell. 6, 59 (2024), Online: https://doi.org/10.1007/s42484-024-00198-5
- [12] S. F. Fischer, et al., OpenML-CTR23 – a curated tabular regression benchmarking suite, in: AutoML Conference 2023 (Workshop), 2023, Online: https://openreview.net/pdf?id=HebAOoMm94
- [13] A. Delilbasic, B. Le Saux, M. Riedel, K. Michielsen, G. Cavallaro, "A Single-Step Multiclass SVM based on Quantum Annealing for Remote Sensing Data Classification," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS), vol. 17, pp. 1434-1445, 2024,Online: https://doi.org/10.1109/JSTARS.2023.3336926
- [14] E. Pasetto, M. Riedel, K. Michielsen, G. Cavallaro, "Kernel Approximation on a Quantum Annealer for Remote Sensing Regression Tasks", in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS), vol. 17, pp. 3262-3269, 2024, Online: https://doi.org/10.1109/JSTARS.2024.3350385
- [15] QC4EO Study technical reports, Online: https://eo4society.esa.int/projects/qc4eo-study/
- [16] Press Release, Boosting Europe’s Quantum Computing Infrastructure, Online: https://www.fz-juelich.de/en/news/archive/press-release/2024/boosting-europe2019s-quantum-computing-infrastructure

Selected Testimonials & Success Stories: SMEs & Public Sector Organizations

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"With EDIH-IS and NCCs help we have been able to analyze our data management systems allowing us to structure our API for High Value Datasets, making it possible for Statistic Iceland (Hagstofan) to verify the accuracy of our API self-service customer platform technology. We are grateful to have received data- and AI consultant support through the NCC Iceland, including user educational support on technical environments. We are happy therefore to have contributed to one success story of the collaboration from Hagstofan with EDIH-IS and NCC Iceland for AI and HPC"

ORB EHF

"With EDIH-IS and NCCs help we have been able to develop our next generation of our next product allowing us to analyze the architecture data cycle, making it possible for Orb ehf to enable estimation of the carbon reserves of forests, wood quality and the quantity of wood products expected in the future customer platform technology. We are grateful to have received data analyze and AI support through the NCC Iceland, including user support on technical environments, data scalability, and configuration of AI models and remote sensing satellite data images. We are happy therefore to have contributed to one success story of the collaboration from Orb ehf with EDIH-IS and NCC Iceland for AI and HPC."

GREENFISH

"With EDIH-IS and NCCs help we have been able to run our fishing localization simulations on GPU based HPC systems allowing us to run larger simulations than ever before and making it possible for GreenFish to verify the accuracy of our technology. We are grateful to have received HPC access through the NCC Iceland, including user support on technical environments, scalability, and configuration of the HPC systems. We are happy therefore to have contributed to one success story of the collaboration from GreenFish with EDIH-IS and NCC Iceland."

GET RÁÐGJÖF

"With EDIH-IS and NCCs help we have been able to develop our data functions as part of Integration management processes with focus on Enterprise resource planning (ERP) systems allowing us to analyze multi-ERP architecture and data cycle. This support is making it possible for Get Ráðgjöf to verify the potentials of adding data support as part of Integration management procedures with focus on B2B customer related processes as well as others.

We are grateful to have received data analyze and AI support through the NCC Iceland, including user support on technical environments, data scalability, and configuration of AI models and verifying our datasets. We are happy therefore to have contributed to one success story of the collaboration from Get Ráðgjöf with EDIH-IS and NCC Iceland for AI and HPC"

LAGAVITI EHF

"With the help of EDIH-IS and NCC Iceland, we have been able to kickstart the development of our product, allowing us to analyze the architecture, data cycle, and system module research. This support has made it possible for LagaViti to advance in developing our newest product to empower user systems with cutting-edge data.

We are grateful for the consulting support provided by EDIH-IS and NCC Iceland, including system platform research and preparation for product development. We're proud to contribute to a success story showcasing the collaboration between LagaViti, EDIH-IS, and NCC Iceland in AI and HPC."

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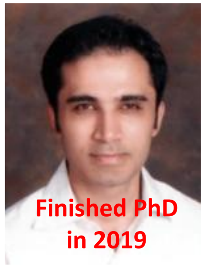

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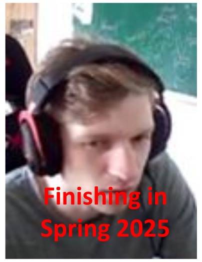

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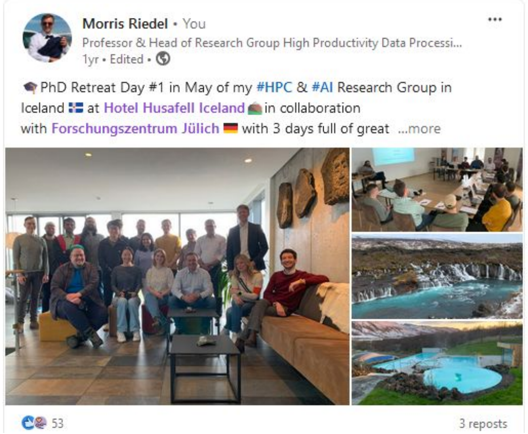

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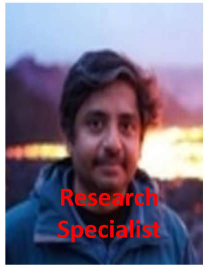

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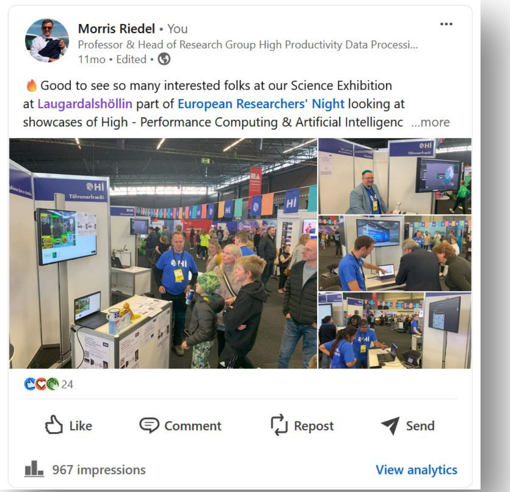

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