Role of HPC in EDIH-IS
Workshop, Gróska, 2022-12-07
Prof. Dr. – Ing. Morris Riedel (UoIceland), NCC Iceland for HPC & AI

- EDIH-IS Demands Snerpa Power: AI exploration
  - Explore different AI models (e.g., LSTM, GRU)
  - Challenges:
    - Data sharing (especially data moving out to data center for HPC(?)
    - Data quality, data reliability/security (not loose or open)
  - Using AWS Services building blocks with different software solutions
    - Costs of running cutting-edge AI models (e.g. GPU hours 24 USD / hour)

- EDIH-IS Offers: Benefits of HPC for AI
  - Faster Training → Distributed Deep Learning (e.g., Horovod, PyTorch-DDG)
  - Hyperparameter Optimization → Better quality of models (e.g., Ray Tune)
  - Sustainable solution → save costs with Responsible Compute(?) & Platform

- **EDIH-IS Ecosophy**

    - Environmental data usage and visualization, data transfer matters:

    - Small clients: fishing boats (hard to see weather forecast, ocean currents, etc.)

    - Demands: data storage? 200 TBs so far, renting in data centers in Finland bare metals, LUMI ($\rightarrow$ 100 PBs of storage expected)

    - No AI? Predictions vs. Visualizations (users use GPUs for vis?)? A: No AI in the moment, formula engine

    - Basic platform on Google Earth? Open Street Map

    - Many EU activities with shared datasets and viewers:
      EUDAT, EOSC set of services?, EPOS, ESFRI roadmap & evn .list of projects

        - Copernicus and Noaa $\rightarrow$ Publicly available data

        - Commercial data sets every six hours, proprietary belgingur providing forecasts

        - Digital Twins $\rightarrow$ „Destination Earth"

    - Remote Sensing activities, satellite data with copernicus services, etc.?

        - Only time series data or also hyper-spectral or multi-spectral data? So more image-based elements?

        - SAR Data

- **EDIH-IS Offers: Benefits of HPC**

    - Sustainable solution $\rightarrow$ save costs with Responsible Compute(?) & Platform

Short overview on status at start

IHPC

In operation ⌄   Support   **Community**   History   Acknowledgements   Hafðu samband – Contact us

Community

To get information regarding upgrades, downtime or some other important issues then we will send those information to users with em
get those information then please sign up. This is not used very regularly so don't worry about getting spammed through this list and or
mailing list can send to it.

IHPC mailing list   **← Community essentially only visible via mailing list**

To get information to HPC admins, then please send an email to help@hi.is and include HPC in the subject.

Short overview on status at start

- Icelandic HPC (IHPC) Community existed
    - ~17 scientific groups & experts, community is growing exponentially
    - Majority of HPC users from UoIceland (~1-2 Met Office, UoReykjavik, etc.)
    - Not as a whole organized (only in ad-hoc grant submission, no roadmap)
    - No involvement of SMEs or companies in a systematic fashion
    - Lack of HPC management resources & community building events
- Strong collaboration in HPC/Cloud
    - Nordic countries, e.g. EOSC-Nordic
    - Germany: Juelich Supercomputing Centre, e.g. joint professorships & PhDs & Projects
- Other collaborations
    - E.g. Prof. Hannes Jonsson (computational chemistry) & Brown University (USA)

[1] DEEP Series of Projects Web Page

UNIVERSITY OF ICELAND
SCHOOL OF ENGINEERING AND NATURAL SCIENCES
FACULTY OF INDUSTRIAL ENGINEERING,
MECHANICAL ENGINEERING AND COMPUTER SCIENCE

JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

[2] JSC Simulation Labs Web Page

What has happened

EURO

rannís

Icelandic National Infrastructure for HPC

- ❖ **HPC hardware funds** by RANNIS; now via **roadmap IReiP**
- ❖ Proposals yearly required to obtain funds still
- ❖ Joint proposal from IHPC community

EuroHPC EuroCC National Competence Center for HPC & AI

- ❖ EU Project (09/2020-08/2021), 2 years
- ❖ Building **Simulation and Data Labs (SDLs)** of the IHPC Community of Users
- ❖ Supports industry engagement in HPC

IHPC National Competence Center for HPC & AI in Iceland

IHPC Community of Users
- ❖ Organized around RANNIS proposals
- ❖ **~53 scientific experts & research group**
- ❖ UoIceland/UoReykjavik, Iceland Geo Survey ÍSOR, Met Office & industry: Matis, etc.

ÍSOR matís Veðurstofa Íslands

NEW EuroHPC

EuroHPC LUMI Supercomputer in Finland
- ❖ Supercomputer funded by Finland, Belgium, Czech Republic, Denmark, Estonia, Iceland, Norway, Poland, Sweden, Switzerland
- ❖ Co-Funds by EC and Iceland participation funds from: UoIceland, UoReykjavik, and Hannes Jonsson & Egill Skulason

Teaching & Education in HPC & AI
- ❖ University of Reykjavik
- ❖ University of Iceland
- ❖ Arctic Webinar Series (with US partners)
- ❖ Digital/Horizon Europe MSc in HPC

HÁSKÓLINN Í REYKJAVÍK REYKJAVIK UNIVERSITY
HÁSKÓLI ÍSLANDS
European Commission
EuroHPC
JÜLICH Forschungszentrum JÜLICH SUPERCOMPUTING CENTRE

International Cooperations
- ❖ Tactical: ~4 Joint PhDs with **Juelich Supercomputing Centre** in Germany (#1 HPC System in Europe)
- ❖ Tactical: **EC Projects** like DEEP-EST, EOSC-Nordic, RAISE Center of Excellence (CoE)
- ❖ Strategic: Plans of building an **Icelandic National Lab** with international cooperation together with Industry (e.g. Kaiser Global, other investors)

NCC Iceland

EURO

RAISE Center of Excellence

DEEP Projects

What has happened

- Increased community building
  - Many small meetings & discussions with academics and industry/SMEs to create Simulation & Data Labs

- 1st Icelandic HPC Community Workshop
  - Held on 2021-08-11 at the University of Iceland
  - ~25 participants (academia, government, industry, SMEs) with six presentations & discussions topics

[5] 1st Workshop Event

NEW

IHPC National Competence Center for HPC & AI in Iceland

1st Icelandic HPC Community Workshop
Endurmenntun HI, Dunhaga 7, 107 Reykjavik – Room Náma
11th August 2021 – 5:00 – 7:00 p.m. GMT

Background
The Icelandic High-Performance Computing (IHPC) activities are increasing in academia and industry that also includes related areas such as Artificial Intelligence (AI), Machine Learning (ML), Data Analytics, and Data Sciences. As a result, the IHPC community members created Icelandic Simulation and Data Labs (SDLs)[1], including academic and industrial partners. They form together in a bottom-up fashion the IHPC National Competence Center for HPC & AI in Iceland partly funded by the EuroHPC Joint Undertaking EuroCC project. The IHPC community seeks more collaborations and new members.

Objectives
This workshop aims to bring together a diverse group of Icelandic and international stakeholders to discuss the role of HPC and related areas within Iceland without losing sight of its international links. The specific objectives of the workshop are to:
- **Document competencies, achievements, activities, and lessons learnt** from participating stakeholders of Icelandic HPC efforts and associated international activities.
- **Perform community building** in developing new successful joint activities between academia and industry, potentially creating new joint Simulation and Data Labs or collaborations.
- **Identify best practices and core principles with a set of recommendations** for developing the future Icelandic HPC ecosystem, including necessary skills, funding opportunities, applications, Centre of Excellences, community events, and sustainable infrastructure developments.

Participants
Approximately 20-25 participants from Iceland, Germany, and the USA. Participants will include:
- Selected Icelandic companies and SMEs from different sectors with interest in HPC & AI
- Academic representatives from the University of Iceland and Simulation and Data Labs
- The Icelandic Centre for Research (Rannís), Startup Iceland, and Icelandic Technology Clusters
- US company that forms government, industry, and academic cooperative research coalitions

Output
The following outputs are expected:
- A short synthesis paper that documents Icelandic competencies, field experiences and achievements in using and/or offerings HPC & AI solutions and consideration of 'best practices'
- A short strategy paper responding to HPC & AI issues and challenges identified during the workshop, including potential options for jointly engaging in EuroHPC funding opportunities
- Strengthened informal networks and transfer of experiences and lessons learnt

Brief overview of main achievements

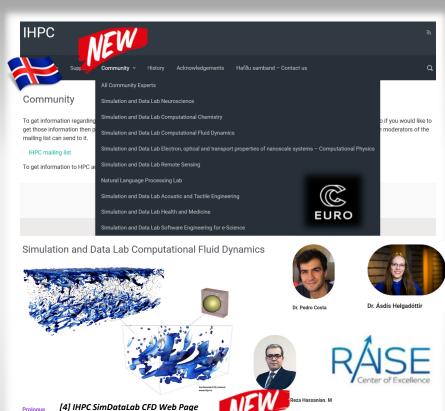

[3] NCC Iceland - Icelandic HPC Community Web page

- Icelandic & bridge to EU HPC ecosystem
  → HPC Users (CASTIEL competence system)
  - Experience in **establishing Simulation & Data Labs (SimDataLabs)** for Community Building
  - **Based on experience over 15 years**

[2] JSC Simulation Labs Web Page

JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE

Simulation Labs

IHPC

Community — History — Acknowledgements — Hafðu samband – Contact us

Community

To get information regarding ... get those information then p... mailing list can send to it.

IHPC mailing list

To get information to HPC a...

All Community Experts
Simulation and Data Lab Neuroscience
Simulation and Data Lab Computational Chemistry
Simulation and Data Lab Computational Fluid Dynamics
Simulation and Data Lab Electron, optical and transport properties of nanoscale systems – Computational Physics
Simulation and Data Lab Remote Sensing
Natural Language Processing Lab
Simulation and Data Lab Acoustic and Tactile Engineering
Simulation and Data Lab Health and Medicine
Simulation and Data Lab Software Engineering for e-Science

Simulation and Data Lab Computational Fluid Dynamics

Dr. Pedro Costa   Dr. Ásdís Helgadóttir

Reza Hassanian. M

RAISE Center of Excellence

Prologue

[4] IHPC SimDataLab CFD Web Page

The Simulation and Data Lab computational fluid dynamics (SimDataLab CFD) i... parallel computing in Computational fluid dynamics in Iceland at the University of Iceland. The SimDataLab is Iceland's representative in the internatio... projects in CFD and parallel computing. SimDataLab CFD aims to develop parallel code applications in CFD and support users who have already developed parallel application codes. SimDataLab CFD participates in the European project network in parallel computing and has an infrastructure and access to powerful parallel systems in-memory optimization, processing system architecture, high scalability, and have performance optimization computer nodes.

How did it work – SME Examples

Simulation and Data Lab Acoustic and Tactile Engineering

Acoustic and Tactile Engineering

General information

The focus of the Acoustic and Tactile Engineering (ACUTE) lab is both on research and product development. For the last few years, our main focus has been on the development of wearable assistive devices for visually impaired persons and cochlear implant recipients. We are also working on other projects, such as solutions for delivering virtual acoustics (i.e., sounds generated by computers) as realistically as possible and on multi-channel recording/playback.

Some of our current collaborations include; Oticon Medical, DTU (Technical University of Denmark), University of Southampton and Treble technologies.

Members

[6] IHPC SimDataLab Accoustic & Tactile Engineering Web Page

Prof. Dr. Ing Rúnar Unnþórsson

Dr. Runar Unnthorsson is a Professor (100%) at the faculty of Industrial engineering, Mechanical engineering, and Computer Science at the University of Iceland. Rúnar's main research interests are in performance engineering and the engineering application of acoustics / vibrations for sensory substitution, non-destructive evaluations, tactile/acoustic displays and product design.

Prof. Runar Unnthorsson, coordinated the 4M€ H2020 RIA project Sound of Vision (no. 643636) which was carried out in the years 2015-2017. The project received the EC's 2018 Innovation Radar Prize in the category Tech for Society for the development of an assistive device for the visually impaired. In 2017, the lab was awarded the 2nd prize for its tactile display at the University of Iceland's Science and Innovation Awards. The ACUTE lab is currently working on the development of the tactile display – with support from the Technology Development Fund (tths.is)

Dr. Ing. Finnur Pind

Dr. Finnur Pind received his MSc in acoustical engineering in 2013 from the Technical University of Denmark (DTU), and his PhD from the same institution in 2020. His PhD research was centered on virtual acoustics and was done in collaboration with the architectural studio Henning Larsen. Between his MSc and PhD studies, Finnur was an acoustic consultant in the building industry for some three years, and before entering the world of acoustics he was a software engineer in the telecom industry. His research interests include wave-based (numerical) acoustic simulations, acoustic virtual reality, room surface modeling, high-performance computing and spatial audio. He is currently a postdoctoral researcher at the ACUTE (Acoustics and Tactile Engineering) group at the University of Iceland and co-founder / CEO of Treble Technologies, which develops state-of-the-art virtual acoustics software.

Elvar Atli Ævarsson worked as an electronics technician for many years, specialising in professional sound system installation. He completed his MSc degree in electrical and computer engineering at the University of Iceland in 2020, having spent time as an exchange student at the Technical University of Denmark (DTU) taking acoustical engineering courses. He is currently a PhD student in industrial engineering at the University of Iceland, working with the ACUTE group and focusing on audio-tactile integration.

SME

IHPC National Competence Center for HPC & AI in Iceland

[3] NCC Iceland - Icelandic HPC Community Web page

NEW

RAISE Center of Excellence

[7] RAISE Center of Excellence Web Page

Treble
Home   Solution   About   Get Started

Enabling a better sounding world

Treble Technologies develops cutting-edge wave-based sound simulation products for the AEC industry. Unprecedented accuracy. Streamlined workflow. Experience how your design sounds and feels.

[8] Treble Technologies

Natural Language Processing Lab   *[10] IHPC NLP Lab*

General information

The Natural Language Processing Lab (NLP Lab) connects a community of researchers in NLP. The main focus is on large language models that require high-performance distributed computing environments to train efficiently.

The NLP Lab is based at the University of Iceland and works together with startups and companies on research projects and innovation. Currently, the lab is working with Nordverse and Miðeind. The NLP Lab disseminates information and knowledge through educational events, special sessions, and tutorials at conferences and publication activities.

Members
Prof. Dr. Hafsteinn Einarsson

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 2018. 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.

Vésteinn Snæbjarnarson

Vésteinn is a researcher at language technology company ... and an MSc student at the School of Engineering and Natural Sciences of the University of Iceland. He works in machine translation, language mod... question answering.

SME

We create software that simplifies complex health information to empower valuable human care.

Nordverse is a Nordic based health tech startup created in 2019 by two medical doctors and a PhD computer scientist. Nordverse has received numerous grants and awards as well as having built a strong team to deliver high-quality software originating from clinical experience and aimed to deliver real clinical value.

nordverse

Our Partners

[9] Nordverse

European Digital Innovation Hub Proposal (1 in Iceland only)

The benefits of EuroCC and CASTIEL

- CASTIEL Competence Mapping
  - Needs understood with more systematic requirement analysis
  - Useful to better understand Icelands unique competencies in comparison to whole Europe

- Sustained Efforts
  - Plan to engage in EuroCC & NCC Iceland with different phases enables trust in industry & SMEs to join activities
  - E.g. industry: deCode Genetics, Ossur, Matis, Nordverse, Mideind, Treble, atNorth, etc..
  - E.g. technology transfer office Audna, Startup Iceland

[11] Audna Technology Transfer Office   [12] Startup Iceland

Competence category	Level of HPC readiness of users				
	Digitalization needed	Digitally ready	HPC ready	HPC users	HPC champions
Awareness creation					
Expert technical consultancy			Experience in teaching technical topics like HPC & HPDA systems (1)	Experience in Modular Supercomputing Architecture Technologies (2)	Experience in parallel & distributed training of HPDA / AI models (3)
Services and products				Application Experience in HPDA & Remote Sensing (#6 in the world) (4)	
Business & project consultancy					
Technological assessment and PoCs					Experience in Quantum Computing (i.e., quantum annealing) (5)
Mastering the EU HPC ecosystem				Experience in forming Simulation & Data Labs (science & industry partners) (6)	

- KPIs
  - Updated in D33.2 from D33.1
  - IHPC Steering Committee is very pleased with progress
  - RANNIS (funding authority) is positive about NCC Iceland & discusses strategic EuroHPC plans

- Selected Challenges
  - Staff in-kind contributions (50%)
  - Integrations of traditional IHPC community elements takes time (e.g., old Web page, old mailing lists, new procedures, etc.)

#	KPI Short Description	Task	Current Value M12	Target Value M24
01	Performed training events for HPC, AI, and Big Data users to improve skills	33.2	4	8
02	Performed technology transfer events with specific topics addressed for SMEs	33.3	3	6
03	Number of industrial partners / SMEs interacted with	33.4	7	8
04	Number of companies (incl. SMEs) who ran pilots	33.4	0	2
05	Number of established Simulation and Data Labs	33.5	9 **NEW 10**	>10
06	Created coordination plans for sharing courses, content & best practices per year	33.2	1	2
07	Number of national HPC, AI, and HPDA infrastructure & NCC competence users	33.6	**80**	>75
08	Number of LUMI HPC, AI, and HPDA infrastructure & NCC competence users	33.6	2	>25
09	Number of completed surveys of collaborating academic & commercial partners	33.7	9	>10
10	Number of events attended to raise awareness of the NCC Iceland	33.7	5	>10
11	Number of Web page posts & social media posts from the NCC Iceland	33.7	30	>100
12	Number of best practices guides, NCC Iceland testimonials, and success stories	33.6	8	>25

NCC Iceland at a Glance

EURO

NCC – REPORT FOR MINISTRY
1 (+3 planned in Phase 2)

NCC – MINISTRY INTERACTIONS
5 (+8 planned in Phase 2)

NCC – MINISTER PRESENTATION
1 (+1 planned in Phase 2)

IDENTIFIED BENEFITS FOR HOSTING HPC AT DATA CENTERS

▼ NCC Iceland Location

State of the art sustainable campuses with exceptional power grid resilience

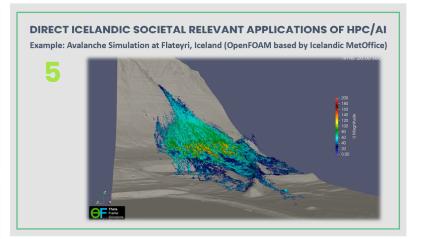Low carbon footprint & TCO in one of the most secure/reliable EU countries

100 %

100% based on Renewable Energies
Based on Hydro power & Geothermal power

SIX PILLARS OF MAJOR AREAS

▼ NCC Iceland Structure

The overall activities of NCC Iceland are structured into six distinct pillars

I. Icelandic HPC (IHPC) Community of Users

II. EuroHPC EuroCC Phase 1 & 2 National Competence Center for HPC&AI

III. Icelandic National Infrastructure for HPC & AI

IV. EuroHPC LUMI Supercomputing in Finland

V. Teaching & Education in HPC & AI

VI. International Cooperations

DIRECT ICELANDIC SOCIETAL RELEVANT APPLICATIONS OF HPC/AI

Example: Avalanche Simulation at Flateyri, Iceland (OpenFOAM based by Icelandic MetOffice)

5

IHPC National Competence Center for HPC & AI in Iceland

NCC Iceland at a Glance

EURO

Summer & Winter Schools
2 (+2 planned in Phase 2)

# of new HPC & AI Professors
2 (+1 planned in Phase 2)

Overall Training Events & Courses
15 (+20 planned in Phase 2)

 # Publicly Accessible Lectures

YouTube

1 PhD Retreat
25 participants

1 Master Class
~50 participants

1 CASTIEL WG Event
Quantum Computing for NCCs

1 CASTIEL SHARING EVENT
Experience Teaching Online/Offline

50	High Performance Computing –CFD Special Course – Spring 2023 (planned for Phase 2)
43	Cloud Computing & Big Data Course – Fall 2022
41	High Performance Computing Course – Spring 2022
41	Cloud Computing & Big Data Course – Fall 2021
15	Centre of Excellence RAISE YouTube Seminars & Trainings

NCC Iceland at a Glance

EURO

Building the Reykjavik Institute

~20 Transfer Meetings with SME Kaiser Global

Support Green Computing Industry

~10 Transfer Meetings with SME Responsible Compute

NEW TECH TRANSFER (planned in Phase 2)

Borealis Data Centers

AtNorth Data Centers

SME Orb Green

SME Datalab

Icelandic Space Agency

19 MAY 2022

Co-Organized Responsible HPC Workshop

~15 different SMEs & Enterprises participated

25 OCTOBER 2022

Data Center Forum Reykjavík

> 100 int. SMEs & enterprises participated

Cooperation with EDIH-IS

Multiple tech-transfer meetings with SMEs & enterprises Origo & Syndis

Industry event with other NCCs @ Prague

NCC Germany, NCC Cyprus, NCC Czech Republic & SMEs

NCC Iceland at a Glance

EURO

Data Centers
Borealis Data Centers
AtNorth
Advania Thor
Kaiser Global (SME)

Large Industry
Decode Genetics
NetApp
Össur
Marel
Atos

SMEs & AI
Nordverse
Treble
Mideind
Vitargames

01 **02** **03** **04** **05** **06**

Industry Associations
Business Iceland
Data Centers by Iceland
Reykjavík Science City

SMEs & Security/Energy
Syndis
Snerpa Power

SMEs & Big Data
Origo
Datalab

Industry Pilots
3 (+6 planned in Phase 2)

 # involved NCC SimDataLabs
3 (+3 planned in Phase 2)

 # different sectors
3 (+3 planned in Phase 2)

NCC Iceland at a Glance

Outlook, next step

EURO

- **Increase Community Building**
  - Establish more NCC Simulation and Data Labs with
    key scientists & industry/commercial partners (~20 in 08/2022)
  - Continue HPC Workshop Series with special emphasis on industry &
    commercial involvement (bi-monthly), hackathons with Startup Iceland, etc.

- **Intensify Raising Awareness**
  - Improvements of Web pages IHPC.IS & running analytics of unique visitors, etc.
  - Dedicated social media Web presence (i.e., Twitter, LinkedIn, Facebook)
  - Increased collaboration with Technology transfer office Audna & Startup Iceland
  - Renew mailing list of IHPC.IS & Exploit contacts with Clusters (Ocean, Energy, etc.)

- **Explore funding possibility in Horizon Europe & Digital Europe with RANNIS**
  - E.g., EuroCC Phase 2 Options, Centre of Excellences & NCC Iceland involvement

References (1)

[1] DEEP Series of Projects Web page, Online:
http://www.deep-projects.eu/

[2] Juelich Supercomputing Centre, Simulation Labs Web Page, Online:
https://www.fz-juelich.de/ias/jsc/EN/Expertise/SimLab/simlab_node.html

[3] NCC Iceland – Icelandic HPC Community Web Page, Online:
https://ihpc.is/community/

[4] Icelandic HPC Simulation and Data Lab Computational Fluid Dynamics, Online:
https://ihpc.is/simulation-and-data-lab-computational-fluid-dynamics/

[5] 1st Icelandic HPC Community Workshop organized by NCC Iceland & EuroCC, Online:
https://ihpc.is/events

[6] Icelandic HPC Simulation and Data Lab Accoustic & Tactile Engineering, Online:
https://ihpc.is/simulation-and-data-lab-acoustic-and-tactile-engineering/

[7] RAISE Center of Excellence Web Page, Online:
https://www.coe-raise.eu/

[8] Treble Technologies, Online:
www.treble.ac

[9] Nordverse, Online:
https://nordverse.com/

[10] Icelandic HPC Natural Language Processing Lab, Online:
https://ihpc.is/simulation-and-data-lab-natural-language-processing/

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[11] Icelandic Technology Transfer Office Audna, Online:
https://ttoiceland.is/
[12] Startup Iceland, Online:
https://startupiceland.com/

Thanks – www.ihpc.is/community