Prof. – Dr. Ing. Morris Riedel (Iceland NCC / EuroCC WP33)

2021-06-07

NCC Iceland at a Glance & Collaboration

Iceland, NCC 33

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

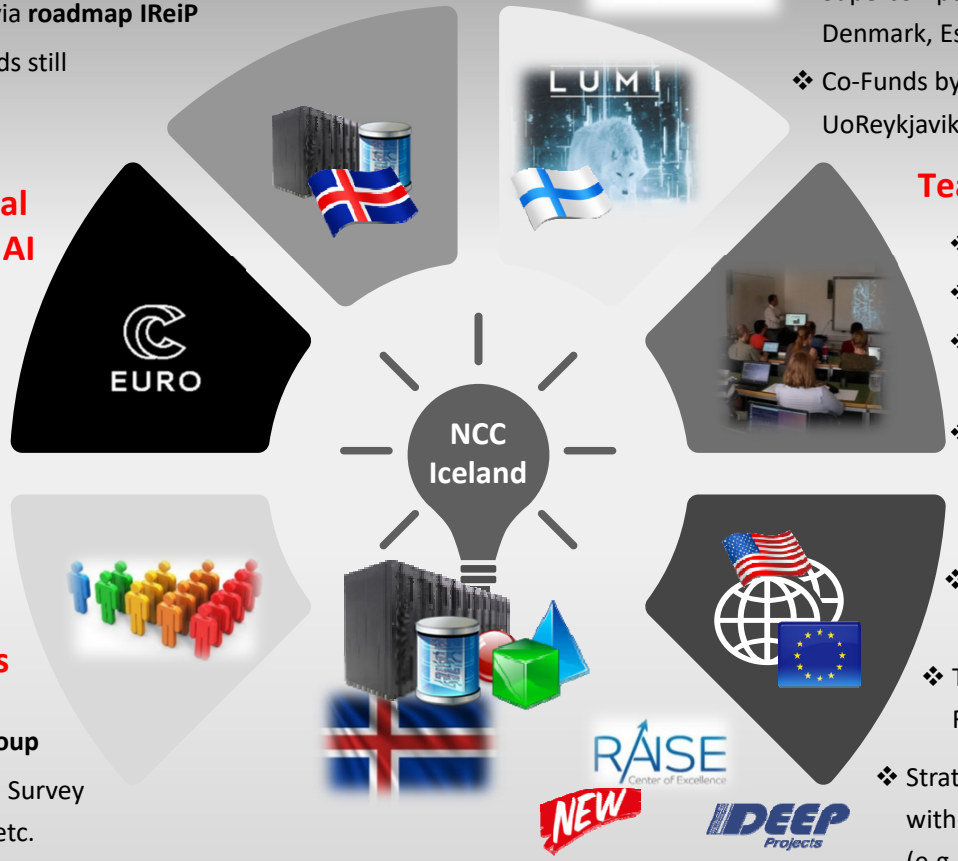
EuroHPC EuroCC National Competence Center for HPC & AI

- EU Project (09/2019-08/2021), 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.



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

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)

The Competences of the NCC at a Glance

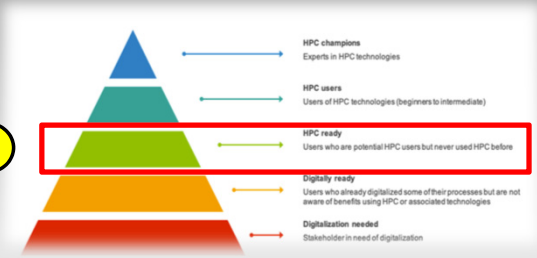
Iceland, NCC 33

EURO

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

Example Competence 1

Experience in Teaching Technical Topics like HPC & HPDA Systems

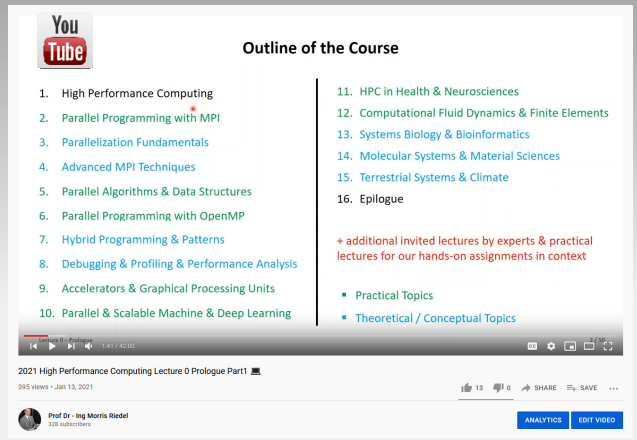


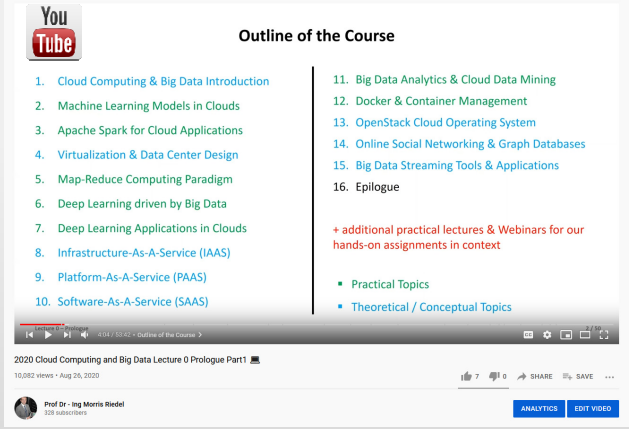
1

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

HÁSKÓLINN Í REYKJAVÍK
REYKJAVIK UNIVERSITY

- Expert Technical Consultancy
  → HPC ready users
  - E.g. **High-Performance Computing Course** (Advanced Scientific Computing)
  - E.g. **Cloud Computing & Big Data Course** (Parallel & Scalable Machine & Deep Learning)
  - E.g. **Natural Language Processing (NLP)**
  - Selected domain-specific courses with HPC relevance





[1] YouTube Channel: https://www.youtube.com/channel/UCWC4VKHmL4NZgFfKoHtANKg

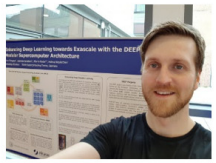
Example Competence 1 – PhD Students

Experience in Teaching Technical Topics like HPC & HPDA Systems

EURO

Pétur Helgi Einarsson

PhD Student in Computational Neuroscience & HPC



Ernir Erlingsson

PhD Student in HPC Application Co-Design

Reza

PhD Student in Computational Fluid Dynamics (CFD) & HPC

Rocco Sedona

PhD Student in **Remote Sensing & HPC**

NEW

Marcel Aach

PhD Student in Computational Fluid Dynamics (CFD) & HPC

NEW

Surbhi Sharma

PhD Student in **Remote Sensing & HPC**

NEW

Dirk Helmrich

PhD Student in Preserving Environments with Plants & HPC

Chadi Barakat

PhD Student in computational healthcare & HPC

NEW

Eric Michael Sumner

PhD Student in Accoustic & Tactile Engineering & HPC

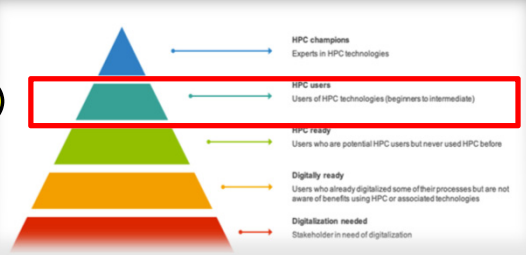
Guiding & Recruiting MSc Students

Great joint students to start PhDs like Gísli Ingolfsson & Liang Tian

Example Competence 2

Experience in Modular Supercomputing Architecture Technologies

EURO



2

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

JÜLICH Forschungszentrum
JÜLICH SUPERCOMPUTING CENTRE

2023

Potentially first Exascale system in Europe

1 EF

- Expert Technical Consultancy
  → HPC users

2020

NEW

85 PF

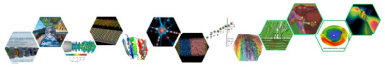
Europe #1 HPC System in Top500

[2] YouTube, 'flexible and energy-efficient supercomputer: JUWELS is faster than 300 000 modern PCs

2018

12 PF

Application Co-Design

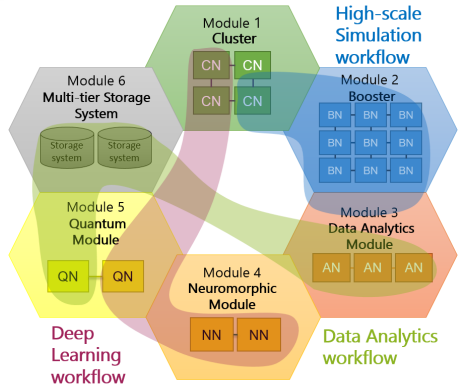


JUWELS Booster – A Supercomputer for Large-Scale AI Research

Stefan Kesselheim[1*], Andreas Herten[1*], Kai Krajsek[1*], Jan Ebert[1*], Jenia Jitsev[1*], Mehdi Cherti[1*], Michael Langguth[1*], Bing Gong[1*], Scarlet Stadtler[1*], Amirpasha Mozaffari[1*], Gabriele Cavallaro[1*], Rocco Sedona[1,2*], Alexander Schug[1,3*], Alexandre Strube[1], Roshni Kamath[1], Martin G. Schultz[1], Morris Riedel[1,2], Thomas Lippert[1]

[1] Jülich Supercomputing Centre, Forschungszentrum Jülich GmbH, Germany, contact <n>.<surname>@fz-juelich.de
[2] School of Engineering and Natural Sciences, University of Iceland, Reykjavik, Iceland
[3] University of Duisburg-Essen, Germany

[6] S. Kesselheimet al., 'JUWELS Booster - A Supercomputer for Large-Scale AI Research', ICS 2021, to appear

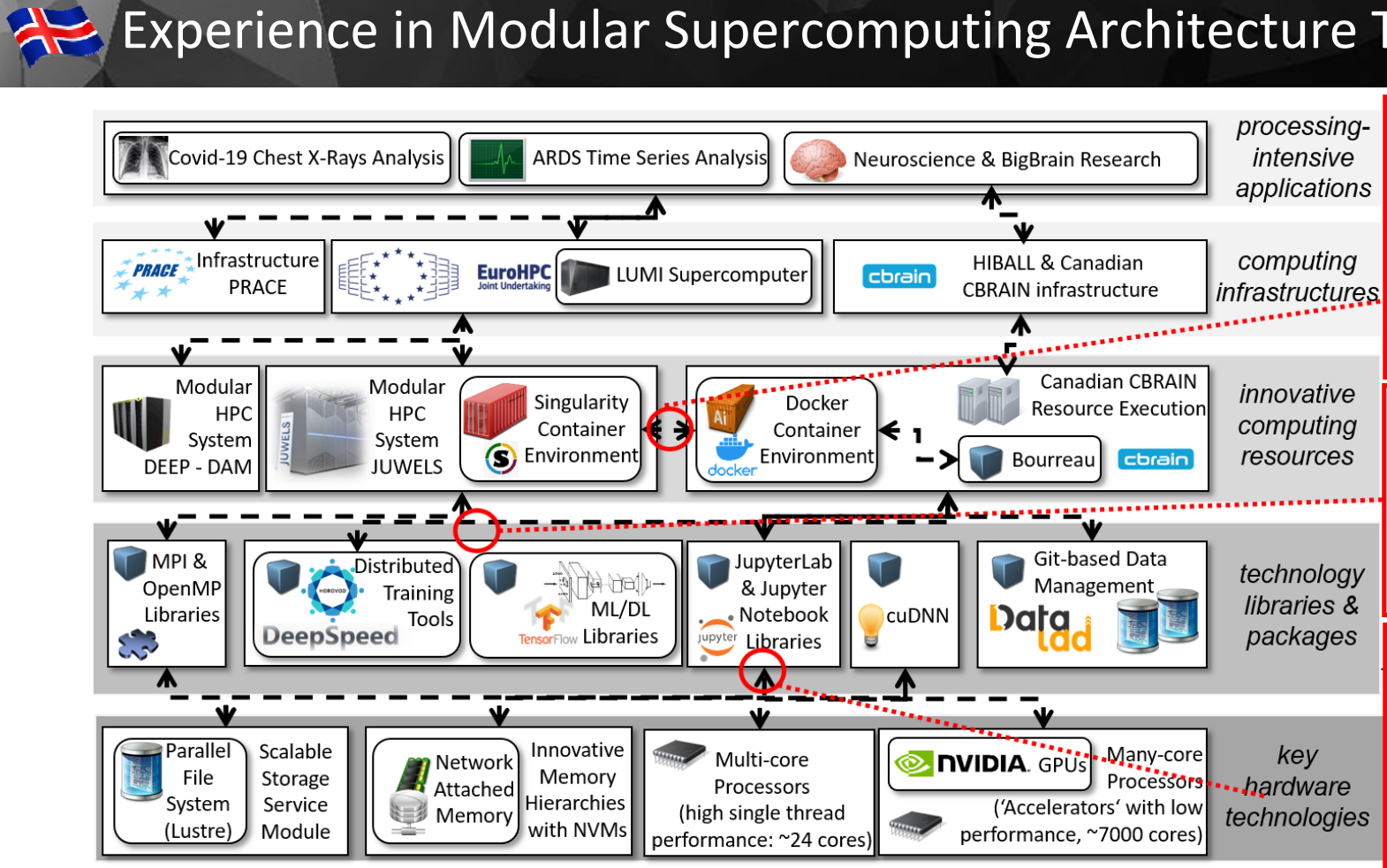


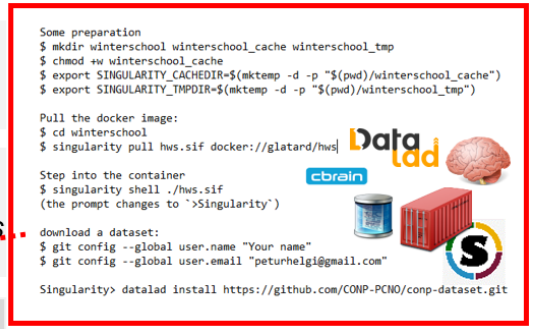
IDEEP Projects

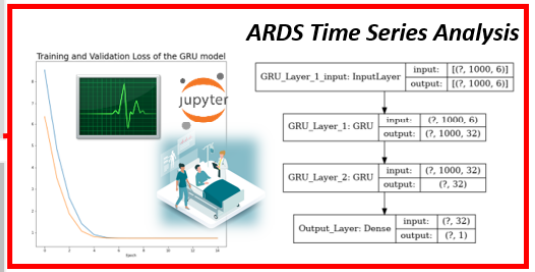
[3] DEEP Series of Projects Web Page

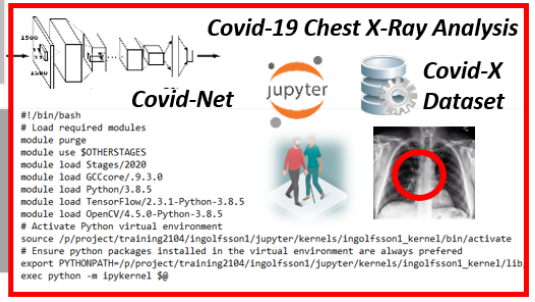
Example Competence 2 – Summary

Experience in Modular Supercomputing Architecture Technologies







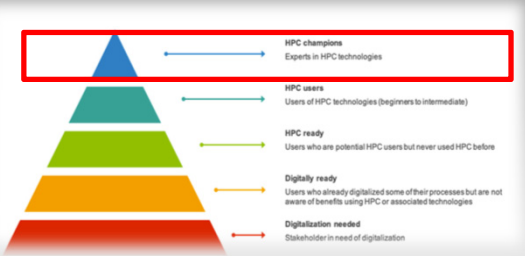


[7] M. Riedel et al., Practice & Experience in using Parallel & Scalable Machine Learning with Heterogenous Modular Supercomputing Architectures, in proceedings of IEEE IPDPS, 2021

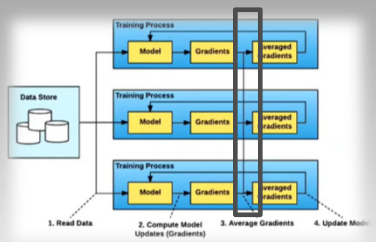
Example Competence 3

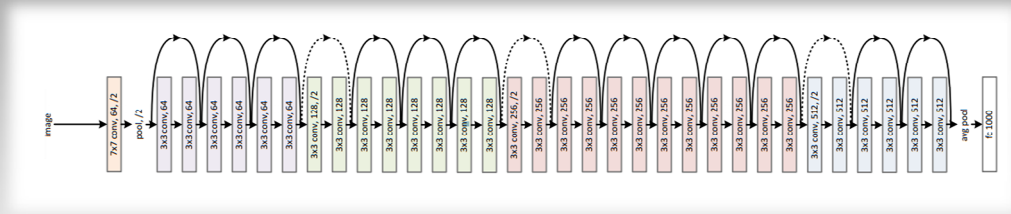
Experience in Parallel & Distributed Training of HPDA / AI Models

EURO



[4] Horovod



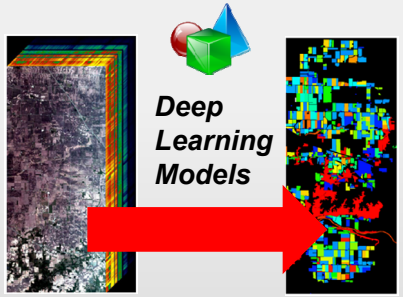


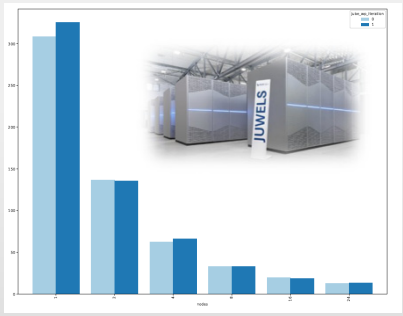
using satellite images in remote sensing

Healthy Patient

Covid-19 Patient

- Expert Technical Consultancy
  → HPC Champions
  - E.g. **using Horovod to scale-up TensorFlow & Keras for Deep Learning**
  - E.g. with remote sensing applications (land cover analysis)
  - E.g. with health sciences applications (Covid-19 Xray analysis)



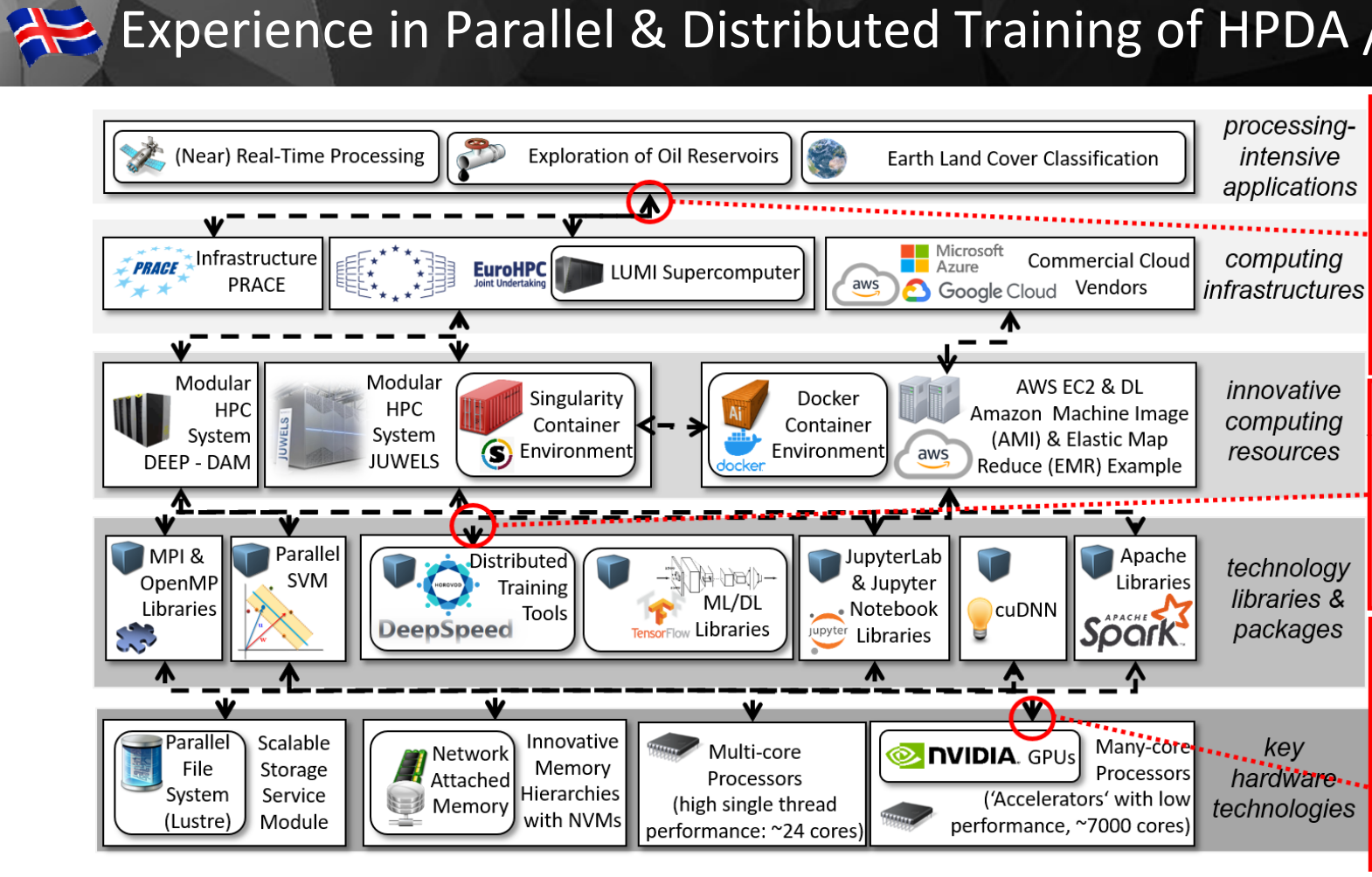


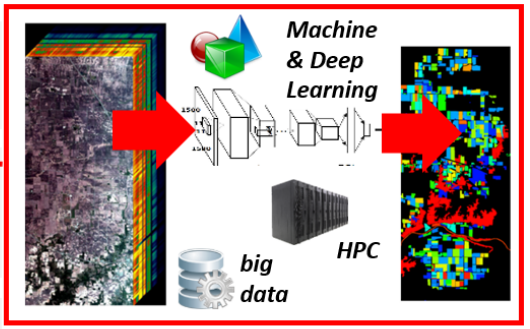
24 nodes x 4 GPUs = 96 GPUs

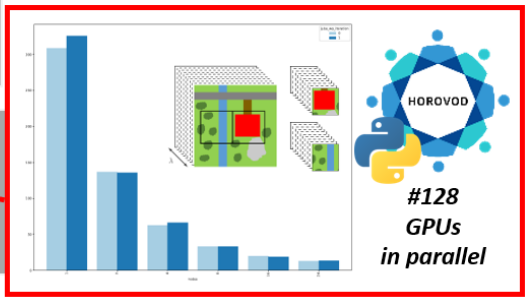
[5] R. Sedona, G. Cavallaro, M. Riedel, J.A. Benediktsson et al.: Remote Sensing Big Data Classification with High Performance Distributed Deep Learning, Journal of Remote Sensing, Multidisciplinary Digital Publishing Institute (MDPI), Special Issue on Analysis of Big Data in Remote Sensing, 2019

Example Competence 3 – Summary

Experience in Parallel & Distributed Training of HPDA / AI Models





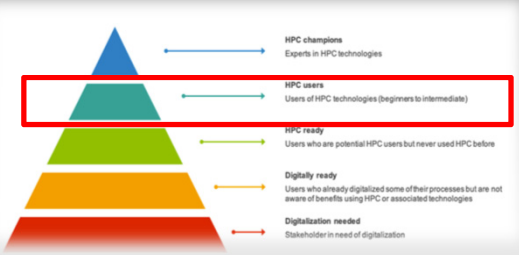


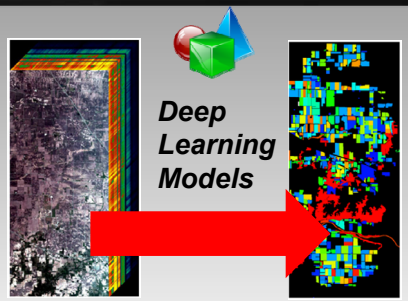
[7] M. Riedel et al., Practice & Experience in using Parallel & Scalable Machine Learning with Heterogenous Modular Supercomputing Architectures, in proceedings of IEEE IPDPS, 2021

Example Competence 4

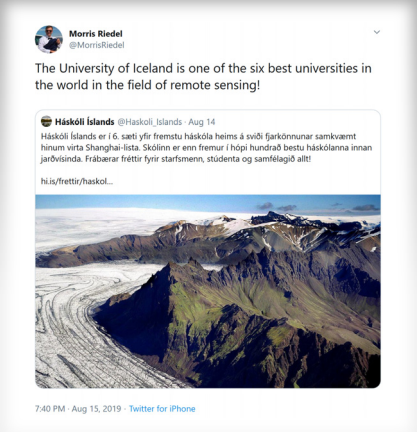
Application Experience in HPDA & Remote Sensing (#6 in the world)

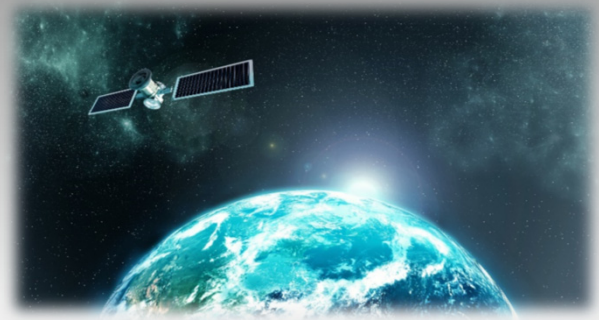
EURO



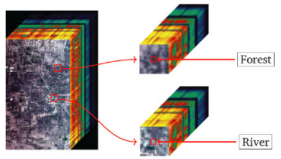


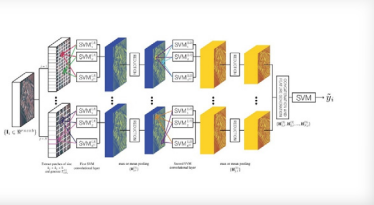
- Services and Products
  → HPC Users
  - E.g. **Feature Selection & Engineering Methods**
  - E.g. **Transfer-Learning** expertise with succesful deep learning networks
  - E.g. **Combination of traditional machine learning & new deep learning models**



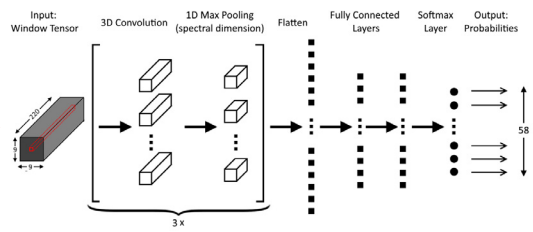


[10] J. Lange, G. Cavallaro, M. Riedel et al., IGARSS Conference, 2018





[11] G. Cavallaro, M. Riedel et al., IGARSS 2019



Feature	Representation / Value
Conv. Layer Filters	48, 32, 32
Conv. Layer Filter size	(3,3,5), (3,3,5), (3,3,5)
Dense Layer Neurons	128, 128
Optimizer	SGD
Loss Function	mean squared error
Activation Functions	ReLU
Training Epochs	600
Batch Size	50
Learning Rate	1
Learning Rate Decay	5×10^{-6}

Example Competence 4 – Contacts

Application Experience in HPDA & Remote Sensing (#6 in the world)

EURO

IHPC

Jötunn | Garðar – decommissioned | History | Community | All Community Experts | Support | Acknowledgements

Hafðu samband – Contact us

Simulation and Data Lab Remote Sensing



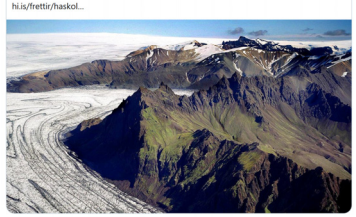
Morris Riedel
@MorrisRiedel

The University of Iceland is one of the six best universities in the world in the field of remote sensing!

Háskóli Íslands @Haskoli_Islands · Aug 14

Háskóli Íslands er í 6. sæti yfir fremstu háskóla heims á sviði fjarkönnunar samkvæmt hinum virta Shanghai-lista. Skólinn er enn fremur í hópi hundrað bestu háskólanna innan jarðvísinda. Frábærar fréttir fyrir starfsmenn, stúdenta og samfélagið allt!

hi.is/frettir/haskol...



7:40 PM · Aug 15, 2019 · Twitter for iPhone

General information

The Simulation and Data Lab Remote Sensing (SimDataLab RS) leads to increase the visibility on interdisciplinary research between remote sensing and advanced computing technologies and parallel programming. This includes high-performance and distributed computing, quantum computing and specialized hardware computing. The SimDataLab RS is based at the University of Iceland and works together with the High-performance and Disruptive Computing in Remote Sensing (HDCRS) working group of the Geoscience and Remote Sensing Society (GRSS). Together with HDCRS, the SimDataLab RS disseminates information and knowledge through educational events, special sessions and tutorials at conferences and publication activities.

Members

Prof. Dr. – Ing. Morris Riedel

Dr. -Ing. Gabriele Cavallaro

Ing. Rocco Sedona

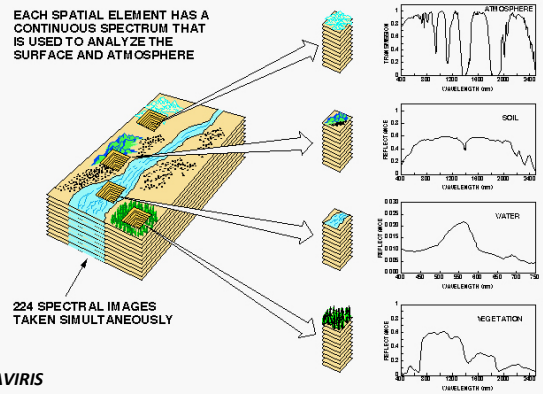
Surbhi Sharma

Ernir Erlingsson

[8] IHPC SimDataLab Remote Sensing Web Page

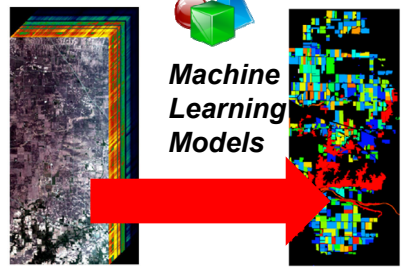
JPL

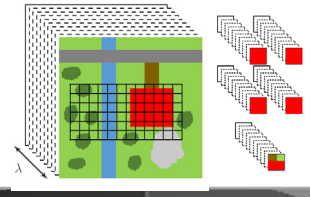
AVIRIS CONCEPT



[9] AVIRIS

Example: Land cover classification



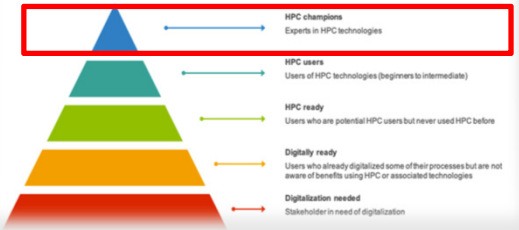


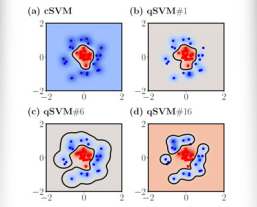
Challenges: mixed pixels & unbalanced land cover classes

Example Competence 5

Experience in Quantum Computing (i.e., quantum annealing)

EURO



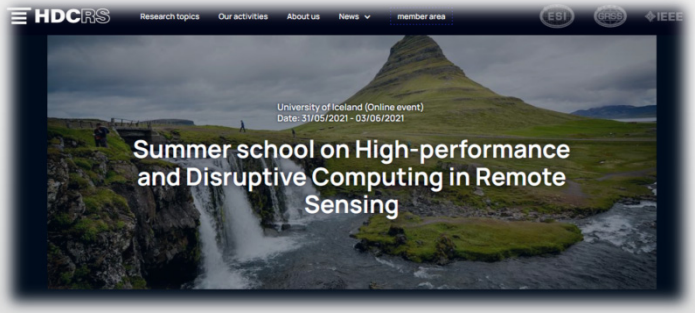


ID	Sensor	Data points	Train Samples	Classes
Im16	Landsat	200×200×7	500	2
Im40	Landsat	200×200×7	500	2

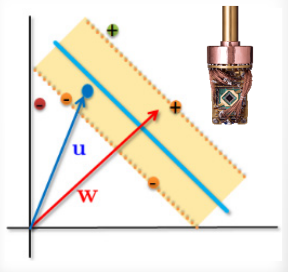
[16] G. Cavallaro & M. Riedel et al., Approaching Remote Sensing Image Classification with Ensembles of SVMs on the D-Wave Quantum Annealer, Proceedings of the IEEE IGARSS 2020 Conference

[15] A. Delilbasic, G. Cavallaro, F. Melgani, M. Riedel, K. Michielsen: QUANTUM SUPPORT VECTOR MACHINE ALGORITHMS FOR REMOTE SENSING DATA CLASSIFICATION, Proceedings of the IEEE IGARSS 2021 Conference, to appear

- Technological assessment & PoCs
  → HPC Champions
  - Experience with **D-Wave Quantum Annealer** System
  - **Cutting-edge IEEE Training Events**



[17] Summerschool Web Page

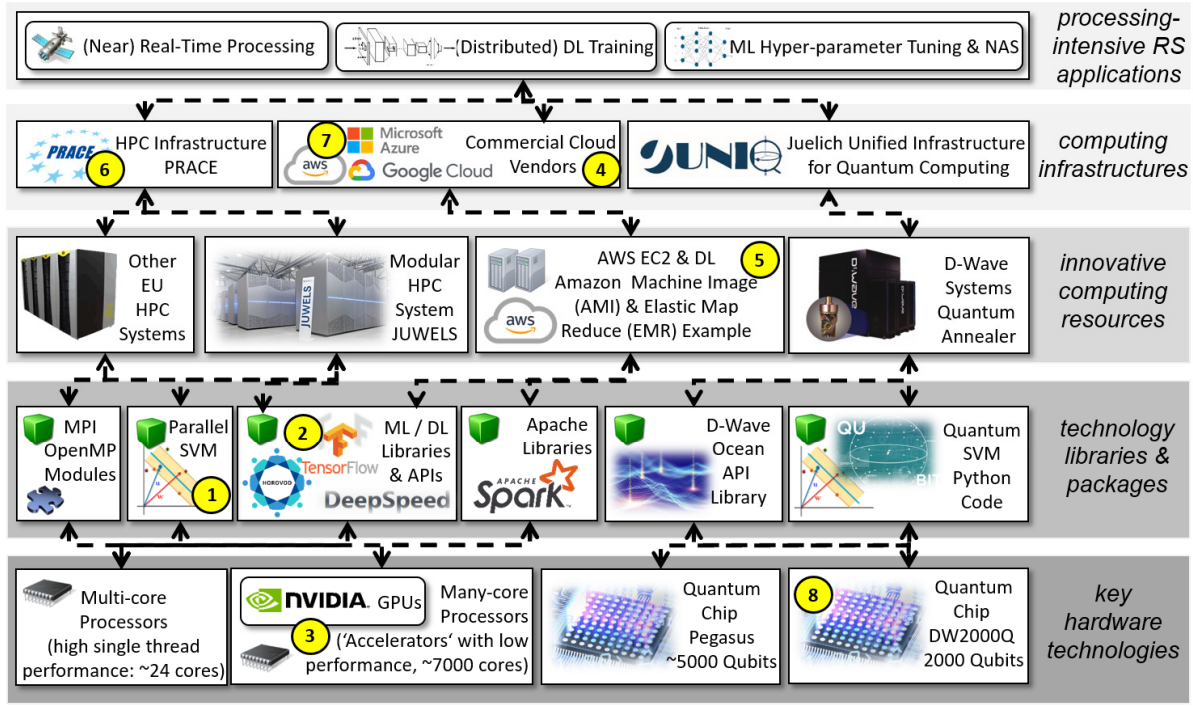


[13] Quantum SVM, D. Willsch et al.

[14] M. Riedel, UTMessan 2020 YouTube Video

Example Competence 5 – Challenges

Experience in Quantum Computing (i.e., quantum annealing)



1. Parallel ML implementations still rare (MPI/OpenMP)
2. Open source tools good, but all need to fit in versions
3. Using very many GPUs beyond NVlink could be tricky
4. Look & feel of CC vendor ML services differ significantly
5. Costs of GPUs of CC vendors (e.g., EC2) tough, 24$/hour
6. GPU hours are free, but requires time grant proposal
7. Free GPUs in Google Colab vary in the available types
8. Works not yet with multi-class problems & large data

Legend:

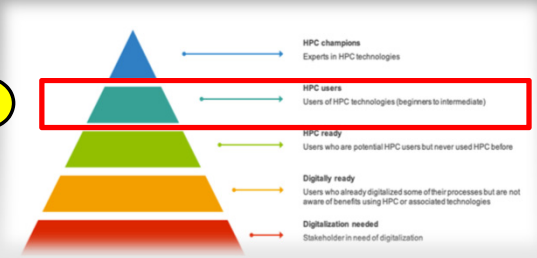
N

Highlighted Challenges & Experiences

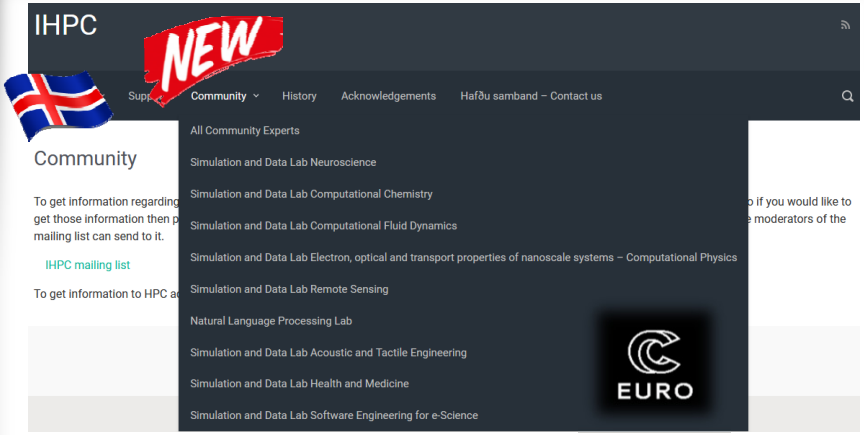
[12] M. Riedel, G. Cavallaro, J.A. Benediktsson, 'PRACTICE AND EXPERIENCE IN USING PARALLEL AND SCALABLE MACHINE LEARNING IN REMOTE SENSING FROM HPC OVER CLOUD TO QUANTUM COMPUTING', in Proceedings of the IGARSS 2021 Conference, to appear

Example Competence 6

Experience in forming Simulation & Data Labs (science & industry)

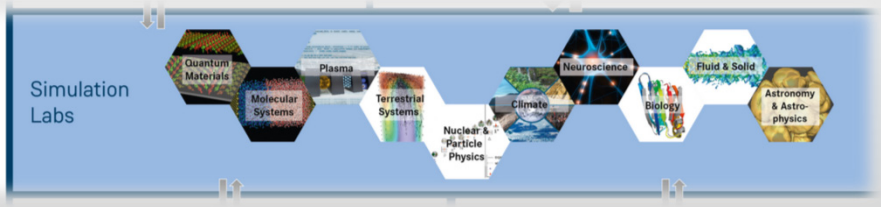


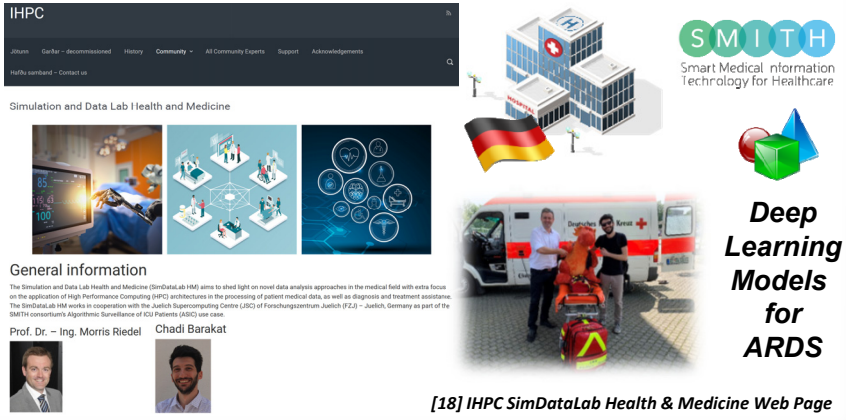
[10] Icelandic HPC Community Web page



- Mastering the EU HPC ecosystem
  → HPC Users
  - Experience in **establishing Simulation & Data Labs (SimDataLabs)** for Community Building
  - **Based on experience over 15 years**

[20] JSC Simulation Labs Web Page





[18] IHPC SimDataLab Health & Medicine Web Page

Example Competence 6 – SMEs

Experience in forming Simulation & Data Labs (science & industry)

EURO

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

[22] 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.

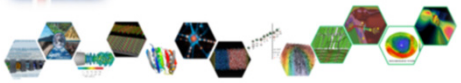
Prof. Runar Unnthorsson, coordinated the 4M€ H2020 RIA project Sound of Vision (no. 643636) which was carried out in the years 2015-2017. The project received the EC's 2018 Innovation Radar Prize in the category Tech for Society for the development of an assistive device for the visually impaired. In 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.

IHPC National Competence Center for HPC & AI in Iceland



[10] Icelandic HPC Community Web page

EURO

[23] EuroCC Project

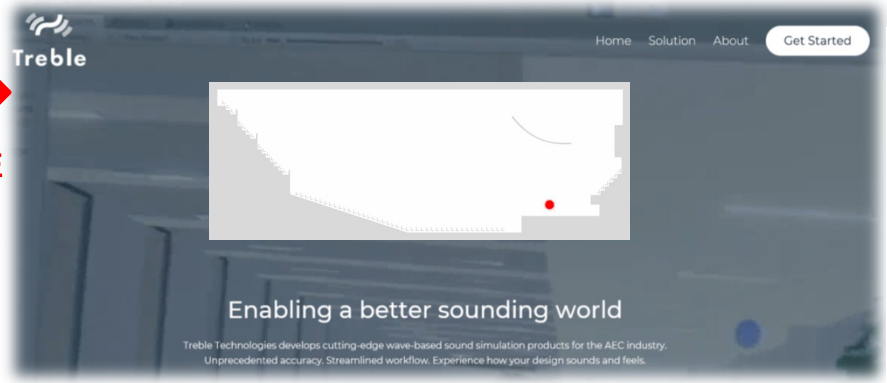
NEW

RAISE Center of Excellence

[21] RAISE Center of Excellence Web Page

SME

SME



[24] Treble Technologies

Natural Language Processing 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 co… and an MSc student at the School of Engineering and Natural Sciences of the University of Iceland. He works in machine translation, language mo… question answering.

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.

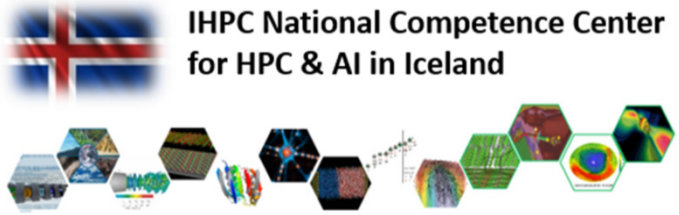
nordverse

Our Partners

[25] Nordverse

Topics of interest for networking

To share with other NCCs



[10] Icelandic HPC Community Web page

- Simulation & Data Lab Communities
  - Get in contact w.r.t. **domain-specific topics**
- Technology Topics
  - Interest to work together w.r.t. **Modular Supercomputing & Quantum Computing**

Simulation and Data Lab Computational Chemistry

General Information

Advancement of theory and methodology for atomic scale simulations, with broad ranging applications for chemistry and physical chemistry, reaction rate theory, adsorption spectroscopy, and magnetism, to name a few.

Prof. Hannes Jonsson

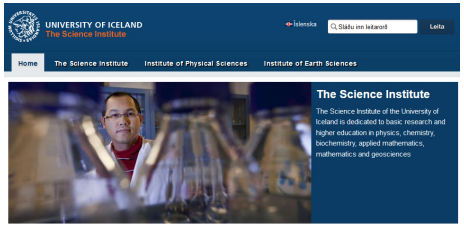
Dr. Elvar Örn Jónsson

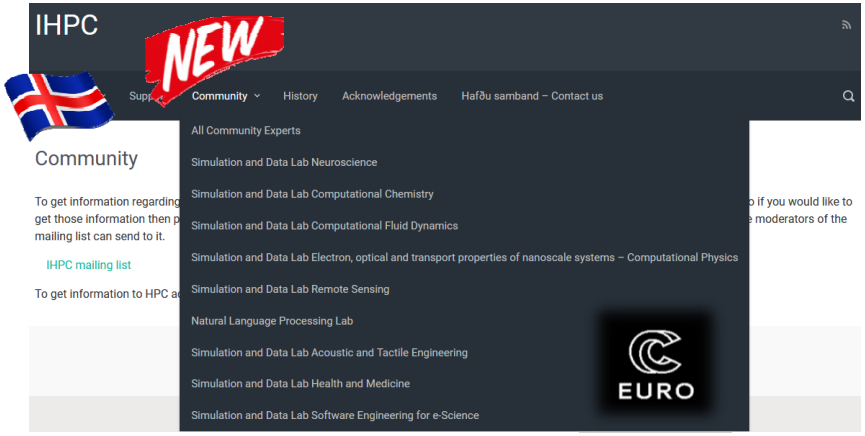
Development of explicit polarizable classical solvent models and methodology for hybrid simulations coupling classical and quantum mechanics for the simulation of solvated molecules and the solid / liquid interface.

Dr. Pavel Bessarab

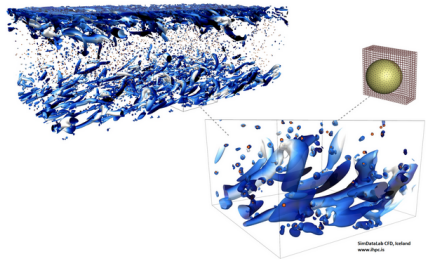
[27] IHPC SimDataLab Computational Chemistry Web Page

[28] Science Institute





Simulation and Data Lab Computational Fluid Dynamics



Dr. Pedro Costa

Dr. Ásdís Helgadóttir

Ph.D. Student S. Reza Hassanian. M

NEW

RAISE Center of Excellence

[26] IHPC SimDataLab CFD Web Page

Prologue

The Simulation and Data Lab computational fluid dynamics (SimDataLab CFD) is leading parallel computing in Computational fluid dynamics in Iceland at the University of Iceland. The SimDataLab is Iceland's representative in the international 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.

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Thanks!

@ProfDrMorrisRiedel @Morris Riedel @MorrisRiedel @MorrisRiedel https://www.youtube.com/channel/UCWC4VKHmL4NZgFfKoHtANKg

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