NEWSLETTER Q3/2019

VSB TECHNICAL
UNIVERSITY
OF OSTRAVA

IT4INNOVATIONS
NATIONAL SUPERCOMPUTING
CENTER

IN BRIEF

THE 18TH OPEN ACCESS GRANT COMPETITION IS NOW RUNNING

You can apply for the computational resources of our supercomputers until 4th December 2019.
For more information HERE

Registration on www.it4i.cz

BEST POSTER AWARD AT THE CISIM CONFERENCE

Pavel Moravec from the Advanced Data Analysis and Simulations Lab won the Best Poster Award at the CISIM 2019 Conference in Belgrade, Serbia.
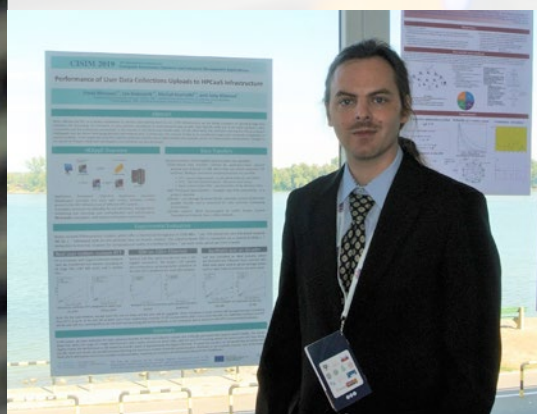
IT4INNOVATIONS IN MEDIA

Read an article about design and construction of our building including the architectural solution of the specific requirements of our technical infrastructure published in the magazine "Stavebnictví" (Civil Engineering)

Read an article

BARBORA, THE NEW SUPERCOMPUTER,
HAS BEEN PUT INTO OPERATION

At the beginning of October, a ceremony was held at IT4Innovations to celebrate the launch of a new supercomputer named Barbora

Barbora was supplied by Atos IT Solutions and Services, and is an extension of the existing Anselm supercomputer, which was commissioned in 2013. It was officially taken over by IT4Innovations National Supercomputing Center and commissioned in late September 2019.

"Our goal is to regularly renew our computing resources so that our users have access to state-of-the-art computing systems, and to be able to meet their growing requirements as much as possible. The demand for computational resources has currently exceeded our capacity more than once. Therefore, I'm pleased that by installing Barbora we can accommodate more people interested in computational hours in the next round of grant competition, and also meet their demands for the latest technologies, such as GPU accelerators," states Vít Vondrák, Director of IT4Innovations National Supercomputing Center.

"We believe that the supercomputer Barbora, based on state-of-the-art technologies, will meet all IT4Innovations' expectations," says Albert Gallina, Head of Big Data & HPC Central and Eastern Europe at Atos, explaining: *"Atos is Europe's leading supercomputer and artificial intelligence player, and therefore we are a strong partner in the EuroHPC initiative, which aims to build a pan-European infrastructure for high-end supercomputers. We are grateful for the opportunity to work again with IT4Innovations and contribute to the development of science and research at a national and European level."*

"It is also worth mentioning a technological shift in some areas. The cooling of the computing nodes is done with hot water, which leads to savings in operating costs. In addition, the new system delivers hot water cooling technology at the switch and power supply level of the computing system, increasing cooling efficiency over the older Anselm and Salomon systems. A new 512-bit instruction set (AVX-512) is available on the processors. Computing node memory is 50% larger and 50% faster, networking is 2 times faster than the supercomputer Salomon. Also, the file handling will speed up thanks to NVMe technology. With 32 GPU accelerators, the NVIDIA V100 delivers up to 4 PFlop/s of theoretical performance through tensor units to accelerate artificial intelligence calculations. In practice, this means 1.5 to 3 times faster routine calculations and the possibility to train even larger neural networks," said Branislav Jansík, Director of IT4Innovations Supercomputing Services.

The opening ceremony was attended, among others, by Roland Galharague, the French Ambassador, Václav Snášel, Rector of VSB-TUO, Pavel Doleček, Deputy Minister of Education, Petr Očko, Deputy Minister of Industry and Trade, Erich Unterwurzacher, the Director for Central Europe at DG Regio, and Ivo Vondrák, Governor of the Moravian-Silesian Region.

BROADCASTS:

Barbora Supercomputer Launch Ceremony, 2nd October 2019 HERE
The supercomputer Barbora has extended our first supercomputer Anselm. HERE

IT'S BARBORA!

- The name was selected by public tender
- There was a total of 1,237 submitted proposals (985 of which were unique names)
- Barbora refers to the patron saint of miners
- Barbora is the name of one of the mines in the Ostrava-Karviná district
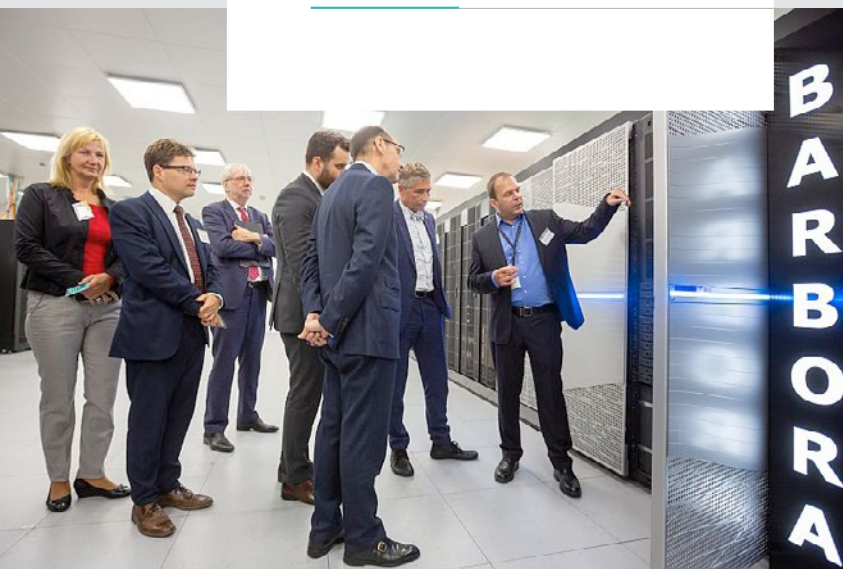
TECHNICAL SPECIFICATIONS OF THE SUPERCOMPUTER BARBORA:

- The combined theoretical computational performance is 826 TFlop/s
- It has a total computing node memory capacity of 43TB
- It has a computing storage speed of 28GB/s
- The speed of the computing network links between individual computing nodes is 100Gb/s
- Computing nodes:
  - There are 192 standard computational nodes; each node is equipped with two 18-core Intel processors and 192 GB of RAM,
  - There are 8 compute nodes with GPU accelerators; each node is equipped with two 12-core Intel processors, four NVIDIA V100 GPU accelerators with 16 GB of graphics memory, and 192 GB of RAM,
  - The fat node is equipped with eight 16-core Intel processors and 6TB RAM,
  - Cooling of standard computational nodes uses the technology of direct cooling of components by liquid medium, and the most effective cooling by so called 'warm water' is used.
- The supercomputer Barbora is built on the HPC architecture of Bull Sequana XH2000.
- The computing network is built on the latest Infiniband HDR technology.
- There is 310 TB SCRATCH data storage with 28 GB/s throughput using Burst Buffer acceleration.
- There is data storage for NVMe over Fabric calculations with a total capacity of 22.4 TB, dynamically allocated to compute nodes.
- It uses the Bull Super Computer Suite cluster operation and management software solution, PBS Pro scheduler and resource manager.

Barbora Supercomputer Launch Ceremony, 2nd October 2019

The supercomputer Barbora was acquired as part of the OP RDE, project entitled "IT4Innovations National Supercomputing Center - Path to Exascale" (CZ.02.1.01/0.0/0.0/16_013/0001791).

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research,
Development and Education

MINISTRY OF EDUCATION,
YOUTH AND SPORTS

OPENQKD PROJECT

IT4Innovations launches another Horizon 2020 project – OPENQKD

The OPENQKD pilot project implements and tests a pilot quantum communication infrastructure in several European countries. Its main targets to boost the security of critical applications in the fields of telecommunications, healthcare, electricity supply, and many other strategic areas, to develop an experimental communication network infrastructure based on QKD (Quantum Key Distribution), and to test the interoperability of QKD equipment from different manufacturers.

The OPENQKD project will focus on several key areas, in particular the telecommunications sector, therefore companies such as Deutsche Telekom, Orange, Telefónica, British Telecom, and many others have formed a telecommunications consortium. Besides creating its own QKD network testbed and developing tools using quantum communication networks, the verification of various application cases such as medical and government data security and transmission of safety-critical data (e.g. in power engineering) will take place. The Ostrava supercomputer will be involved in the solution of distributed computationally demanding tasks via QKD. The Principal Investigator on the behalf of IT4Innovations prof. Miroslav Vozňák, Head of the Laboratory for Big Data and Analysis, says about the project: *"I believe that this project will lay the groundwork for a pan-European quantum communication infrastructure that uses satellite as well as ground-based solutions. The European Com-*

mission and several EU countries announced plans to work together to explore the development of such a quantum communication infrastructure linking European regions and cities. The current cryptography and its key problem of key distribution is based on the principles of computational complexity, the new incoming technology uses the physical principles of quantum mechanics to significantly shift the area of network security. I am very pleased that IT4Innovations is joining partners such as AIT, the University of Cambridge, the Max Planck Institute, Deutsche Telekom, Orange, Telefónica, British Telecom and many others. This project can be only successful because of the strong collaboration between research, industry and the public sector."

OPENQKD PROJECT

- · Consists of 38 partners form 13 member states
- · Involves quantum equipment manufacturers, network operators, system integrators, small and medium-sized enterprises, research and technology organisations, universities, certification and standardisation bodies and end users
- · Will last three years
- · Has a budget of € 15 million

More about the project

WHAT IS QKD?

QKD (Quantum Key Distribution) is a form of encryption that cannot be breached by quantum computers, thus enabling the long-term security of data and communication messages.

More information HERE

NATIONAL CENTER FOR ENERGY

IT4Innovations in cooperation with the ENET Center
are involved in a common project.

From the beginning of 2019, VSB - Technical University of Ostrava has been the manager of the National Centre for Energy (NCE). Its objective is to create new, more efficient, and safer technologies for the use of alternative fuels, and secure the energy self-sufficiency of the Czech Republic.

The project involves 23 research organisations and companies from the energy industry, such as the Research Centre Řež, ČEZ, Doosan Škoda Power, Veolia Energy ČR, and others.
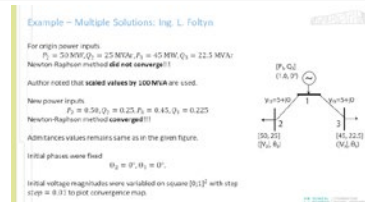
Dr Jan Martinovič and his team from the Advanced Data Analysis and Simulations Lab, in cooperation with the ENET Center at VSB-TUO, are involved in this project. Their involvement consists in solving parts of projects from the segment 'Alternative energy sources and waste', whose guarantor is prof. Stanislav Mišák from the ENET Centre.

The first research results were presented at the beginning of September at the Horizon 2020 Conference "The Project Factory on Energy Technologies" in Brussels.

The National Centre for Energy project received the highest rating from the Technology Agency of the Czech Republic, which financially supports the project.

OPTIMISATION OF A PHOTOVOLTAIC POWER PLANT'S POWER GENERATION AT THE GENERATION SITE/RELIABILITY, SAFETY, AND OPTIMISATION OF THE ELECTRICAL POWER NETWORK OPERATION.

The aim of the project is to analyse, model, and optimise dynamic processes taking place in electrical power networks – modelling of scenarios of failures in the network; modelling and optimisation of power flows in the network using deterministic and stochastic algorithms; analysis of time series describing the operation of electrical power networks.

National Center for Energy, prof. Stanislav Mišák, principal investigator of the project.

Numerical stability testing of electrical network modelling algorithms, including solution

Numerical IT4Innovations experiments point to four possible solutions (shown in colours)

NCE

DEVELOPMENT OF A DETECTOR OF FAULTS AT INSULATED CONDUCTORS OF OVERHEAD LINES

The aim of the project is to develop and test methods for contactless scanning of partial discharge patterns and their evaluation using statistical methods of artificial intelligence. At present, classification algorithms are being tested: decision trees, neural networks, SVM and clustering algorithms.
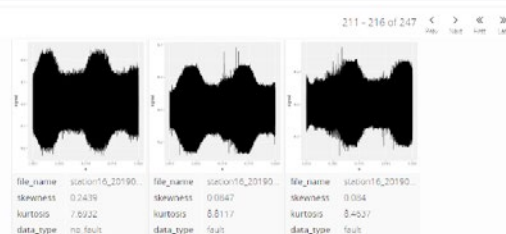
Development of software for visualisation and statistical description of data

OPTIMISATION OF DISTRIBUTION NETWORK OPERATION IN CASE OF ABNORMAL AND FAILURE CONDITIONS OCCURRENCE.

The aim of the project is to develop and test methods for modelling and optimising power flows of electricity in the distribution network using both deterministic and stochastic methods.

IT4Innovations, in cooperation with the ENET Centre, uses mathematical modelling to verify and optimise models of distribution grids in the Czech Republic.

The figure shows an example of an electrical network simulation solution in the pandapower software package, which is developed by the cooperation of the Energy Management and Power System Operation (the University of Kassel), the Department for Distribution System Operation (the Fraunhofer Institute for Energy Econo-

mics) and Energy System Technology (IEE, Kassel, Germany). The colouring of the individual nodes of the network indicates the per-unit value of the voltage in that node. In nodes coloured in red, the voltage value is higher than the local nominal value, i.e. there is an overvoltage condition, in contrast, in nodes coloured in blue the voltage value is less than 90% of the local nominal value, and thus there is an under voltage condition. The colouring of the individual power line sections indicates the relative load: i.e. the line sections which are coloured dark red are loaded at 100%.

The project uses HyperLoom (a platform for defining and running interconnected computing tasks on distributed systems, developed at IT4Innovations) to explore different optimisation scenarios for a distribution network model.
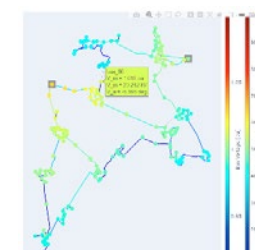
[Read more about pandapower](#)
Guarantor of the projects:
prof. Stanislav Myšák, VSB – TUO

Demonstration of mathematical model of electricity distribution network with the pandapower package

IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER PROJECT – PATH TO EXASCALE HAS REACHED ITS MIDPOINT

The objective of this project is to upgrade and modernise the research infrastructure of IT4Innovations and maintain the existing technological level of HPC in the Czech Republic in comparison with developed, particularly European countries. The project has been running since 2017 and will be completed in 2021.

As part of the research infrastructure modernisation project, a specialized NVIDIA DGX-2 artificial intelligence system has been launched this year with 130 TFlop/s (2 PFlop/s for AI calculations), the first installation of this type in Central and Eastern Europe. As part of this project, at the beginning of October we launched a supercomputer called Barbora, with an output of 849 TFlop/s. By the end of 2020, we plan to acquire a modernized version of the supercomputer Salomon. The entire supercomputer family will be interconnected in 2020 by a modernised centralised ICT infrastructure consisting of a WAN network, data storage, and virtualization infrastructure.

Within this project the research is carried out in three research programmes:

· VP 1 - Modelling of photonic and spin-photonic structures

· VP 2 - Design of innovative materials based on electronic structure calculations

· VP 3 - Analysis of bioimages using HPC
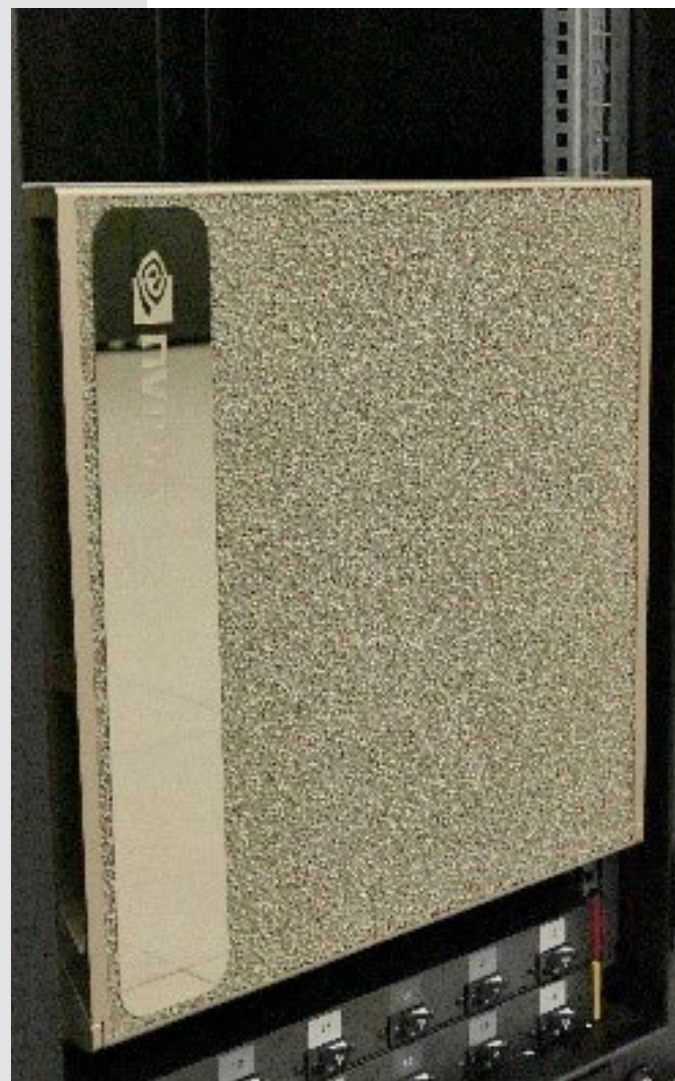
The supercomputers NVIDIA DGX-2 and Barbora was acquired as part of the OP RDE, project entitled "IT4Innovations National Supercomputing Center - Path to Exascale" (CZ.02.1.01/0.0/0.0/16_013/0001791).

RESEARCH PROGRAMME VP 1 - MODELLING OF PHOTONIC AND SPIN-PHOTONIC STRUCTURES

Principal investigator: prof. Jaromír Pištora

The aim of the research programme is to effectively use the expanded supercomputer infrastructure in the field of modelling of photonic structures and spin photonics. The solution is based on cooperation of renowned foreign scientists in the field of photonics, plasmonics, and photovoltaics. A unique feature of the project is the synergy of photonic structures areas with the existing and planned IT4Innovations computing infrastructure. The scientific activities of the team include the issues of spin lasers, terahertz photonics, diffractive photonic structures, and photovoltaics.

RESEARCH PROGRAMME VP 2 - DESIGN OF PROGRESSIVE MATERIALS BASED ON ELECTRONIC STRUCTURE CALCULATIONS

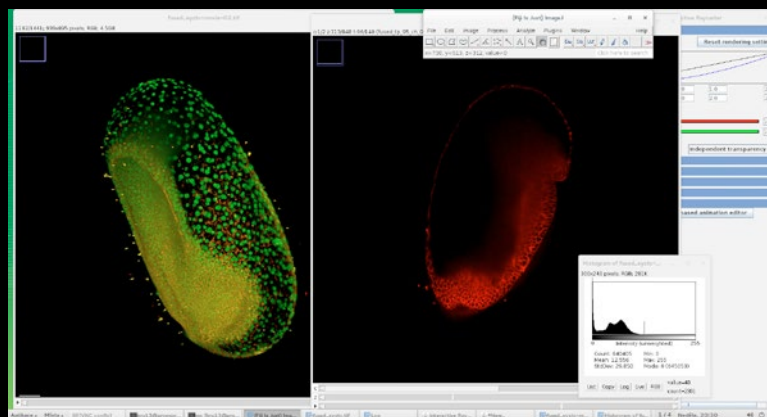**Principal investigator:** Dr Dominik Legut

The research programme consists of excellent research in the fields of magneto-optics, spintronics and ultrafast laser pulses, nonlinear optical phenomena, a search for super hard layers of thermoelectric materials for solar cells, magnetically low-dimensional structures for high-capacity data recording, and a study of new superconducting materials and high-temperature entropic stabilized alloys for the aerospace industry. The basis is the most accurate calculation of the electronic structure based on fundamental postulates of quantum mechanics, i.e. calculations without any experimental or empirical parameters.

RESEARCH PROGRAMME VP 3 - ANALYSIS OF BIOIMAGES USING HPC

Principal investigator: Dr Pavel Tomančák

Solving relevant biomedical problems, such as civilization diseases, depends on a deep understanding of the mechanisms of functioning of biological systems. One of the most important tools of knowledge of biological mechanisms is microscopic observation. Modern microscopes produce huge amounts of image data that cannot be analysed without computerised image analysis methods. Large multidimensional data from today's most advanced microscope technologies are increasingly larger than desktop capacity. Therefore, the use of high-performance supercomputer technology (HPC) is essential to address biomedical problems involving large image data.

Data Processing in the Fiji Application Environment
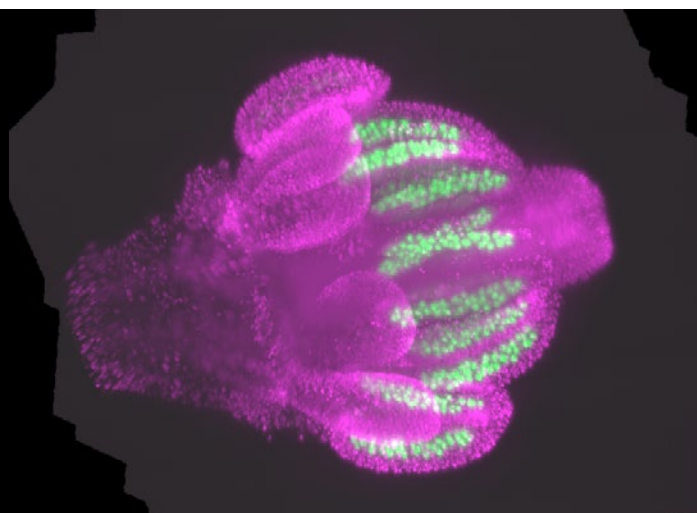
Image of Arabidopsis plants using light fluorescence microscopy

In this issue of the Newsletter we will focus on the research programme Analysis of bioimages using supercomputers.

Light sheet microscopy is a method of fluorescence microscopy. It is one of the most important tools for understanding biological mechanisms, in which the sample is illuminated by a thin laser beam passing through the object perpendicularly to the microscope objective, thus detecting only in the plane of sharpness. Scanning typically happens at regular time intervals in multiple planes and captured images are then registered and reconstructed into 3D time-lapse videos. Modern microscopes make it possible to capture images at very high resolutions, with one image from one time interval often exceeding 10 GB of data. It is then common that complete datasets take up entire terabytes of data. Without HPC, processing this amount of data would mean months of waiting, with uncertain results. Thanks to HPC, this data can be processed in hours. The calculations are carried out on tens of nodes by the supercomputer Salomon, with a total of tens of thousands of cpuhours being used per dataset.

JOne of the often reconstructed model organisms is Drosophila (it can be also found at home). This species belongs to widely used model organisms of evolutionary biology. Due to its rapid development it is possible to observe developmental changes in a short time. Light Sheet Microscopy allows the capture of their complete evolution from egg to larvae (at optimal temperatures they hatch within 24 hours and you can often see in datasets how larvae leaves the scanned area).

All data processing takes place in the Fiji application environment, to which we contribute by developing plug-ins and modules to process data on HPC resources. We repoted about one of these plug-ins in an article published in Bioinformatics magazine, to read **HERE**.

Drosophila is not the only organism whose images are processed on our supercomputers. In recent research, we processed images of a flower. In an article titled "Germ line differentiation of developmental stages of Arabidopsis using light sheet microscopy", awaiting publication in eLife magazine, we have helped to develop a methodology for live imaging of germ cells within floral reproductive organs of higher plants, especially Arabidopsis, using light sheet fluorescence microscopy. This method enables new avenues of research into plant reproduction.
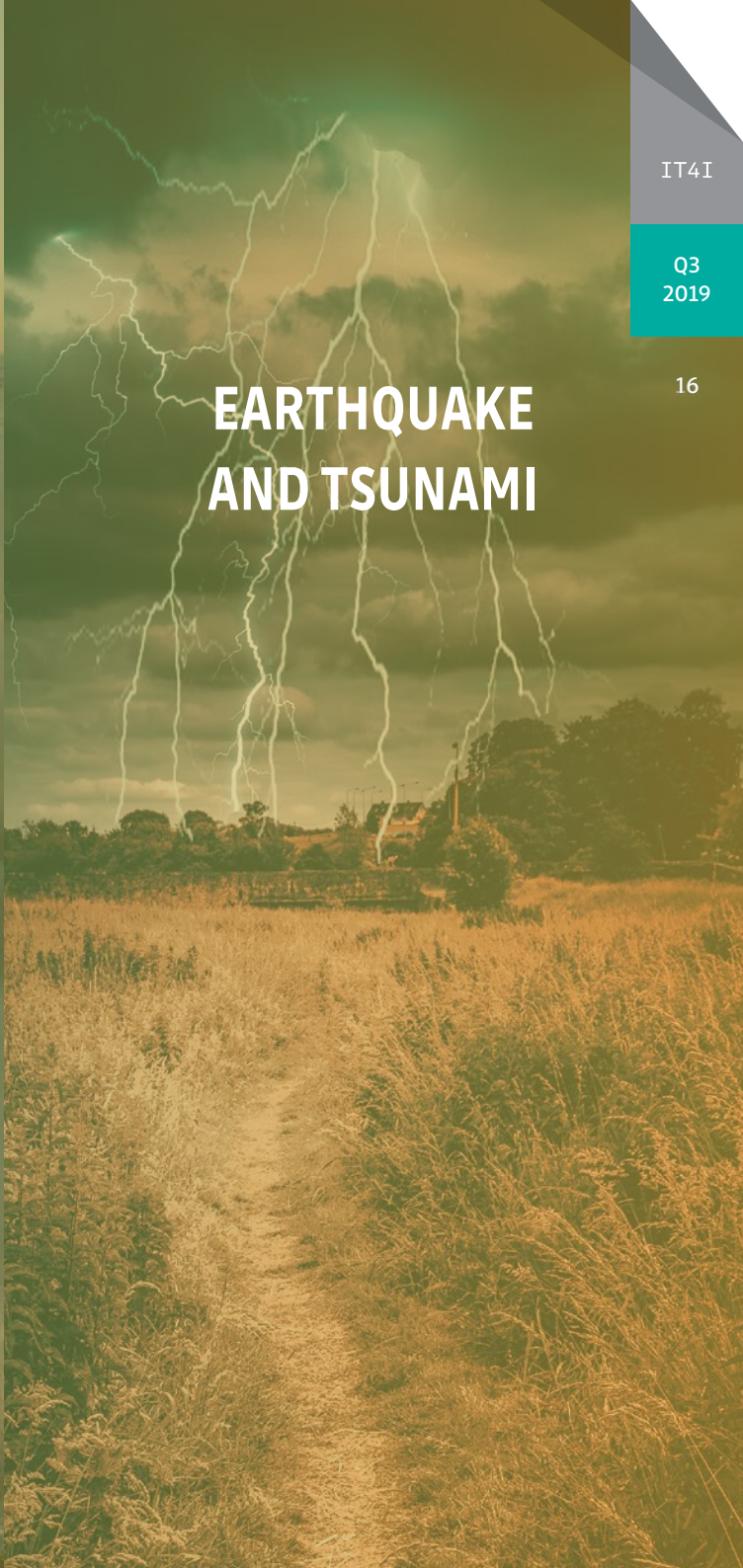
More in the pre-print article **HERE**

back to content

AERONAUTICS

WEATHER
AND CLIMATE

EARTHQUAKE
AND TSUNAMI

THE LEXIS PROJECT

In September, the second meeting of LEXIS partners was held in Turin, Italy. During the meeting, the project partners presented the first tangible

The main objective of the meeting was to verify the initial results of experimentation with new LEXIS technologies, including Atos Smart Burst Buffer technologies, advanced compute hardware (GPUs, FPGAs) as well as novel data management solutions and workflow/pipeline mechanisms. *"I am very pleased that the joint meeting of partners took place. This Face to Face Meeting was the right place to present to the entire consortium, coming from all over Europe, key developments within the project. Particular focus was placed on the results coming from the technical innovations within the LEXIS Platform itself, and how the three project Pilots (Aeronautics, Earthquake and Tsunami and Weather and Climate) leverage these new capabillities"* states the Project Coordinator Dr Jan Martinovic, head of the Advanced Data Analysis and Simulations Lab at IT4Innovations.

Mr Donato Magarielli of AvioAero who is leading the industrial Aeronautics Pilot ads: *"The work done over the last months confirms that our dream is achievable! We can drastically reduce the running time of our CFD simulations and bring to the European aeronautics sector a compelling competitive advantage in terms of reduced design time and improved design process quality using enhanced and sophisticated simulations running on newly designed HPC/Cloud/BD platforms".*
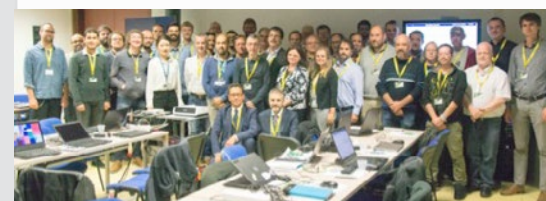
Dr Thierry Goubier of CEA (Alternative Energies and Atomic Energy Commission) adds that:*"We are driving the Earthquake and Tsunami Use case and we are confident we can significantly improve both forecast and responses to such major disasters. This is something that is, of course, essential for the French Atomic Energy Commission."*

The same sentiments are echoed by Dr Antonio Parodi of CIMA (International Centre on Environmental Monitoring) and Dr Emanuele Danovaro of ECMWF, stating that: *"The Weather and Climate Use case developed during the initial phase of LEXIS offers an excellent basis for testing the practical advantages of HPC cloud convergence in weather forecasting. At the same time, it is paving the way to extensive data fusion from non-traditional weather sources such as innovative Smart Gateways. This work will support diverse use cases including providing Civil Protection Services with more actionable information in case of extreme weather events, to help improve their response."*

THE LEXIS PROJECT

The target of the LEXIS international project is to build an advanced engineering platform leveraging modern technologies from High Performance Computing and Big Data and Cloud Computing, focusing on data and computationally demanding tasks in the aviation industry, weather and climate models, as well as earthquake and tsunami issues. The consortium consists of 16 members, including major supercomputing centers and representatives of industrial enterprises and technology providers from across seven European countries. The LEXIS project is funded by the Horizon 2020 Framework Programme and it is the first project of this significance coordinated by VSB –Technical University of Ostrava, namely the team of Jan Martinovič from IT4Innovations National Supercomputing Center. Read more about the project.

back to content

DOCTORAL SCHOOL FOR EDUCATION
IN THE MATHEMATICAL METHODS
AND TOOLS IN HPC

Doctoral School for Education in Mathematical Methods and Tools in HPC has started

Within the Operational Programme Research, Development and Education we have established a doctoral school focused on the development of effective mathematical methods and algorithms for HPC and their application in computationally demanding scientific and technical fields.

Studying at the doctoral school provides a wide range of study and research activities across prestigious universities, opportunities for internships at universities and research institutions not only in the Czech Republic, but also abroad, and access to high-tech HPC at the university institute IT4Innovations.

"We expect the Doctoral School project to create the germ of a national platform for the education of doctoral students in the field of HPC, and to create the conditions for its further growth, even after the project is completed. The main aim of the project is to link workplaces involved in HPC from various fields such as science, research, and education. The secondary goal is to strengthen the internationalisation of our doctoral programmes (computational sciences) and to create conditions for the establishment of joint doctoral programmes with foreign universities (double degree)," says Dr René Kalus, a guarantor of the Doctoral School project.

THE DOCTORAL SCHOOL LINKS DOCTORAL STUDIES AT:

- The Faculty of Mathematics and Physics, Charles University (MFF UK)
- The Institute of Mathematics, the Czech Academy of Sciences (MÚ AV ČR)
- The Faculty of Electrical Engineering and Computer Science, and IT4Innovations National Supercomputing Center (VSB-TUO)

THE STUDY PROGRAMMES INVOLVE:

- Mathematical and Computer Modelling (the Physics programme, MFF UK + MÚ AV ČR)
- Scientific and Technical Calculations (the Mathematics programme, MFF UK + MÚ AV ČR)
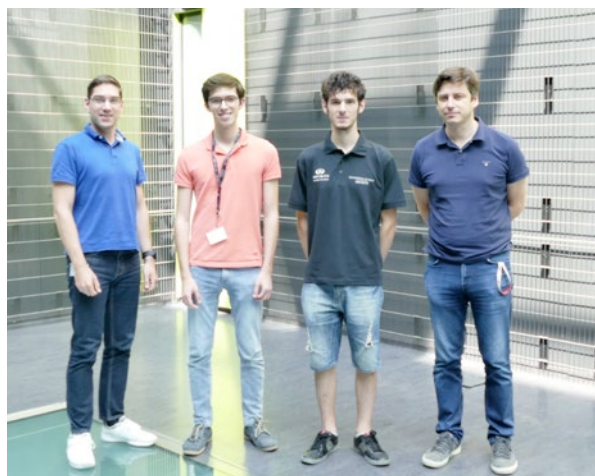- Computational Sciences (the Computational Sciences programme, VSB-TUO)

PRACE SUMMER OF HPC

We hosted two students of PRACE Summer of HPC

Already for the seventh time we joined the Summer of HPC programme, which is designed for university students organized by PRACE (Partnership for Advanced Computing in Europe).

PRACE Summer of HPC 2019 graduates David Izquierdo and Pablo Lluch Romero with their IT4Innovations mentors

Pablo Lluch Romero and David Izquierdo presenting their results

The objective of the PRACE Summer of HPC programme is to support students in gaining experience with using high performance computing (HPC) for solving problems in their field of study. Students can choose from a wide range of exciting projects offered by centers from the UK, Ireland, Luxembourg, Italy, Spain, Greece, Germany, the Netherlands, Slovenia, Slovakia, and the Czech Republic. Internships take place in July and August under the guidance of experienced mentors. At the end of the internship students prepare final reports and produce a visualisation or video summarising the results of their projects. This summer, 25 selected students took part in the internship. After a kick-off training week focused on the basics of HPC at the CINECA supercomputer center in Bologna (Italy) students went to 11 host organizations across Europe. This year we welcomed David Izquierdo and Pablo Lluch Romero.
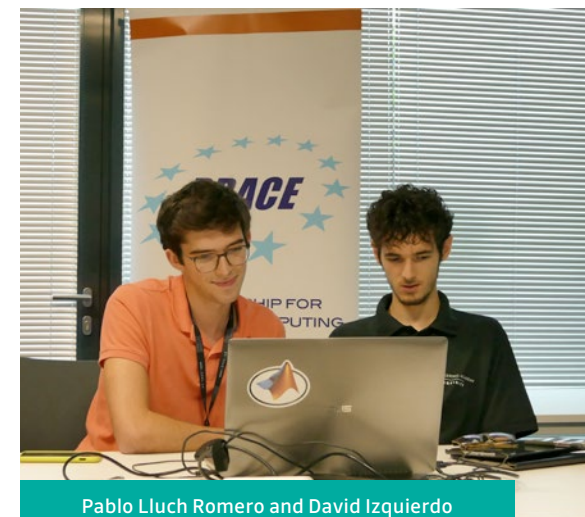
David Izquierdo, a bachelor of aeronautics engineering at Carlos III University in Madrid, worked on the project "Analysis of CFD simulations of Aerodynamics of Cars; Formula Student".

This project was focused on the application of the open source tool OPEN FOAM to solving engineering problems, analysing parallel CFD simulations and testing optimal settings for using clusters in IT4Innovations to create a numerical model for calculation of external aerodynamics of vector 05 - student VSB-TUO formula. His mentor was Tomáš Brzobohatý from the Parallel Algorithms Research Lab.

Final project presentation, David Izquierdo

Pablo Lluch Romero, a bachelor's student of Artificial Intelligence and Software Engineering in Edinburg, worked on the project "Emotion Recognition using Deep Neural Networks".

The project aim was to create an application for the recognition of seven basic emotions by their facial expressions in real-time using one of IT4Innovations' supercomputers. This should help visually impaired individuals to better recognise other people's emotions during conversation. Pablo´s mentor was Georg Zitzlsberger from the Advanced Data Analysis and Simulations Lab.

Final project presentation, Pablo Lluch Romero

What interested you the most about the PRACE Summer of HPC programme?

David: *: "I was interested in several things, the training itself in the area of HPC, conducting CFD simulations, etc., but also meeting and exchanging experiences with other participants. A great benefit was the kick-off training focused on the basics of HPC in CINECA. I think participation in PRACE Summer of HPC has helped me to become a more open person by sharing experiences with other participants from the training programme, with mentors, with people working for IT4Innovations, and with local people during my travelling around the Czech Republic."*

Pablo: *"Within the Summer of HPC programme I chose a field in which I had no previous experience, so everything I learned during the summer school was extremely valuable to me. I was impressed by the neural network analysis process and the correct interpretation of facial muscle movements using numerical models without my prior knowledge in this field."*

Would you recommend PRACE Summer of HPC to your friends, and IT4Innovations as a hosting organisation?

David: *"Yes, I would. This summer internship has moved me not only in knowledge but also on a personal level. I learned to better present my thoughts and opinions. I think it's a great experience. As for IT4Innovations, I can say that I enjoyed working in the modern environment of the center.*

*Furthermore, the people from IT4Innovations were really nice and helpful."*

Pablo: *"I would truly recommend attending this summer internship not only to my friends in computer science, but to anyone working in science. With this programme you will get to know a variety of HPC disciplines that previously seemed difficult to understand. Working on the IT4Innovations project was a great experience for me. Everyone was very kind and helpful, especially my mentor Georg, who supported me throughout the project."*

Would you share with us your career dream?

David: *"Formula 1 Engineer. I have loved motorsport since my childhood. I am interested in technology and especially in aerodynamics. I'd like to work in the F1 team to develop my ideas. I am especially attracted by the atmosphere of teamwork and the enthusiasm for the common cause."*

Pablo: *"I am interested in artificial intelligence, especially how smart computers can improve human life, and I would like to pursue this field in the future. I am particularly interested in the interaction between art and artificial intelligence, which challenges the definition of art itself, but is also a great tool to explore the limits of creativity."*

We would like to thank David and Pablo for their enthusiasm for working on IT4Innovations projects and wish them all the best in their studies and careers.
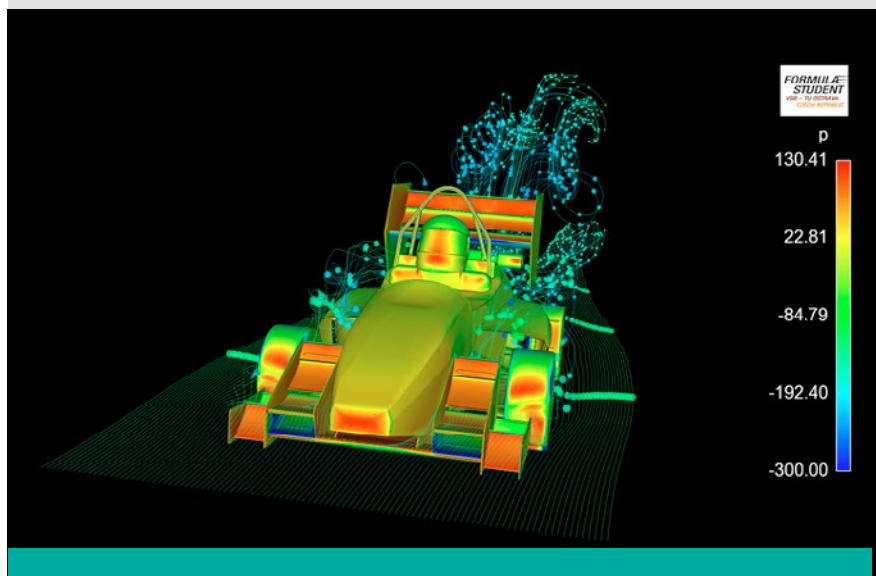
David Izquierdo: The visualization of the results CFD

Pablo Lluch Romero in IT4Innovations

**THE IT4INNOVATIONS BUILDING
HAS CELEBRATED ITS 5TH BIRTHDAY**

Five years have passed since the doors of the new IT4Innovations building opened for the first time at the end of August 2014. The center has grown not only by the number of employees but also by the number of supercomputers.

Within five years, IT4Innovation together with the CESNET and CERIT-SC infrastructures has become an e-Infrastructure of the Czech Republic e-INFRA CZ, received the status of a digital innovation hub, and has been involved in many important international and national projects. IT4Innovations currently has four supercomputers.

"We have come a long way in the last five years. We have become a supercomputer center that is well registered on the European map of supercomputer centres, as evidenced not only by our membership in prestigious organisations, but also by the success of the EuroHPC petascale system, which will be installed in IT4Innovations next year. We have achieved many successes in the scientific field, we are part of international and national projects, for some of which we are the direct coordinators. All of this would not have been possible without a great team consisting of many experts. A special thank you goes to them. Without them, IT4Innovations would not be where it is today." - Vít Vondrák, Director of IT4Innovations, summarising the events of the last five years.

ONGOING INTERNATIONAL PROJECTS:

PRACE – Partnership For Advanced Computing in Europe

LEXIS – Large-scale Execution for Industry & Society

POP2 – Performance Optimisation and Productivity 2

ExaQUte – Exascale Quantifications of Uncertainties for Technology and Science Simulation

TETRAMAX – Technology Transfer via Multinational Application Experiments

CloudiFacturing – Cloudification of Production Engineering for Predictive Digital Manufacturing

EXPERTISE – EXperiments and high PERformance Computing for Turbine Mechanical Integrity and Structural Dynamics in Europe

OPENQKD – Open European Quantum Key Distribution Testbed

Superheroes 4 Science

SUPERCOMPUTERS AT IT4INNOVATIONS:

Anselm – installation 2013, output of 94 TFlop /s
Salomon – installation 2015, output of 2 PFLop /s
NVIDIA DGX-2 – installation 2019, output of 130 TFlop /s, output of 2 PFlop /s in artificial intelligence computations
Barbora – installation 2019, output of 849 TFlop /s

ONGOING NATIONAL PROJECTS:

- IT4Innovations National Supercomputing Center – Path to Exascale
- Doctoral School for Education in Mathematical Methods and Tools in HPC
- NCE – National Center for Energy

More about national projects HERE

OUR MOST IMPORTANT ACADEMIC USERS:

Computational time is assigned through a grant competition, which is run three times a year. We provide computing time to academic institutions in the Czech Republic free of charge. Included in our academic clientele are:

- VSB – Technical University of Ostrava
- The Czech Academy of Sciences
- CEITEC
- Charles University
- Czech Technical University in Prague
- Brno University of Technology
- Masaryk University
- Ostrava University

DIGITAL INNOVATION HUB FOR BUSINESS

A part of the IT4Innovations computing capacity is also used to collaborate with enterprises from different industries to contribute to digitalization of the Czech community and industry. Companies can rent the computing time of our supercomputers or use the expertise of IT4Innovations experts to provide a comprehensive solution to a specific problem.

IT4Innovations building

OUR COLLEAGUES HAVE BEEN STUDYING
AT SUMMER SCHOOLS

Some of our colleagues used the summer months not only for relaxation but also for studying at prestigious foreign institutions. Among the organising institutions were the European Network on High Performance and Embedded Architecture and Compilation (HiPEAC) and the Gran Sasso Science Institute (GSC) in Italy, the Mediterranean Embedded Computing Resources (MECO) in Montenegro, the Aerospace Propulsion Institute at Samara University in Russia, and the Argonne National Laboratory in the USA - organising the Argonne Training Programme on Extreme Scale Computing (ATPESC).

We asked some of them a few questions:

WHAT WERE YOUR EXPECTATIONS OF GRADUATING FROM THE SUMMER SCHOOL?

Tomáš Panoc (ATPESC)

"The programmes of the past years are available on the school website and two of my colleagues were there a year ago, therefore I had some idea of what awaited me. Two weeks full of lectures is really challenging, so I went to the USA with the expectation that the school will give me a summary and broader awareness of important topics in the field of supercomputing. The programme changes slightly from year to year and is known only a day or two before the start. I mainly wanted lectures on artificial intelligence and machine learning. I was lucky :-). It came true."

Vojtěch Moravec (HiPEAC)

"This was my first experience with this kind of event. I was expecting to experience a completely new type of tuition and I was also interested in the topics the school was offering. At the same time I was looking forward to the international experience and the opportunity to meet people from all over the world."

Petr Ferfecki (Samara)

"To deepen theoretical and practical knowledge in the field of rotor systems dynamics and to use the gained experience in my further professional activities."

ATPECS 2019 participants, Source: Argonne National Laboratory

HOW WOULD YOU DESCRIBE YOUR SUMMER SCHOOL STUDIES? WHAT COURSES OR SUBJECTS DID YOU TAKE? WHAT CAUGHT YOUR ATTENTION OR SURPRISED YOU?

Lukáš Drábek (MECO)

"Within the CPS & IoT 2019 Summer School 18 different lectures took place, of which I consider the most interesting to have be the topics on technologies used in autonomous vehicles and safety in embedded systems. A pleasant variegation was sightseeing and an excursion to the attractions in Montenegro."

Radek Furmánek (GSC)

"The courses consisted of morning lectures and afternoon workshops. I was most impressed by a lecture on IoT. In this lecture, IoT was extended by a 5G network enabling real-time monitoring of traffic changes. Very interesting also was a lecture on 3D navigation, for example in buildings .This 3D navigation enables better penetration of material using shorter wavelengths. A visit to the Thales Alenia Space was also a very nice experience."

Vojtěch Moravec (HiPEAC)

"Generally, the courses focused on the HPC ecosystem. I was most interested in the distributed parallel programming course in which I learned about the existence of the UPC ++ C ++ library. But probably the biggest benefit to me, personally, was the opportunity to meet students from around the world and to discuss how these things work in different countries."

Tomáš Panoc (ATPESC)

"We had very interesting dinners together. We moved to a room with prepared food and a projector with a screen. We took our dinner, sat down at the table and the lecture began. The aim of these lectures was to present an interesting topics from science or industry connected with supercomputing. During the study at the summer school we could meet other students and scientists from different parts of the world and scientific fields and take advantage of consultations with lecturers. Lectures included hardware architectures in supercomputers, programming with OpenMP and MPI, parallel I / O, data visualisation, numerical libraries, machine learning, performance tuning and measurement tools, etc. A big plus was the fact that many lecturers were also directly behind the development of the technologies, methods, and tools presented."

Summer School Participants (GSC)

Participants of the summer school at the University of Samara on a trip around the Volga

Participants of CPS&IoT 2019 in Budva, Montenegro

Summer School (GSC) participants on a tour of the Thales Alenia Space

WHERE YOU MIGHT HAVE SEEN US

ART&SCIENCE

The Art & Science event is held annually during the first week of September at VSB – Technical University of Ostrava. The morning programme is attended by high school students and the afternoon is open to the general public. Visitors to the university campus had the opportunity to see the beauty in science with their own eyes and at the same time that in art is a piece of science. At the IT4Innovations booth they could see how mathematics is applied in animated film and learn about supercomputers through the Superheroes 4 science comics. This year, the festival was connected with the celebrations of 170 years since the university was founded. This event was crowned with a concert by Monkey Business.

NATO DAYS

Also this year IT4Innovations did not miss the biggest event of the Moravian-Silesian Region, the NATO Days. It took place on 21st and 22nd September 2019 at Leoš Janáček Airport in Mošnov. The beautiful weather attracted over 220,000 visitors. Many of them came to our booth.

RESEARCHER'S NIGHT

At the end of September, IT4Innovations took part in the nationwide event Researcher's Night with this year's theme "Considering the Planet". Over the course of the five hours, 740 visitors came to our institution. They were presented with a smart fun-packed programme including excursions to our infrastructure. Both children and adults had the opportunity to visit 10 different sites and learn about interesting things from the world of supercomputers and the research that is being done there. The Smart Cities concept, the use of supercomputers in simulations and visualizations, the development of materials and structures for the development of future-friendly planetary applications, and much more was presented.

LINUX DAYS

On the first weekend of October, a professional conference, Linux Days, took place in Prague. 1,500 visitors were able to attend dozens of workshops and lectures, two of them were our colleagues from the supercomputer services department. We then presented our computing infrastructure at our booth.

VSB TECHNICAL
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OF OSTRAVA

IT4INNOVATIONS
NATIONAL SUPERCOMPUTING
CENTER

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