D7.1 – USTUTT-HLRS transnational success story

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ABSTRACT:
This document provides a summary of Yuliia Dikova's research visit to the High Performance Computing Center Stuttgart (HLRS).

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Executive summary

In this deliverable, we present one of the many success-stories of young researchers visiting foreign research institutions under the project HPC-Europa3. Most of the document is a personal accord of Yuliia Dikova on her visit to HLRS.

The editor of this document would also like to note, that this visit was a particularly lucky success in hindsight, as it allowed a young Ukrainian researcher to temporarily establish herself in Germany while war rages over her country.

1 Yuliia Dikova visit to HLRS

1.1 Visit Overview

Yuliia graduated at the Faculty of Computer Science and Technology at Donetsk National Technical University, and she is now Assistant professor of the Department of Computer Science and Computer Engineering of Donetsk National Technical University, Ukraine.

Yuliia applied and was selected for a research visit to HLRS under the HPC-Europa3 call #12 in May 2020. The project is about "Development and implementation of a subsystem of distributed parallel simulation environment (DPME), its focus on providing modelling support for the design of the automated monitoring systems and forecasting of technological processes of industrial enterprises with distributed parameters". The project was hosted by Dr. Alexey Cheptsov at HLRS, Germany for 10 weeks.

1.2 Project Objectives

The project aims at the development and implementation problem-oriented parallel simulation environments subsystem that provides support for a model of development of automated information-measuring systems of multi-parameter monitoring and forecasting of technological industrial enterprises with distributed parameters. The theoretical basis of the project is the development of parallel algorithms for the construction and training of artificial neural networks for solving real-time to diagnose and forecast the state of technical objects. High-performance parallel computing resources of the new architecture will improve the accuracy of existing algorithms in their parallel implementation, as well as to investigate the effectiveness of using the modified algorithm. The work is relevant at the global level and calls for new approaches to processing the data received from the hardware component used in real-time from multiple source systems.

The practical goal of the project is the modification and adaptation of algorithms for construction and training of artificial neural networks within the existing automated control systems of the basic parameters of the production process.

1.3 Personal and Professional Experience.

My name is Yuliia Dikova, I graduated the Faculty of Computer Science and Technology of the Donetsk National Technical University, Ukraine. I defended my Ph.D. thesis in the specialty "Computer systems and components" and now I work as an assistant professor in the department of "Computer Engineering". In the winter of 2021/22, I spent ten weeks at the Center for High Performance Computing (HLRS) at the University of Stuttgart in Germany as part of the HPC-Europa3 transnational access program, where I was hosted by Dr. Alexey Cheptsov.

Fig. 1: During Covid-19 in compute room of HLRS

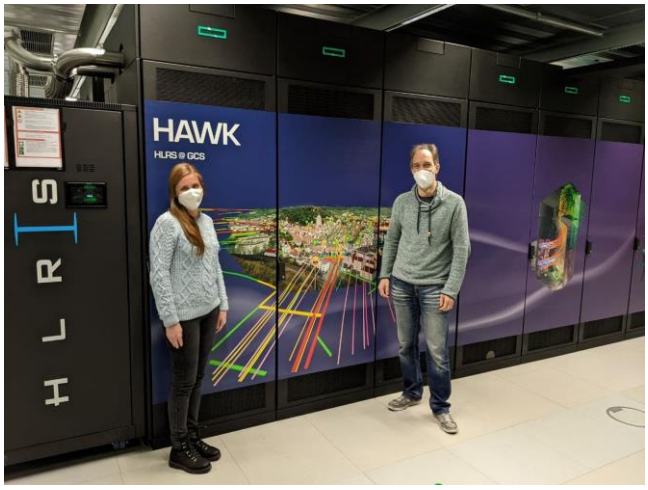

Fig.2: Tour of HLRS facilities with Uwe Wössner

Fig. 3: Enjoying free time at Bodensee

Our project is aimed at studying algorithms for constructing and training artificial neural networks for diagnosing and predicting the state of technical objects in real time in order to modify and adapt these algorithms within the framework of automated control systems for the main parameters of service production processes.

High-performance parallel computing will improve the accuracy of existing algorithms when used on the latest parallel architectures, as well as explore the effectiveness of using modified algorithms. The concept of the developed application was to collect data from sensors in the mine branch with the possibility of storing them in a database, as well as their visualization. The aim of the project is to build a subsystem to improve the efficiency of forecasting and diagnostics of objects based on advanced data processing algorithms using existing methods for parallelizing computational processes for processing information from sensors of existing systems, and adapting these algorithms for integrated control of production processes

1.4 Major Outcomes

The designed neural networks were tested on the software and hardware architecture of Hawk using Python packages.

As a result of experiments, it was found that parallelization of the received data using a GPU cluster shows a data processing speed 20% higher than that of a CPU cluster. For the system being designed, this is a significant increase in time, which will significantly reduce the number of emergencies.

During the discussion with the Host, we came to the conclusion that it is worth trying the implementation of a multi-agent architecture with a service-oriented approach to system design and development, which will allow experimenting with different schemes for building systems, the ability to combine tasks performed, optimize the verification and analysis of results, etc. In the future, it is planned to store and primary data processing using data mining technologies.

The final step is to visualize the results obtained with Gnuplot and Covise.

However, my time in Stuttgart was devoted to more than just work. During my visit, I discovered not only all corners of Stuttgart, but also Augsburg, Strasbourg, Baden-Baden and other towns around Stuttgart.

I also had a great opportunity to communicate with some employees, share experiences and discuss the prospects for further scientific cooperation between DonNTU, HLRS and the universities of Stuttgart.

2 Role of HPC-Europa3

HPC-Europa3 has been instrumental in this collaborative project. Given the conditions at Ukrainian Universities, young researchers do rarely have the financial means to go abroad. For Yuliia this was the first opportunity to collaborate with foreign researchers. Also, access to compute resources, or the means to do visualisation in virtual reality environments, are very limited or not existent at all. As such, this visit was a unique opportunity to foster Yuliia young researcher's career.

As a host, HLRS has also benefitted from this visit. Over the course of the years HLRS has conducted several HPC-Europa projects with young researcher from DonNTU on related projects which often build on each other. This has not only helped to strengthen established relations between senior researcher at HLRS and DonNTU, but more importantly to help transition these relations into the next generation of researchers.

3 Visit epilogue

Editor's note: Towards the end of Yuliia's visit, Ukraine was invaded by Russian forces and Yuliia could not safely return to her home. Jointly, Yuliia and Dr. Cheptsov applied for an HPC-Europa3 project extension to conduct research which they had previously agreed to do after her return to Ukraine. This proposal was approved and Yuliia extended here visit by another 3 weeks.

Since then, Yuliia has decided to stay in Germany and has applied for a position at HLRS.