HiPEAC info 63

JUNE 2021

Don't miss ACACES 2021 in Fiuggi!

EU cascade funding: Powering innovation across Europe

HiPEAC Vision recommendations

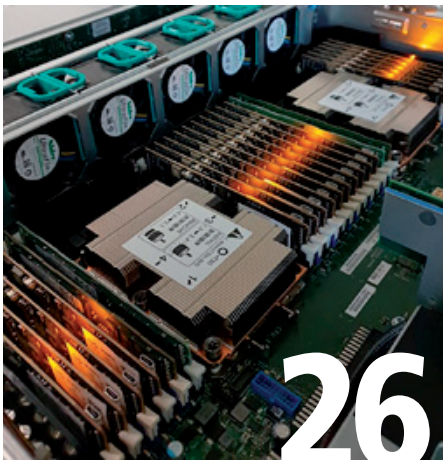
Processing- in-memory breakthrough

contents

Introducing Anna Puig-Centelles

HiPEAC Vision 2021 recommendations

EU cascade funding special



Processing-in-memory breakthrough

Celebrating 10 years of Mont-Blanc

Career talk: John Davis, BSC

For the first time in more than a year, there are good reasons to be optimistic about the coming months. Thanks to increasing vaccine supplies, people in Western countries are being vaccinated at a very high rate now. From countries that have already vaccinated their population, there are hopeful signs that the vaccines work, and will bring back our freedom to move and to meet. Many of us cannot wait until that moment happens.

Small crises lead to small changes; big crises lead to big changes. I am wondering how different the new normal will be from the old normal.

In the United States, President Biden seems to understand that there is a once-in-a-lifetime opportunity to create a new normal by investing heavily in infrastructure, in future technologies, and in the climate transition. He also wants to reduce inequality and take care of people that are hit by the transition to the new normal, as well as bringing back high-tech manufacturing jobs to the United States and securing the supply of critical digital components for the whole manufacturing sector. COVID has proven that global supply chains can be very vulnerable, especially if they span geopolitical borders. HiPEAC has previously recommended bringing back semiconductor manufacturing to Europe in order to build up expertise and capacity, create more jobs and become less dependent on other countries. It may be good for Europe to pay close attention to how Biden's experiments unfold.

However, the new normal might also have a dark side. After a year of lockdowns and limited freedom to meet and to act, frustration has been piling up and all this frustration might surface at once as soon as the COVID restrictions are lifted. There might be unrest all over the world in areas where there are political tensions. In other countries, unions will consider COVID as an opportunity to ask for a redistribution of wealth. Students might ask for student loan forgiveness. According to the Financial Times, global government debt levels as a percentage of gross domestic product (GDP) are now as high as at the end of the Second World War. We'll need strong governments to create the new normal.

Within the HiPEAC community, we should not be afraid of change, but see it as an opportunity to innovate. There are millions of changes that will critically depend on computing technology.

Take care,

Koen De Bosschere, HiPEAC coordinator

HiPEAC is the European network on high performance and embedded architecture and compilation.

hipeac.net

@hipeac hipeac.net/linkedin

HiPEAC has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 871174.

Cover image: © Erlantz Perez | Dreamstime.com
Design: www.magelaan.be
Editor: Catherine Roderick, Madeleine Gray
Email: communication@hipeac.net

We're ringing in the changes at HiPEAC, with a new project officer, Anna Puig-Centelles (PhD), who is based at the European Commission's recently established Health and Digital Executive Agency (HaDEA). We caught up with Anna to find out a bit about her background, what policy areas she is most passionate about, and how she thinks HiPEAC can contribute to these.

Introducing Anna Puig-Centelles

Can you tell us a little bit about your background?

I received my degree in computer engineering from the Universitat Jaume I (Spain) and my MSc from Vrije Universiteit (The Netherlands) on medical protocols. Following this, I obtained my PhD in computer graphics after doing research internships at the Universidad Rey Juan Carlos (Madrid, Spain) and the Université de Limoges (France).

After working in academia for many years, I started working as project and programme manager at a research and development (R&D) company focused on neuroscience and satellite technology, where I contributed to and managed FP7 and H2020 projects.

I joined the European Commission as programme officer in DG CNECT and later moved to HADEA, the new Health and Digital Executive Agency established by the European Commission. I have always worked in European projects, first as a project trainee, then as a project researcher and finally as a project manager, but I always wanted to see what it was like on the other side of the fence.

What policy areas are you most passionate about?

My responsibilities in the European Commission and HADEA include working as project officer for H2020 projects and also working on policy. While at DG CNECT, I was heavily engaged in developing the initiative for the Digital Europe Programme and Digital Innovation Hubs (DIHs). In particular, over the last two years I have been passionate about helping member states designate candidates for European Digital Innovation Hubs (EDIHs).

What are your first impressions of the HiPEAC community? How do you think HiPEAC can contribute to EU policy goals?

My first impressions of the HiPEAC community are very positive. The work that has been done to bring together European researchers and industry representatives in computing systems is remarkable. In my opinion, HiPEAC can contribute to European Union (EU) policy goals by providing evidence on the evolution and trends of digital technologies. An important and controversial concept in digital policy today is 'strategic autonomy'. There is no simple solution for this, so HiPEAC can contribute by providing a detailed view of the fields in which it makes sense, for the EU, to push towards technological autonomy, and the fields where this is not a requirement.

What are the main policy directions that will affect the HiPEAC community over the next few months?

The new calls in the Horizon Europe and DIGITAL programmes will include many topics that are very relevant for HIPEAC, especially in the areas of 'World Leading Data and Computing Technologies' and 'Digital and Emerging Technologies for Competitiveness and Fit for the Green Deal'. I would strongly encourage HiPEAC members to keep an eye out for forthcoming announcements from the European Commission.

FURTHER READING:

Health and Digital Executive Agency (HaDEA)
hadea.ec.europa.eu

Horizon Europe Programme
bit.ly/Horizon_Europe_EC

Digital Europe Programme (DIGITAL)
bit.ly/Digital_Europe_EC

CSW Spring 2021 webinar series

AI for humanity, accelerating with RISC-V, open-source futures and much more

The COVID-19 pandemic may still be hindering face-to-face networking events, but the HiPEAC Computing Systems Week webinar series offers bite-sized knowledge nuggets which you can access anytime, anywhere. Taking place live over seven weeks in March, April and May 2021, the 12 webinars covered a range of topics from exascale to the edge, and from secure runtime environments to personalized medicine.

The series includes keynote talks from the ever-listenable Marc Duranton (CEA), editor-in-chief of the HiPEAC Vision, open-hardware authority Luca Benini (ETH Zürich, Università di Bologna) on RISC-V and Gaël Blondelle (Eclipse Foundation) on the unique opportunities open source offers for Europe.

If you missed the webinars at the time, don't worry: you can catch up on all of them in your own time via HiPEAC's dedicated YouTube playlist.

What did you think of the HiPEAC CSW webinar format? We'd love to hear your opinion – email communication@hipeac.net *with your feedback*

FURTHER INFORMATION:

CSW Spring 2021 webinar programme
hipeac.net/csw/2021/spring-webinars/#/program

CSW Spring 2021 YouTube playlist
bit.ly/CSWSpring21_YT_playlist

Nine hundred join a virtual HiPEAC 2021

The sixteenth edition of the annual HiPEAC conference saw the highest ever number of computing systems researchers, industrialists and enthusiasts brought together by the network on 18-20 January 2021.

This edition was the occasion of the launch of the HiPEAC Vision 2021, which explores a range of topics including the effects of COVID-19 on digitization, open-source hardware and the need and drive for digital sovereignty. For further information, read the recommendations from the Vision on p.14.

The programme featured keynote talks from leading international experts Evangelos Eleftheriou (IBM), Brad McCredie (AMD) and Tulika Mitra (National University of Singapore). Attendees also enjoyed a packed schedule of workshops and tutorials and a paper track of ACM-published research. A virtual exhibition allowed sponsors and European Union (EU) projects to continue their networking efforts.

'In these strange and challenging times, virtual events provide us with opportunities to meet and exchange information on our research; HiPEAC and its conference help this goal immensely,' said Professor Mario Kovač, of the European Processor Initiative. 'HIPEAC has continuously, over the years, provided great support for experts in the field to share their views and for newcomers to learn about the state-of-the-art technology and talk to prospective employers. We are therefore glad that the European Processor Initiative was a sponsor of this year's event and we will continue to support it in the future.'

Once again, HiPEAC Jobs played a key role, via a number of sessions dedicated to career planning. Turn to p.39 to find out what participating students learned from major international companies and innovative small and medium enterprises (SMEs).

As the event took place online, the vast majority of sessions, including keynote talks, are available for free on the HiPEAC YouTube channel; see below for further information.

The HiPEAC conference would not be the same without the generosity of its sponsors, and this year's event was no exception. A full list of sponsoring organizations is available on the HiPEAC21 website.

FURTHER INFORMATION:

HiPEAC 2021 website
hipeac.net/2021

HiPEAC 2021 YouTube playlist
bit.ly/hipeac21videos

Artemis Industry Association ECS Brokerage Event 2021

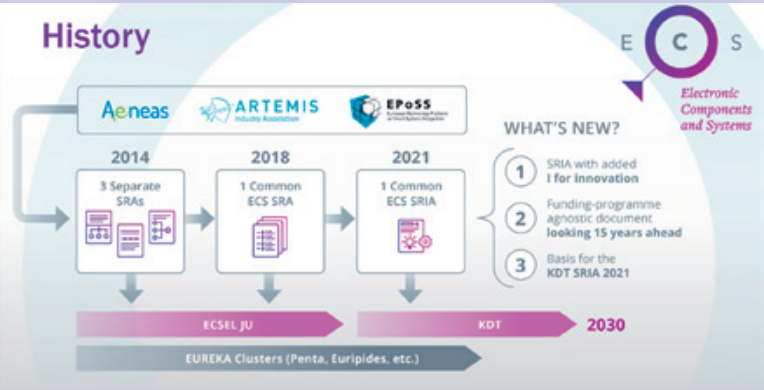
Iris Hamelink, ARTEMIS IA

Over 600 people took part in the ECS (Electronic Components and Systems) Brokerage Event on 12-13 January. In collaboration with the AENEAS and EPoSS Industry Associations, the ARTEMIS IA ran the event as an online meet-up to help their associated communities prepare to make project proposals and to meet new consortium partners.

Participants received an overview of the research, development and innovation (R+D+I) landscape and the role of Industry Associations; strengthening the European ECS ecosystem and facilitating networking and collaboration opportunities for the research community is one of the most important aspects of their work. The IAs are also very involved in shaping the future of Key Digital Technologies (KDT – the successor of ECSEL) under Horizon Europe and the EUREKA Clusters. Last but not least, the IAs represent the interests of the ECS community in ECSEL/KDT and in EUREKA and co-create and shape the R+D field with the European Commission and National Public Authorities.

In terms of forthcoming funding opportunities, 2021 sees the transition from Horizon2020 to Horizon Europe. A transition like this is always a big venture, but the COVID-19 crisis is making it even more of a challenge than usual. The objectives of Horizon Europe are to strengthen the foundations of European science and technology, and to boost Europe's innovation capacity, jobs and competitiveness. The European Commission aims to deliver on citizens' priorities, sustain the European social economic model and promote European values.

Event participants also learned about the ECS-SRIA – the ECS Strategic Research and Innovation Agenda, which lays out a vision for the next ten years, independent of any particular research funding programme.



Read more about Horizon Europe, the KDTs and the ECS-SRIA:
bit.ly/ECS_brokerage_2021
Access the ARTEMIS ECS Collaboration Tool, which aims to bring consortia together around project ideas:
ecscollaborationtool.eu.

CLASS and ELASTIC join forces at Smart City Live 2020

Barcelona Supercomputing Center (BSC) took part in Smart City Live 2020, the leading smart cities conference, which took place online on 17-18 November 2020. Globally known as Smart City Expo World Congress, last year the event turned into a unique digital experience with a programme packed with talks, sessions, and updates on the latest advancements in urban mobility, sustainable urban living, and resilient city infrastructures. Projects featured included CLASS and ELASTIC, which are delivering software architecture to enable big data analytics for public and private transport in smart cities.

Eduardo Quiñones, senior researcher at BSC and coordinator of the CLASS and ELASTIC projects said: 'We were excited to participate once more in this leading smart city event showcasing our technology and being a part of the industry's map of ground-breaking innovations.'

Technology from the CLASS and ELASTIC projects was included in Smart City Live's Tomorrow.Radar, a digital portfolio that showcases the boldest technologies, prototypes, and market-ready solutions in the field. The projects were selected by the Generalitat de Catalunya as joint participants in the platform, in order to present their novel big data software architecture for the development, deployment and execution of advanced analytics services.

FURTHER INFORMATION:
Tomorrow.Radar (registration required)
tomorrow.city/radar
CLASS project
class-project.eu
ELASTIC project
elastic-project.eu

EXSCALATE4CoV performs the most complex supercomputing experiment ever to identify new therapies against Sars-Cov-2 virus

Gianluca Palermo, Politecnico di eMilano

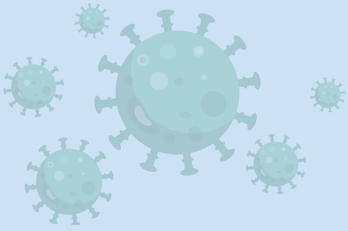
In late 2020, the public-private consortium EXSCALATE4CoV carried out the most complex supercomputing simulation ever realized. EXSCALATE4CoV has received €3 million from the European Commission under the Horizon 2020 scheme dedicated to the coronavirus emergency. The consortium is named after Exscalate, a 'smart platform against pathogens' accompanied by a chemical library of half a billion molecules provided by Italian pharmaceutical company – and EXSCALATE4CoV leader – Dompé.

The objective of the run executed at the end of 2020 was to simulate the behaviour of the Sars-Cov-2 virus to identify the best therapeutic treatment. More than 70 billion molecules were simulated on 15 active sites of the virus with a total of more than a trillion interactions evaluated in just 60 hours. This was possible thanks to the simultaneous availability of three key elements: the aggregated computing power (81 petaflops: millions of billions of operations per second) of Eni's HPC5 (the most powerful industrial supercomputer in the world) and Cineca's Marconi100; the virtual screening software accelerated by the Politecnico di Milano and Cineca; and the Exscalate molecular library from Dompé.

Using these technologies, it was possible to reach the new goal of simulating five million molecules per second, making the very most of the supercomputing infrastructure. Overall, the experiment generated 65 terabytes of results, representing the most comprehensive scientific wealth of knowledge on Sars-Cov-2 virus available in the world. The results coming from the simulation will be shared within the scientific community on the MEDIATE open science portal (see 'Further information', below).

This supercomputing experiment is part of the second phase of the EXSCALATE4CoV project, which aims to screen completely new molecules. The research on drug repurposing conducted during the first phase of the project resulted in a clinical trial being authorized for the use of the osteoporosis drug Raloxifene as a potential treatment for COVID-19 patients with few symptoms who are in hospital or at home.

FURTHER INFORMATION:
exscalate4cov.eu
mediate.exscalate4Cov.eu



HealthSupervisor: mobile app for remote healthcare monitoring

Led by HiPEAC Member Professor Anatoliy Melnyk, the HealthSupervisor start-up has developed a mobile application for smartphones that demonstrates the vital role cyber-physical systems can play in health and wellbeing. The app allows a supervisor (such as a doctor or family member) to observe the functional state of another person, making it particularly relevant for older or disabled people who can live independently but may need regular support.

The application is based on wireless devices and is designed to monitor an individual's functional state around the clock, regardless of their location. This is estimated on the analysis of the following parameters: the oxygen level in the blood, pulse frequency and respiratory rate. These data, obtained from the pulse oximeter wirelessly connected to the client's smartphone, are sent to the server, where the supervisor receives information about the client's functional state and can decide whether intervention is needed. The app allows supervisors to access current data and state history as well as receive messages when parameters are outside the limits set.

The app allows supervisors to track the functional state of people that need constant observation, with Covid-19 being used as a primary use case. It can also be used to monitor patients with conditions such as asthma, vascular disease or cancer.

How a doctor sees patient data in the app

healthsupervisor.com.ua

Photo credit: Pexels on Pixabay

A fresh idea for reducing fruit and vegetable waste

nosh

Nosh Technologies, a startup featured in HiPEACinfo 62, recently presented intellectual property (IP) on fruit and vegetable classification at the IEEE IndiCon 2020, the flagship conference of the IEEE India Council.

Nosh Technologies is a UK-based agricultural technology, or 'agtech', startup set up by HiPEAC member Somdip Dey. It delivers an award-winning artificial intelligence (AI)-powered food management app – nosh – to reduce food waste at home.

The IP in question utilizes computer vision-based machine learning and edge computing to develop a performance-, power- and memory-efficient classification method of 132 different types of fruit and vegetable in a smartphone. This method was primarily developed so that nosh app users can record the fruit and vegetables they have bought, just by using the in-app camera feature.

However, this method could prove to be valuable for the agricultural industry in general. Nosh Technologies has also developed another piece of IP to make it more convenient for nosh app users to trace and track their food produce. This IP leverages blockchain and QR code to enable the app user to trace and track their groceries right from the app while getting additional information on the items (such as expiry date, quantity and nutritional info) which would usually not be available from a one-dimensional universal product code (1D UPC) barcode. nosh has also recently been named as one of the top 50 innovations in the 'Food & Water' theme in Accenture's Blue Tulip Awards.

FURTHER INFORMATION:

Nosh Technologies website nosh.tech

S. Dey, S. Saha, A. Singh and K. McDonald-Maier. 'FruitVegCNN: Power- and Memory-Efficient Classification of Fruits & Vegetables Using CNN in Mobile MPSoC'
2020 IEEE 17th India Council International Conference (INDICON), 2020, pp. 1-7 DOI: 10.1109/INDICON49873.2020.9342108
ieeexplore.ieee.org/document/9342108

HiPEAC student wins prize in the Xilinx Adaptive Computing Developer Contest 2020

HiPEAC student Dimitrios Danopoulos, who is doing his PhD at the National Technical University of Athens (NTUA), was awarded second place in the category of Adaptable Compute Acceleration in the Xilinx Adaptive Computing Developer Contest 2020, which had a total of 1,086 participants and 65 submissions.

Supervised by Dr Christoforos Kachris and Professor Dimitrios Soudris, Dimitrios won a prize of 5,000 USD for his excellent work.

The project – COVID4HPC – was developed in the Microprocessors and Digital Systems Laboratory (MicroLab) of the School of Electrical and Computer Engineering of the NTUA. The aim of the project is to identify COVID disease in patient chest X-rays. The application uses neural networks to identify the disease from the X-ray images. It was accelerated using cloud field-programmable gate arrays (FPGAs), specifically the Xilinx Alveo U50 FPGA. Achieving great results in terms of accuracy (97% accuracy) as well as speed (3600 X-rays/sec), this is therefore a very useful application that can help medical staff in their diagnosis during the pandemic.

The work has been done as part of the project CloudAccel: Hardware Acceleration of Machine Learning Applications in the Cloud, which has received funding from the Hellenic Foundation for Research and Innovation (HFRI) and the General Secretariat for Research and Technology (GSRT) under grant agreement no 2212, and the Xilinx University Program.

FURTHER INFORMATION:

CloudAccel project: cloudaccel.github.io
Youtube video: bit.ly/Covid4HPC_video
Covid4HPC on Hackster.io bit.ly/Covid4HPC_Hackster

EERA launches new joint research programme on digitalization for energy

Rafael Mayo Garcia, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)

The largest energy research community in Europe, the European Energy Research Alliance (EERA), has launched a transversal Joint Programme (tJP) on Digitalisation for Energy (DfE) in recognition of the critical role that information technologies play in supporting the transition towards climate neutrality by 2050.

A Joint Programme (JP) is a permanent structure that allows EERA to promote pan-European research and innovation (R+I) collaboration in a joint Strategic Research and Innovation Agenda, with the aim of building leading-edge expertise in various fields of clean energy. In this case, the structure of the new JP has been designed as a cross-cutting entity, allowing it to complement pre-existing expertise with high-level scientific knowledge on the latest digital concepts and technologies, with a particular focus on high-performance computing (HPC), data science, and artificial intelligence (AI).

Digitalisation for Energy has its roots in the expertise of numerous researchers involved in EERA activities. Many of these researchers have already been active in digital challenges in the clean energy sector, and some already participate in HiPEAC. Examples include the projects EERAdata, which aims to advance the state of the art of FAIR and open-energy data, and the Energy Oriented Centre of Excellence, EoCoE, which brings together a network of experts in HPC and in sustainable energies, from academia, industry, and the public sector.

DfE will integrate all the existing sub-programmes belonging to established Joint Programmes that have already developed a specific expertise in digitalization topics. This innovative approach will allow easy integration with current and future sub-programmes on digitalization (i.e. cybersecurity, blockchain, etc.). The modular structure of the DfE sub-programmes (SPs) and transversal sub-programmes (tSPs) is:

- SP1 - High Performance Computing
- SP2 - Data Science and Artificial Intelligence
- ESI tSP: Technology
- AMPEA tSP: Multiscale modelling of materials, processes and devices
- Hydropower tSP: Digitalisation
- Nuclear Material tSP: Physical modelling, materials health monitoring and non-destructive microstructure examination for nuclear materials

HiPEAC members wishing to collaborate with DfE can explore potential lines of collaboration by completing a short questionnaire. Topics related to HPC, data science, and artificial intelligence – on which there is much expertise in the HiPEAC community – are of special interest. DfE is also working on collecting a map of numerical codes, repositories and digital methodologies in the energy sector that will eventually be made public. HiPEAC members are invited to complete a questionnaire available on the tJP website to contribute to this area of work.

FURTHER INFORMATION:
bit.ly/EERA_Dig4Energy

Dates for your diary

PLDI 2021: ACM SIGPLAN Conference on Programming Language Design and Implementation
20-26 June 2021, virtual
HiPEAC Paper Award conference
dl.acm.org/conference/pldi

ISC High Performance 2021
24 June- 2 July 2021, virtual
isc-hpc.com

PUMPS + AI summer school
5-9 July 2021 (tentative), virtual
pumps.bsc.es/2021

FNC 2021: 16th International Conference on Future Networks and Communications In conjunction with MOBISPC: 18th International Conference on Mobile Systems and Pervasive Computing
9-12 August 2021, Leuven, Belgium
cs-conferences.acadiau.ca/fnc-21

2021 IEEE Nordic Circuits and Systems Conference (NorCAS)
26-27 October 2021, Oslo, Norway
(hybrid event)
Special session proposal deadline:
15 June 2021
Paper submission deadline: 15 August 2021
events.tuni.fi/norcas2021

EFECS 2021: European Forum for Electronic Components and Systems
23-25 November 2021, virtual
efecs.eu

DAC 2021: Design Automation Conference
5-9 December 2021, San Francisco, CA, United States
HiPEAC Paper Award conference
dac.com

HiPEAC 2022
17-19 January 2022, Budapest
hipeac.net/2022/Budapest

Introducing AI@EDGE:
A secure and reusable Artificial Intelligence platform for Edge computing in beyond 5G Networks

Great progress has been made in recent years in terms of the accuracy and performance of artificial intelligence (AI)-enabled platforms, yet their integration in potentially autonomous decision-making systems or even critical infrastructures requires end-to-end quality assurance, ubiquitous availability and low-latency transport of data to the compute resource.

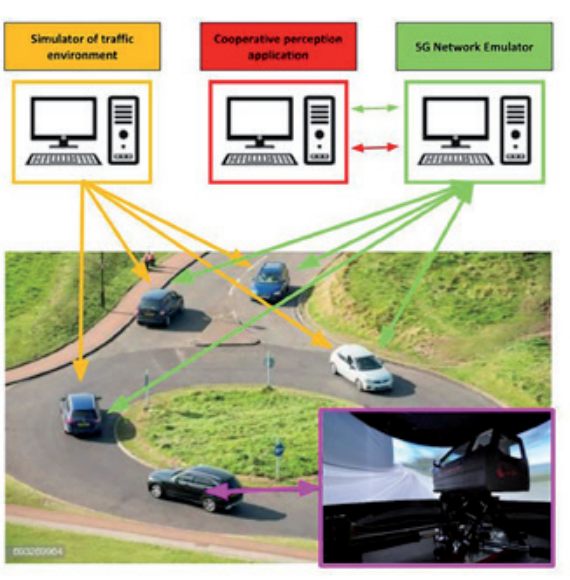
A new Horizon2020 project, AI@EDGE, will tackle these challenges head on, aiming to build a platform and tools enabling secure and automated roll-out of largescale edge and cloud compute infrastructures, with close to zero-touch of the underlying heterogeneous multi-access edge computing (MEC) resources (network, storage, and compute resources).

The AI@EDGE project brings together 19 partners from industry and academia across Europe to focus on six main innovations:

1. AI/machine learning (ML) for closed-loop automation.
2. Privacy-preserving ML for multi-stakeholder environments (automotive).
3. Distributed and decentralized connect-compute platform.
4. Provisioning of AI-enabled applications.
5. Hardware-accelerated serverless platform for AI/ML.
6. Cross-layer, multi-connectivity and disaggregated radio access.

AI@EDGE leverages the concept of reusable, secure, and trustworthy AI for network automation and is looking to achieve European Union (EU)-wide impact on industry-relevant aspects in multiple stakeholder environments. The efficacy of the AI@EDGE platform will be demonstrated through four real-life use cases from the following domains:

(i) connected and automated mobility
(ii) industrial internet of things
(iii) in-flight entertainment
(iv) unmanned aerial vehicles (drones) for industrial operations



FURTHER INFORMATION:
AI@EDGE website
aiatedge.eu
AI@EDGE on the CORDIS website
cordis.europa.eu/project/id/101015922

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101015922

ACCORDION webinar series on cloud and edge computing

With edge computing gaining momentum, this series of webinars from the ACCORDION (Adaptive edge/cloud compute and network to support nextgen applications) project offers timely insights into how to fully exploit the edge and cloud paradigms. Webinars take place on the second Thursday of the month, and recordings from previous editions can be found on the ACCORDION YouTube channel.

FURTHER INFORMATION:
ACCORDION project website
accordion-project.eu/webinars

Launch of ACROBA: AI-Driven Cognitive Robotic Platform for Agile Production environments

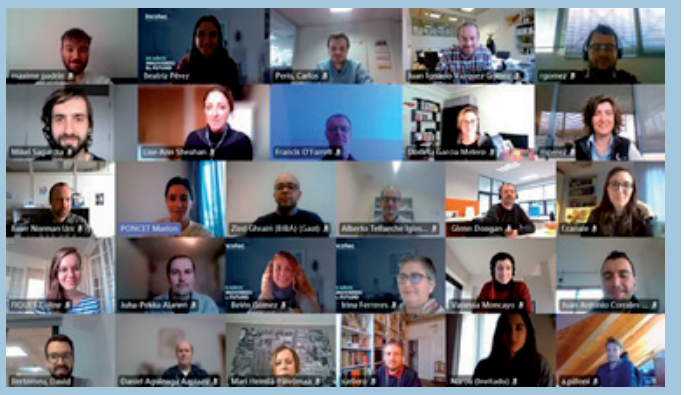
A new consortium of 17 partners from across the European Union (EU) came together in January 2021 to kick off the ACROBA project. The project addresses the challenges of developing and demonstrating a novel concept of cognitive robotic platforms based on a modular approach able to be smoothly adapted to virtually any industrial scenario applying agile manufacturing principles.

Fast-changing market trends and customer demands require manufacturing industries to shorten their time to market to maintain their competitiveness. Customers changing their requirements and increased product complexity are the two principal drivers of agile manufacturing, as they mean that companies have to constantly re-program production tools and robots. These are costly and time-consuming adaptations, especially for small and medium enterprises (SMEs).

To address this challenge, the ACROBA project will develop generic robotic platforms tailored to the specific needs of the companies. This is anticipated to be the key step towards increasing their level of automation within agile production and mass customization scenarios, reducing costs, improving performance and therefore increasing competitiveness.

A novel industrial concept of cognitive robotic platforms

ACROBA will develop a novel industrial platform. This platform will take advantage of **artificial intelligence and cognitive modules** to meet personalization requirements and enhance mass product customization through advanced robotic systems capable of self-adapting to different production needs.



The ACROBA project team

- The project will depart from existing robot operating system (ROS) **COPRA-AP reference architecture** for the design of a novel generic module-based platform that is easily configurable and adaptable to virtually any manufacturing line. Through their marketplaces, these initiatives offer open reference architectures, catalogues and libraries of plug-and-play implementations for the development of robotic platforms for industrial applications.
- This platform will be provided with a decentralized **ROS node-based structure** to enhance its modularity. It will serve as a cost-effective solution for a wide range of industrial sectors, both inside the consortium and others that will be addressed in the future. The project approach will be demonstrated by means of five large-scale real-life industrial pilots.

The ACROBA Platform will be tested through **twelve dedicated hackathons and two ACROBA On-Site Lab (AOSLs)** for manufacturing SMEs.

acrobaproject.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101017284

Cloud for holography and augmented reality: Launch of the CHARITY project

January 2021 saw the start of the Horizon 2020 CHARITY project (Cloud for HologrAphy and Cross RealITY). Delivered by a consortium of 15 partners, the project aims to allow the intelligent orchestration of cloud, edge, and network resources in order to create a symbiotic relationship between low- and high-latency infrastructures that will facilitate the needs of emerging applications.

The project will also facilitate the transition from traditional hosting environments to a novel one created by CHARITY. To this end, CHARITY will equip application providers with adaptive, end-to-end lifecycle management tools and continuous integration and delivery techniques. At the same time, automation at the network level will be facilitated by zero-touch, network-slice lifecycle management. The project will also create a virtual network function (VNF) repository to help applications benefit from the compute- and network-continuum management environment.

The key value proposition is CHARITY's work on infusing intelligence at the level of resource-management strategies. This does not rely solely on utility functions, as previous work has done, but rather on cognitive decision-making based on an overall understanding of resource, application and context characteristics. To facilitate this, solutions and approaches enabling efficient, seamless management of heterogeneous computing and network resources are crucial.

In summary, the main outcome of CHARITY will be a community-driven, open-source framework consisting of:

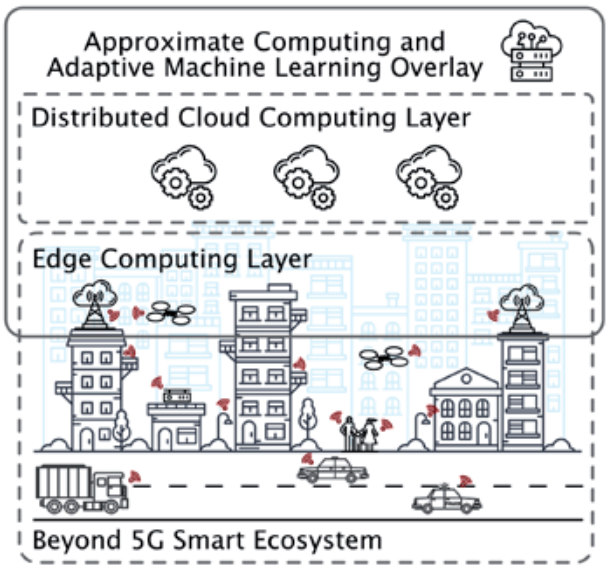
- A system for the autonomous orchestration, life cycle management and efficient exploitation of a wide range of compute and network resources, as well as infrastructures, that is not dependent on a single large vendor yet remains compatible with all.
- A collection of tools, mechanisms and algorithms enabling the efficient, contextualized and network-aware exploitation of edge resources and application reconfiguration.
- A set of VNFs along with a VNF repository that will support highly interactive applications leveraging tools, technologies and platforms stemming from fields such as big data.
- Tools for application providers to simplify the deployment and management of application components, mainly targeting the needs of small and medium enterprises (SMEs) (DevOps automations, specifications, application programming interfaces (APIs) and best practices).

charity-project.eu/en
@CharityProj
facebook.com/CharityEUProject
linkedin.com/company/charity-eu-project

CHARITY will be facilitating use cases such as virtual reality medical training – Image credit: ORamaVR

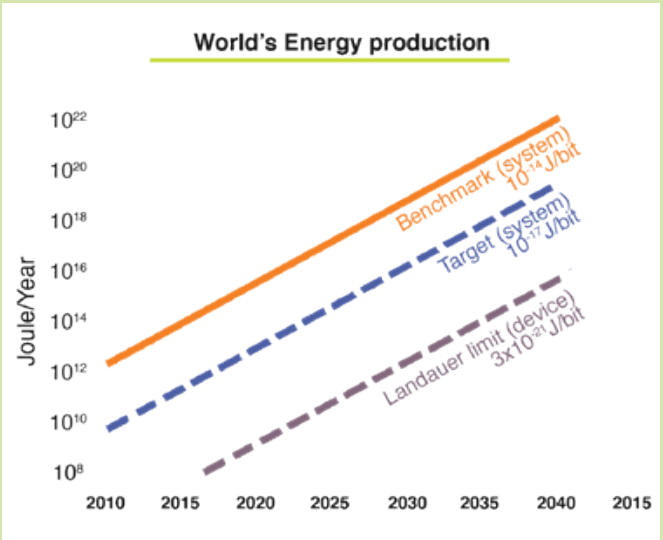
Approximate computing as an enabler for a greener future

The Horizon2020 project Approximate Computing for Power and Energy Optimisation (APROPOS) was launched in November 2020. The project's primary goal is to train 15 early stage researchers (ESRs) to tackle future embedded and high-performance computing challenges by using disruptive methodologies. APROPOS is currently recruiting researchers to 14 beneficiaries from Finland, Sweden, The Netherlands, Austria, Italy, Switzerland, UK, Spain, and France. The consortium also boasts a dozen industrial partners from these countries plus Ireland and Poland.



Why is this research so important? Modern devices with computing capabilities are expected to need more energy than energy resources can provide by 2040. By 2026, the development and heavy use of data centres alone are expected to consume up to 25% of all electricity generated. Moreover, on the communications side, the energy consumption trend of mobile broadband networks and smartphones is comparable to that of data centres. Finally, the rise of the internet of things (IoT) is also expected to bring with it more than 50 billion interconnected devices, creating even more pressure on networks and data centres.

APROPOS ESRs' research will contribute to decreasing energy consumption in both distributed computing and communications for cloud-based cyber-physical systems by introducing an adaptive energy-aware approximate computing overlay. Coupling approximate and adaptive precision computing paradigms with application-specific processing structures provides the critical elements in achieving the required energy efficiency improvements. Since energy consumption is the product of (computing or communication) time and average power consumption of the device while carrying out an operation, these two factors, time and power, must be addressed in order to decrease energy consumption. Adding the invaluable and novel third dimension, accuracy adjustment for decreasing time and power, is the APROPOS network's main contribution.



APROPOS will train the next generation's most promising researchers to manage the technologies, methodologies and tools for successfully applying approximate computing to power and energy saving. In this first Innovative Training Network (ITN) to address approximate computing, the training is to a large extent done by researching energy-accuracy trade-offs on the circuit-, architecture-, software-, and system-level solutions, bringing together world-leading European organizations. The network is coordinated by Prof. Jari Nurmi of Tampere University and many of the scientists in charge are HiPEAC members.

projects.tuni.fi/apropos/
info.apropos@tuni.fi

"By 2026, the development and heavy use of data centres alone are expected to consume up to 25% if all electricity generated"

HiPEAC Vision 2021
Key recommendations

January 2021 saw the publication of the HiPEAC Vision 2021. We caught up with HiPEAC Vision Editor-in-Chief Marc Duranton (CEA) to take a look at the Vision's recommendations, which are grouped into three clusters: technical, global policy and societal.

1. TECHNICAL RECOMMENDATIONS

The technical recommendations can be condensed into the following: a move towards **5S.(CPS)²**. (CPS)² stands for the new generation distributed systems that interact with the physical world: they are **C**ognitive **C**yber and **P**redictive **P**hysical **S**ystem of **S**ystems: CCPPSS = (CPS)², pronounced 'CPS squared': It is a supercharged version of current CPS systems, a squared version. **5S** stands for the key non-functional requirements: **S**ober, **S**ecure, **S**afe, **S**traightforward and **S**ustainable.

"(CPS)2 stands for Cognitive Cyber and Predictive Physical System of Systems. 5S stands for Sober, Secure, Safe, Straightforward and Sustainable"

For Europe to lead in **5S.(CPS)²**, the following research challenges should be tackled.

Recommendation 1: Cognitive

Artificial intelligence (AI) is the number one disruptive technology of the moment. Yet it is reaching a productivity plateau in some application domains, while having hardly scratched the surface in others. In the context of CPS systems, it allows better analysis and understanding of the environment of the systems, hence the 'cognitive' label.

AI is still facing serious challenges such as trustability on the part of users, the computing cost of the training phase of current deep-learning approaches, the associated need for large and unbiased labelled databases, the necessity of low-power accelerators for

edge devices and efficient integration in traditional computing substrates.

HiPEAC recommends investment in ultra-low power accelerators for AI and in investigating approaches that do not rely so much on labelled data.

Recommendation 2: Cyber

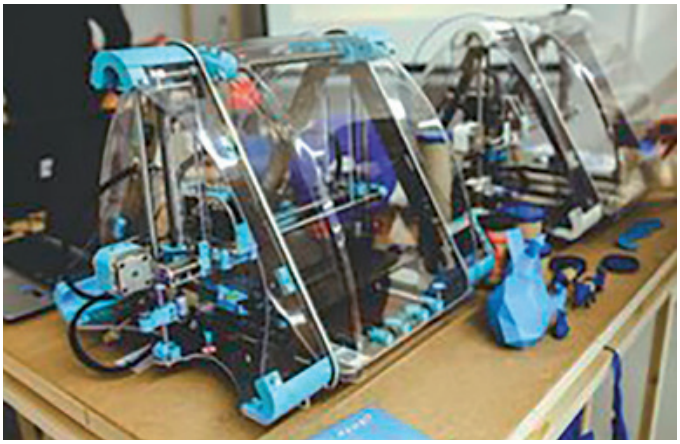
The cyber space is growing enormously. 90% of all the data in the world was generated in the last two years, and almost half of the world's population uses the internet. Due to its intertwining with the physical world, the 'next web' will have to cope with new constraints (non-functional properties for example, such as response time, energy consumption, cost, localization and so on) and more machine-to-machine communications while remaining compliant with legacy.

Just as Europe set the basis for the world wide web, **HiPEAC recommends** that it should secure its place at the forefront of the 'next web' by adding the necessary innovations and standards to existing technologies in order to satisfy human needs and interests.

"Just as Europe set the basis for the world wide web, HiPEAC recommends that it should secure its place at the forefront of the 'next web' on top of existing technologies"

Recommendation 3: Predictive

Modern cyber-physical systems (CPS) should be able to anticipate the actions or reactions of the real world and not just be reactive to it. This reactivity will allow them to have faster and more effective reactions, and to anticipate changes in the environment. This requires them to have access to an accurate model of the environment (thanks to AI for example), a 'digital twin' of the world they are operating in, and to be able to run it with sufficient speed and accuracy.



The physical model implemented in a CPS is an essential factor in determining its success or usefulness

HiPEAC recommends investment in digital twins and models that can be executed accurately and efficiently at the edge.

Recommendation 4: Physical

Interacting with the physical world requires not only that computing systems understand the environment, but also that they can react appropriately and according to the user's specifications. This means that a CPS needs to be more than just functionally correct. It must also respect the non-functional requirements imposed by the physical world: timing, energy consumption, reliability, resilience, size and form factor, among others.

HiPEAC recommends investment in research into ways to correctly model non-functional properties and to guarantee them in the systems.

Recommendation 5: System of systems

Modern CPS applications are executed in a continuum of computing and storage resources ranging from deep edge (microcontrollers linked to sensors or actuators), to edge, concentrators, micro-servers, servers and cloud or high-performance computing (HPC). Every system is itself now a component of a larger system, and an increasing number of systems are very dynamic: they not only change behaviour over time (via updates), but also move around (like vehicles in a transportation system, or smartphones), and can dynamically participate or stop working in the CPS continuum of applications.

Orchestrating this complexity so that the missions are correctly executed requires new approaches and tools to help designing and managing the systems as components in more complex systems.

HiPEAC recommends investment in systems-of-systems research and the development of tools for orchestrating large dynamic heterogeneous systems.

Recommendation 6: Sober

Ultra-low power computing remains the holy grail of computing because power consumption is, in practice, the hard limit on performance. It is needed to extend the battery life of mobile and IoT systems, and it is a key performance metric for affordable cloud computing and supercomputing (to decrease the cost of ownership and the cost of cooling infrastructure). Exponential growth of the internet can only be sustainable if it is matched with a similar increase in power efficiency of devices and communication, as well as data-centre and cloud infrastructure.

Substantial gains in energy efficiency can only be achieved holistically, from computing languages, to architecture, to technology.

HiPEAC recommends investment in the development of ultra-low power computing platforms covering the complete digital continuum, and in tools allowing assessment and design of systems with explicit power constraints.

Recommendation 7: Secure

Security is used to protect computing systems against attempts by unauthorized parties to steal information from systems or to disrupt the correct operation of a system, to use it for the benefit of the unauthorized parties. For systems directly controlling physical devices (i.e. CPS), it can lead to dangerous safety issues. The attack surface of a system grows with the complexity of a system. Security is an arms race between attackers and defenders and the use of AI techniques and formal methods can help detect system flaws and abnormal behaviour.

HiPEAC recommends greater investment in cybersecurity research, and in particular in the automated finding of security risks in existing applications, in the means to automatically mitigate or remove those risks, and in the development of secure hardware and tools that can produce secure-by-design software and hardware.

Recommendation 8: Safe

CPS systems that actively interact with the real world should not cause damage to physical goods or injure living beings. Safety means protecting the outside world against unwanted actions by computing systems. These actions could be intentional, caused by malware, or unintentional, caused by defects, bugs or bad specifications. We should aim for systems that are safe by construction, or that can be proven to be safe, or which use safeguards to ensure that safety is always observed even in unforeseen conditions.

HiPEAC recommends further investment in research and development in methodologies and design of safety-critical systems.

Recommendation 9: Straightforward

Future 5S.(CPS)^2 will, in practice, be very complex, and they should be manageable at the human scale. Therefore, effective tools should be developed to help design, understand, implement and maintain such systems. Formal proof, self-managed systems, exposing properties for intelligent and efficient composition are, among other, directions to manage this increasing complexity.

HiPEAC recommends the development of approaches that improve human productivity to design, produce and manage complex systems, including with the use of AI techniques.

Recommendation 10: Sustainable

State-of-the-art electronic devices require the use of around 65 of the 102 elements of periodic table of the elements, the supply of which is not guaranteed forever. At the moment, only 15% of the world's computing devices are recycled, and state-of-the-art recycling technology can only extract 17 of the 65 elements. Conversely, supporting ten billion people while protecting the planet will be impossible without the radical use of advanced computing solutions to optimize resource consumption.

HiPEAC recommends that Europe funds research to lower the embodied energy of devices, and help extend product lifetimes through upgrading, reuse and repair. Europe should aim to be a leader in the design of sustainable electronics. In addition, 5S.(CPS)^2 can contribute significantly to the United Nations' Sustainability Goals.

"Europe should aim to be a leader in the design of sustainable electronics"

Currently, only 15% of the world's computing devices are recycled

2. GLOBAL POLICY RECOMMENDATIONS

To help carve a uniquely European niche in the global technology economy, HiPEAC recommends working towards policy solutions which reflect European values, while establishing the necessary support structure to push Europe to the forefront of technology development.

Recommendation 11: Open source

HiPEAC recommends investment in open-source digital commodities that guarantee privacy compliance, inspection and audit, verification of compliance, security, sustainability, and so on.

However, moving to open source is challenging without help to manage the choice of licence, clarify legal aspects, business model(s), infrastructure, support, third parties, value creation and so on. **HiPEAC proposes** the establishment of a European open-source structure to support European open source (software and hardware), to help people move to open source, and to promote collaboration. **HiPEAC also recommends** that the critical parts of the cybersecurity of information and communication technology (ICT) systems are based either on open source software and hardware, or on EU-made, trustable because audited, hardware or software.

Recommendation 12: New computing technologies

While classical silicon technology is still delivering performance

HiPEAC recommends that Europe continues to investigate emerging technologies, not with a view to them directly replacing silicon technology, but to complementing it.

a) **HiPEAC recommends** that Europe promotes an active ecosystem based on three-dimensional (3D) technologies such as monolithic 3D, 2.5D (use of interposers and chiplets) to maintain the capability of modularity and independence for complex designs made by assembly of standardized chiplets.

b) **HiPEAC also recommends** that Europe retains its knowledge base in advanced semiconductor technology (Gate-all-around transistors – GaaFET) to enable understanding and efficient use of these devices in systems.

c) **HiPEAC recommends** that advanced research should be wide-ranging, and include new ways to code information: for example, using 'qubits', temporal coding as with 'spiking' neuromorphic architectures, or using physical phenomena like light, as in analogue computing approaches. Methods should also be investigated to efficiently integrate these approaches as 'accelerators' in a silicon technology-based system, both on the hardware and software sides.

d) Furthermore, in the field of quantum computing, HiPEAC recommends that Europe supports research and development (R+D) in the field of architecture and software stack for quantum computing, develops the integration of quantum accelerators into computing infrastructure, and promotes the emergence of a European quantum cloud.

Recommendation 13: 'Guardian Angels' moonshot programme

The goal of a moonshot programme is to synergize technologies across disciplines.

HiPEAC recommends the creation of a 'Guardian Angels' moonshot programme that encompasses all the 5S.(CPS)2 technologies in a system that will serve European citizens and companies, ensuring that the various developments are interoperable and can be used together. This would entail the development of a 'next web' that intertwines the cyber and physical worlds for industrial and personal use.

From the user's point of view, the interface should be natural and easy to interact with, similar to today's personal assistants, but open rather than proprietary. The core technology would consist of advanced orchestrators, which are called 'Guardian Angels', loyal to their users rather than corporations and placed at the interface of the physical and virtual worlds. These would orchestrate the various services provided by the 'next web' safely and securely, according to the user's requirements, which would be expressed in a natural way.

A 'Guardian Angels' moonshot programme would seek to help industrial and personal users navigate an increasingly complex cyber world in a trusted manner

Recommendation 14: International competence centre

Europe has many national competence centres with well-established international reputations in computing. However, there are few international computing competence centres comparable to institutions like CERN, the European Organization for Nuclear Research, for physics, or the European Space Agency (ESA) for space research, that attract worldwide researchers and can invest in large infrastructure and tools.

HiPEAC recommends the creation of a well-funded European competence centre in computing so that Europe is able to retain and attract top talent, to set its own ambitious research agenda, to attract large investments, and to form the core of a network of regional competence centres. Such a network will be crucial for defending Europe's position as a scientific powerhouse. It will also the entry point of an innovation pipeline.

Recommendation 15: Digital infrastructure

The success of the digital transformation of Europe depends on the quality of the digital infrastructure (networks, data centres, security tools and services, and so on).

HiPEAC recommends that Europe invests in state-of-the-art digital infrastructure. The fast roll-out of 5G is crucial for supporting the next generation of productivity-enhancing and resource-saving applications (smart cities, smart transportation, industry 4.0, and so on).

3. SOCIETAL RECOMMENDATIONS

Digital technologies will continue to transform society. This gives rise to concerns including the impact of computer-based automation on employment, the use of AI for automatic decision-making and the impact of social media on public opinion.

Recommendation 16: Training

As the digital transformation progresses, economies and societies depend on technology – and on the people who develop and maintain it – more than ever. In order to use technology correctly, people should have a basic understanding of how it works.

HiPEAC recommends that Europe invests in education and training in general, in order to stay competitive, and produces more highly-skilled computer scientists to advance the state of the art in 5S.(CPS)2 in all its aspects. Given the speed with which technology evolves, Europe should also invest in lifelong learning to retrain the existing workforce in new technologies, and with new skills. Education in technology should reach all European citizens, in order to them to understand and use it.

Recommendation 17: Innovation culture

Thanks to its excellent research infrastructure, Europe produces 20% of the top scientific publications, and these publications attract 22% of global citations. Yet, for a similar research output, the United States attracts six times more venture capital to commercialize the results. Europe is clearly underperforming in innovation. The transfer from research to real-life products should be encouraged, promoted and helped.

HiPEAC recommends that Europe invests more in the creation of an innovation culture at all levels (education, society, industry) to stay competitive in this fast-evolving world and to help attract venture capital for scale-up companies.

Recommendation 18: European values and digital ethics

When computing ceased to purely be about technology and began encompassing content and data, it entered into a difficult relationship with social and ethical values.

HiPEAC recommends that digital ethics should be developed as a separate discipline and become a standard element in computing curricula. Developers should be aware of the ethical impacts of their works (such as AI being biased due to poorly chosen training databases). This should lead towards greater trust in technology and its use for the betterment of society. All technology companies should comply with the European ethical frameworks if they want to do business in Europe.

"Digital ethics should become a standard element in computing curricula"

FURTHER INFORMATION:

HiPEAC Vision 2021
hipeac.net/vision

HiPEAC Vision articles
bit.ly/HiPEACVision2021_articles

HiPEAC Vision comic
bit.ly/HiPEACVision_comic

HiPEAC Vision video
bit.ly/HiPEACVision2021_video

© Matthias Gabriel on Pixabay

Thanks to third-party funding, small and medium enterprises (SMEs) across Europe can get access to finance and expertise from Digital Innovation Hubs. In this article, we find out about how these umbrella initiatives are driving forward innovation throughout Europe, thanks to innovative experiments addressing real-world issues.

Cascade funding: a winning formula for EU innovation

BOOSTING REGIONAL COMPETITIVENESS WITH BOWI

Interregional collaboration to share expertise across Europe

Natasa Siljkovic, CIVITTA

As we all know, the levels of digitalization and application of smart technologies vary between European countries. Although the gap is closing, there is still a lot of work to do in reaching the European Digital Single Market, such as creating 'corridors' for interregional collaboration.

This is where the BOWI project, funded by the European Union (EU) comes in. This project supports collaboration between Digital Innovation Hubs across Europe to increase their ability to support small and medium enterprises (SMEs) with smart technologies and thus strengthen regional economies and their competitiveness. The support provided by BOWI will then serve as a precedent for similar collaborations – including those carried out after the conclusion of the project – and form collaboration corridors between EU regions.

Between 2020 and 2023, BOWI plans to distribute €4.8 million among 60 technology transfer experiments (TTEs). These experiments each involve mature hubs and young hubs that help an SME/mid-cap with a specific technological challenge. During the experiments, the hubs also focus on evaluating and improving their proposed collaboration. By the end of the experiments, we want to have a working business model with clear value for all parties involved as well as a general framework for interregional collaborations. This will lead to the improvement of hub sustainability through experience and resource sharing.

At BOWI, we believe that a coherent and practical approach is a cornerstone for creation of these collaboration corridors. We expect that such a setup will help close the technological gap between EU regions and build new business opportunities for both sides. As Maurits Butter (TNO), industrial innovation policy expert and sustainability leader in the BOWI project, puts it: 'Interregional corridors will provide the backbone to sustain our European industrial leadership in the world.'

Get involved and get up to €60,000

Until 1 September 2021, mature Digital Innovation Hubs are invited to apply for the upcoming round of BOWI TTEs. Your mature hub could be the one that, together with a young hub, supports SMEs with their experiments. You could be selected to

share your know-how in assisting the developing hub you are matched with to address the technological challenges identified by its regional companies. Meanwhile, you would be testing the proposed model for inter-hub collaboration and working on a sustainable corridor. The collaborations will be based on technological- and business-need matchmaking between the hubs.

Each of the selected applicants can support up to four experiments and receive up to €60,000 to support these activities.

Details of the open call: bowi-network.eu
Latest news: spaces.fundingbox.com/c/bowi

The BOWI project has received €7.8M funding under the European Union's Horizon 2020 research and innovation programme under grant agreement no 873155. Starting on 1 January 2020, the project will run until 30 June 2023.

SMART ANYTHING EVERYWHERE

Helping European businesses innovate better through digital technologies

Julia Koch, Smart Anything Everywhere

Currently in its third phase, over the last five years the Smart Anything Everywhere (SAE) Initiative has delivered enormous economic and societal impact.

With the introduction of the Horizon2020 programme's 'Financial Support to Third Parties' scheme – otherwise known as 'cascade funding' – small and medium enterprises (SMEs) could sign a light-touch contract with one of the projects' beneficiaries rather than entering into a direct and more complex contract with the European Commission. This significant simplification of the funding process led to the number of applications for open calls increasing dramatically. As a result, more than **200 application experiments involving partners from 25 countries with a total of more than €18 million** in phases 1 and 2 of Smart Anything Everywhere.

All application experiments are related to the following technology areas:

- Customised low-energy computing powering cyber-physical systems and the internet of things
- Cyber-physical and embedded systems
- Flexible and wearable electronics/Organic large-area electronics
- Advanced computing
- Smart systems integration

They enable applicants to enhance their products and services through the inclusion of innovative digital technologies.

Below are some of the highlights from different Innovation Actions aligned to SAE.

AgriNav: Helping small farmers benefit from variable-rate fertilizer technology

diatomic

Supporting Innovation Action: DIATOMIC
Application Area: Agriculture / Environment

To obtain high yields, farmers often overuse fertilizer. This causes overgrowth of algae, leading to severe problems in terms of the health of rivers. By reducing the volume of fertilizer used, both the farmer and the environment benefit. Using Vultus software and AgriNav guidance, all-terrain vehicles with fertilizer spreaders can move precisely along each crop row. The project involved the development of software for the application of variable quantities of fertilizer to a crop according to need. DIATOMIC has greatly supported AgriNav with training and coaching. As a result of this, the commercial applications have been mapped out and potential customers have been identified.

bettair®: Mapping urban air quality

Supporting Innovation Action: FED4SAE
Application Area: Environment / Health

Air pollution in cities is a challenge that most countries in the world face. Ambient air pollution kills over four million people every year, mainly in urban environments, and the problem is being aggravated further by unprecedented population growth in cities. bettair® is a platform as a service (PaaS) that allows, for the first time, air and noise pollution in cities to be mapped on a previously unimaginable scale based on large-scale deployment of outstandingly accurate gas sensors using an advanced post-processing algorithm. The information provided by the bettair® platform allows cities to implement appropriate urban plans to improve air quality, as well as to make smart and better decisions to mitigate air pollution.

FLEXCAP: novel EEG recording system using flexible and printed electronics

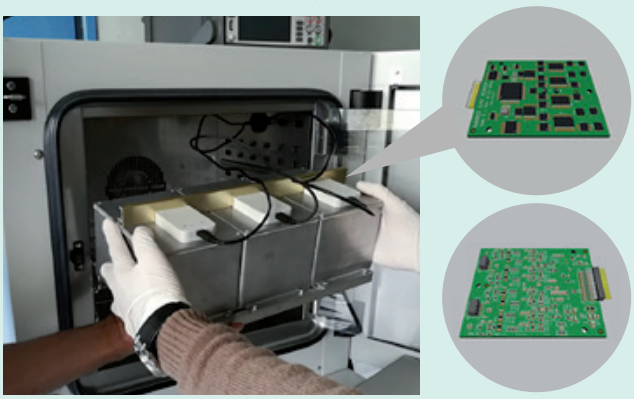
Supporting Innovation Action: SmartEES
Application Area: Health

Existing electroencephalography (EEG) recording systems based on 'traditional electronics' require multiple wiring, which hinders the setup of the system and reduces user comfort and acceptance of the technology. This constitutes a barrier to the wider development of neurotechnology and the penetration of applications in the home. FLEXCAP tackles these issues through a novel EEG recording system that takes advantage of flexible and printed electronics. The conventional rigid EEG headset with multiple wirings is replaced with an elastic cap functionalized with conductive tracks, into which it is possible to plug-in EEG sensor. This results in a more comfortable and user-friendly EEG system, removing the barriers preventing the increased use of neurotechnology applications in domestic settings.

MEATRACK: Miniature gas sensors for real time tracking of meat freshness

Supporting Innovation Action: TETRAMAX
Application Area: Food / Health

MEATRACK increases the smartness of refrigerators by developing and testing miniature gas sensors for tracking real time freshness of meat (beef in this project) by using patented gas-sensing technology from IM2NP combined with artificial intelligence (AI) tools from NVISION and an internet of things (IoT) software platform from S&C. Project partner NANZOZ developed the required electronics for sensor and fabricating the prototypes.



MEATRACK gas sensor prototypes used for experiments at AM2NP

Find out more about the challenges and technical solutions of these and many other SAE success stories:
smartanythingeverywhere.eu/success-stories

Register for the SAE newsletter and keep up to date with the latest success stories:
smartanythingeverywhere.eu/contact-us

FED4SAE BRINGS SUCCESS TO START-UPS ACROSS EUROPE

FED4SAE Coordinator Isabelle Dor, CEA

After three years, the FED4SAE programme concluded in January 2021 as a shining example of the power of EU funding for research and innovation. The programme directly supported 32 companies from across Europe to create an array of prototypes and innovative products which increased the competitiveness of European innovators in the cyber-physical and embedded system markets. It also contributed to the expansion of the Digital Innovation Hubs (DIHs) across the continent.

FED4SAE has helped to create a competitive ecosystem where European start-ups and scale-ups can thrive thanks to access to leading technology sources, competencies and industrial platforms, in addition to as well-connected business infrastructure and existing regional innovation hubs. To celebrate these results, the FED4SAE website has been redesigned as a showcase of the work done so far and the many successes that the start-ups have achieved.

Wide-ranging communications activities, including open calls, brokerage events, exhibition booths, information workshops and webinars brought the FED4SAE initiative to the attention of over 3,000 companies, with funding proposals submitted from 34 countries across Europe.

The broad range of industrial platforms, advanced technologies and testbeds offered by FED4SAE also translated into a wide range of targeted technical fields and application domains in the funded projects: from computer vision, machine learning, virtual reality and artificial intelligence to smart sensors and audio processing. In total over 30 different technology uses could be identified, with usually more than one field being featured in a proposal.

The companies that were selected had access to:

- Up to €58,000 in funding
- End-to-end services
- Leading-edge industrial platforms
- Research institutes' advanced technology and testbeds
- Support through technical expertise and coaching
- Business, market analysis and guidance from concept through to market release

The 32 companies also had access to the Innovation Management programme where they benefited from bespoke coaching support around their business model, market strategy and overall innovation management.

FED4SAE relied on its consortium of 14 partners, located across 10 different countries, to provide a unique marketplace providing access to technologies, technical expertise, business and financial services. With these partners' help, this programme has helped provide new opportunities for European companies.

Even though FED4SAE has come to an end, there are still ample opportunities for European companies to continue to improve and develop. Among these are DigiFED, which aims to support companies in their digitization routes, enhance the DIH offer and increase DIH collaboration across the continent, and Smart Anything Everywhere, which, as noted in this feature, offers start-ups access to funding and expertise through other DIHs. These programmes are able to provide more of the support and value previously offered by FED4SAE.

FURTHER INFORMATION:

fed4sae.eu

digifed.org

smartanythingeverywhere.eu

As noted in the HiPEAC Vision (see p.18), Europe has traditionally lagged behind the United States in turning research results into tangible innovations – something HiPEAC wants to change. In this new series, HiPEAC's Innovation Manager Xavier Salazar (Barcelona Supercomputing Center) explains the methodology behind the Innovation Radar, which aims to discover and promote innovations from European projects.

Innovation on the horizon: The Innovation Radar

Scanning the landscape of European Union (EU) projects, the EU's Innovation Radar aims to provide 'actionable intelligence' on innovations which can then be taken out of the lab and into the market.

The methodology of the Innovation Radar was originally described in a Joint Reseach Center Report titled 'Innovation Radar: Identifying Innovations and Innovators with High Potential in ICT FP7, CIP & H2020 Projects'; see 'Further reading', below. This paper describes the criteria used to assess the innovation potential and capacity of results from European-funded projects. It draws on the results of a questionnaire provided within the paper, which was completed by external experts.

The main indicators are the 'innovation potential' and the 'innovation capacity' of the innovator in question.

Innovation potential

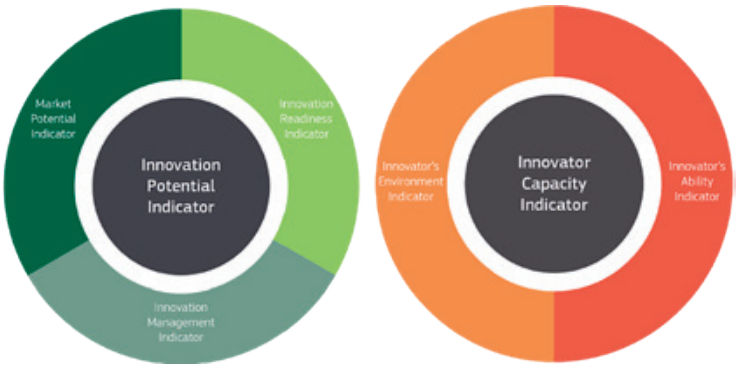
This encompasses three indicators:

- **Innovation readiness**: this relates to the technical maturity of the technology. It accounts for project activities relating to preparing a result for commercialization, such as prototyping, demonstration, testing or feasibility studies.
- **Innovation management**: this relates to the consortium's capability for bringing innovations to the market. It examines how the project tackles issues relating to ownership, intellectual property rights (IPR), the preparation of a business / exploitation plan or market study, or securing follow-up funding from public or private sources, for example.
- **Market potential**: this relates to target markets and how the technologies created within the project are able to meet their requirements.

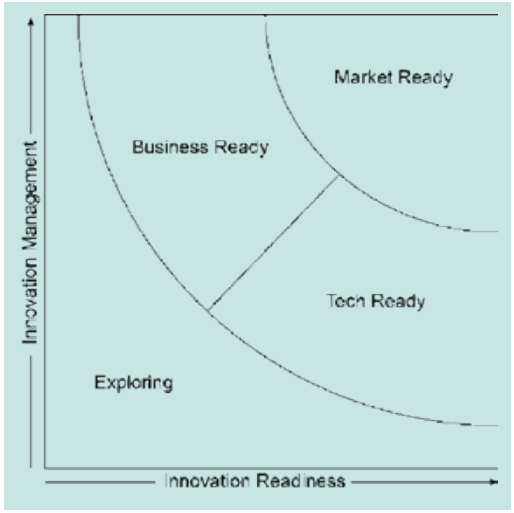
Innovation capacity

This considers two main areas:

- The **innovator's ability** – that is, the ability of organizations to develop innovations. This is evaluated, for example, by the number of times the organization has been spotted by the innovation radar and / or by the opinions of external reviewers.
- The **innovator's environment**: this examines the overall conditions in the project consortium, based on the premise that a favourable environment is more likely to result in innovations spilling over. It considers the commitment of partners to exploiting innovations and the presence of organizations interested in taking advantage of innovations, for example.



Following an analysis of these indicators, innovations are mapped according to four different maturity levels, as shown in the diagram:



HiPEAC innovation booster

- **Exploring**
  Both innovation readiness and innovation management are at an early stage.
- **Tech ready**
  Technologies with high innovation readiness, but lower innovation management capacity.
- **Business ready**
  Acknowledged innovation capacity, but a technology which is less mature.
- **Market ready**
  Where both indicators are excellent.

As a next step, projects are informed of any innovations identified as a result of this analysis and the innovations are published on the Innovation Radar Platform (see 'Further reading', below).

In addition, following the same Innovation Radar methodology, every year the Innovation Radar Prize is awarded to the technologies that are considered to be most promising. Open to a public vote, this award provides additional opportunities to boost the visibility of the selected technologies.

Endorsement by the Innovation Radar is a great way for projects and their institutions to promote innovations developed within projects. Many projects make the most of this opportunity by preparing press releases or website news items to highlight success stories, for example. See the example of the EPEEC project, below.

So far more than 300 innovations arising from the HiPEAC community have been featured on the Innovation Radar Platform, which is an impressive achievement. We look forward to seeing even more innovations being highlighted in future.

Have you received notification that your project will be featured on the Innovation Radar Platform? Let us know and we will help you promote it. communication@hipeac.net

FURTHER READING:

Innovation Radar Platform innoradar.eu

Innovation Radar: Identifying Innovations and Innovators with High Potential in ICT FP7, CIP & H2020 Projects
Giuditta De Prato, Daniel Nepelski, Giuseppe Piroli, 2015
bit.ly/JRC_Innovation_Radar

Five components from EPEEC selected by the Innovation Radar

The EPEEC (European joint Effort toward a Highly Productive Programming Environment for Heterogeneous Exascale Computing) project aims to develop and deploy a parallel programming environment to make heterogeneous, exascale platforms more manageable for programmers. Led by HiPEAC member Antonio J. Peña (Barcelona Supercomputing Center), the consortium is advancing programming models, runtime systems, and tools with three overarching objectives in mind: high coding productivity, high performance, and energy awareness. See our interview with Antonio in *HiPEACinfo* 59 for more information on the project.

Recently, an impressive five components from the EPEEC project have been selected by the Innovation Radar. Two of these were considered market ready, with one even being awarded the Innovation Radar Prize, as follows:

- **Parallelware technology**: a static analysis tool aiming to reduce the burden of making code parallel
  Owner: **Appentra Solutions**, whose chief executive is HiPEAC member Manuel Arenaz.
  Highlighted as having a noteworthy level of market creation potential.
  Awarded the **Innovation Radar Prize 2020** in the Innovative Science category.
- **ArgoDSM**: a distributed shared memory system
  Owner: **Eta Scale**, whose co-founder and chief executive is HiPEAC member Stefanos Kaxiras.

The remaining three components selected were defined as 'actively exploring value creation opportunities' and 'addressing the needs of existing markets and existing customers', respectively:

- **GASPI**: Global Address Space Programming Interface
  Owner: Fraunhofer
  Highlighted as a female-led innovation, thanks to the leadership of EPEEC researcher Valeria Bartsch, who spoke at HiPEAC's 2019 Computing Systems Week in Bilbao
- **Extrae**, **Paraver** and **Dimemas**: performance tools
  Owner: Barcelona Supercomputing Center
- **OmpSs Parallel Programming Model**
  Owner: Barcelona Supercomputing Center

A news piece was published on the EPEEC website and shared on social media to highlight these successes. Congratulations to all the teams involved!

FURTHER INFORMATION:

Innovation Radar news on EPEEC website
bit.ly/EPEEC_Innovation_Radar

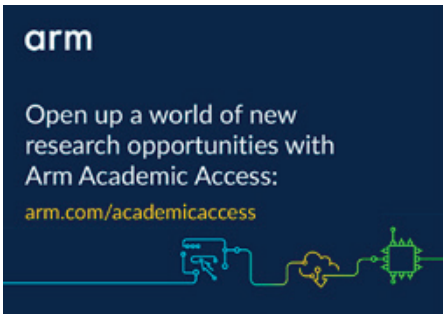
EPEEC components on the Innovation Radar Platform
innoradar.eu/resultbykeyword/EPEEC

With its processor technology reaching over 70% of the world's population, Arm is the world's most pervasive computing platform. Charlotte Christopherson, Marketing and Communications Manager at Arm, briefs us on the cutting-edge resources it makes available to academic research teams.

Achieve your research goals with free access to Arm IP, tools and resources

One of the most significant challenges facing academic researchers can be finding the most suitable platform for their research. Often, it can be necessary to design and build a system before the fundamental research can begin. As securing funding becomes ever more competitive, it's more important than ever to ensure resources are focused in the most effective way.

Arm technology reaches over 70% of the world's population, with a trusted ecosystem of thousands of partners developing technology which has the potential to impact millions of people worldwide. For many projects, using industry-standard intellectual property (IP) can enable your research to have even greater impact across academia and possible future real-world applications. In recognition of this, and to support innovation across computing research, Arm offers a wide range of tools, materials and resources available to academic researchers at no charge.



Whether your research is in computer architecture, embedded systems, machine learning, security, or any other area, our dedicated Research Collaboration and Enablement team are here to help you. We can provide free individual access to a range of IP, tools and resources for academic research use, enabling you to get started quickly using commercially proven IP.

Our Arm Academic Access program provides institutional access to the most commonly used Arm technology – including processor IP for microcontrollers, application processors, systems IP, tools and resources.

Access is arranged through a simple institutional agreement, which enables all relevant academic researchers within the institution to benefit from the technology portfolio – making it easier than ever to establish new research projects or investigate new ideas.

'Our experience of the Arm Academic Access program has been very positive, the process of signing up and setting up the infrastructure within the university was straightforward and getting individual researchers enabled is a lightweight process which they have found easy to engage with. The range of IP that Arm has made available is benefiting our work in the many complex systems we are working on, such as multicore event-based architectures, cybersecurity, intermittent computing, three-dimensional integrated circuits (3D IC) and optical communications for data centres and high-performance computing,' says John Darlington, University of Southampton.

As well as the University of Southampton, other institutions around the world, including Imperial College London, Barcelona Supercomputing Center, the University of Athens, TSRI and Europractice have already joined the programme, which opens a world of new research opportunities.

'One of the real benefits of the programme to the University of Southampton is the global community of researchers that it brings together,' explains Professor Geoff Merrett. 'Our researchers collaborate with peer universities around the globe. Sharing access to common Arm IP will really benefit future partnerships and enable us to deliver new forms of computation for the benefit of society.'

Find out how Arm could help you achieve your research goals: arm.com/rce

Arm is a longstanding gold sponsor of the HiPEAC conference, including the 2021 edition. Without the support of our sponsors, the HiPEAC conference would not be possible in its current form. For further information, visit hipeac.net/2022/budapest

As the HiPEAC community is well aware, traditional von Neumann architectures are struggling to keep pace with applications increasingly reliant on vast amounts of data. Now, a small company in the French Alps has achieved a breakthrough solution in the form of in-memory computing. Rémy Cimadomo, Business and Technology Manager at UPMEM, tells HiPEAC all about it.

Processing in memory is here: Introducing UPMEM PIM

The technology

Memory walls in data-intensive applications represent the main challenge for traditional von Neumann architectures. Excessive memory transactions to and from the central processing unit (CPU) hinder progress in processor capabilities and increase power requirements.

Processing in memory (PIM) gets to the heart of this issue by placing thousands of cores inside the dynamic random access memory (DRAM) of the server, removing the need for data movement and carrying out the computing where the data is. Silicon benchmarks prove that applications can be accelerated to run over 15 times faster, energy consumption is reduced by a factor of eight on average, while the overall total cost of ownership is seven to 12 times lower than those of central processing unit (CPU)-, field-programmable gate array (FPGA)- or graphics processing unit (GPU)-based solutions.

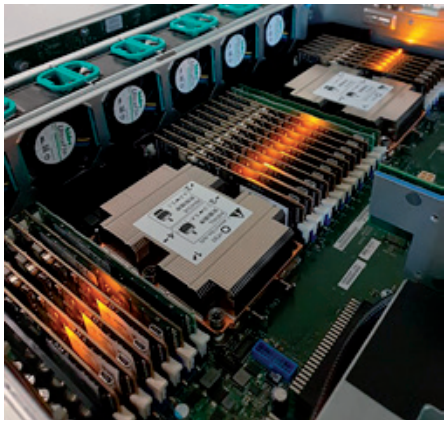
"UPMEM is the first company to mass produce a general-purpose accelerator based on PIM, a breakthrough awaited by the computing industry for nearly two decades"

First PIM-based general-purpose accelerator

UPMEM is the first company to mass produce a general-purpose accelerator based on PIM, a breakthrough awaited by the computing industry for nearly two decades. This is quite an achievement for a start-up incorporated in 2015 in Grenoble, at the heart of the French Alps.

The breakthrough lies in successfully incorporating processing cores within a regular DRAM design, one of the most regulated and challenging semiconductor environments. The efforts that have gone into overcoming these constraints have been well rewarded, with two major benefits standing out: the new accelerator can be produced using cost-effective manufacturing processes already used for DRAM and the PIM technology is compatible with existing computing architectures, so is well positioned to be of interest to a wide range of customers.

Every UPMEM memory module packs in 16 PIM chips containing 128 data processing units (DPUs), clocked at 450MHz. A dual-socket platform can have no fewer than 20 PIM DIMMs which translates into 2560 DPUs, 160GB PIM DRAM and 2.5 TB/s of actionable bandwidth.



Dual socket Intel server with 20 UPMEM PIM DIMMs, 2560 DPUs @400MHz

The technology is enabled by a comprehensive software development kit (SDK), allowing developers to code with ease using C or Rust. We would encourage the HiPEAC community to have a look and start experimenting with the simulator; see link below.

High-potential sectors for UPMEM

Genomics has been a fast-growing area for computing in recent years. The demand for affordable and fast sequencing puts UPMEM PIM in an ideal position to replace CPUs, FPGA or GPUs. Several successful implementations of UPMEM PIM – such as mapping and alignment and soon FM-index – are inspiring companies and labs around the world to develop commercial solutions using our technology. Data analytics, artificial intelligence (AI), image processing, edge computing and security are also highly promising sectors for the company.

Future plans

In terms of business, the company is aiming to expand its customer base within genomics, data analytics and AI. With access to more mature use cases, key industry players and cloud computing providers are expected to transition to PIM. Meanwhile over twenty research labs worldwide are investigating algorithms that can take full advantage of the UPMEM architecture. To support this work of investigation, UPMEM is also continuously growing its own PIM data centre.

The product roadmap is clear: increasing production capabilities with DPUs that will run increasingly faster while bringing up new highly dense PIM servers such as the Intel Ice lake, which would allow platforms with 3584 DPUs. In addition, with lower power and unique security features coming up this year, the DPU will become an ideal secure enclave and an ally of choice for low-energy edge solutions.

FURTHER INFORMATION:

UPMEM website upmem.com

UPMEM SDK sdk.upmem.com

'It's the memory, stupid': A conversation with Onur Mutlu HiPEACinfo 55, p.13

Interview with Evangelos Eleftheriou of the IBM Zurich Research Laboratory HiPEACinfo 62, p.16

"Genomics, data analytics, artificial intelligence (AI), image processing, edge computing and security are highly promising sectors"

In this issue, we look back at completed projects: Mont-Blanc, which changed the landscape of supercomputing, and Exa2pro, which has been enhancing productivity of high-performance computing (HPC) applications. There are also plenty of new projects on the horizon, which are designing new accelerators, orchestrating cloud-to-edge resources, predicting pollution hotspots, and optimizing logistics via the internet of things (IoT), among other things. Finally, don't miss the new Centre of Excellence PerMedCoE, which is boosting European competitiveness in personalized medicine.

Innovation Europe

MONT-BLANC 2020: PAVING THE WAY TO THE EUROPEAN PROCESSOR FOR HPC

Pascale Bernier-Bruna, Atos

Now that the Mont-Blanc 2020 project has come to an end, it is time to look back on its accomplishments. Mont-Blanc 2020 was the last of a long series of projects. The initial concept when we started in 2011 was very disruptive: leveraging mobile (Arm) chips and their power-efficiency to run high-performance computing (HPC) applications. Successive Mont-Blanc projects have witnessed and accompanied the rise of Arm processors in servers: the current Fugaku system ranked first in the TOP500 has reached the apex of high-end Arm CPUs, vindicating the initial rationale behind the project.

One of the strong points of the Mont-Blanc projects was their industry / academia collaboration. Mont-Blanc 2020 was no exception, with a team of three core partners with complementary profiles (Arm, Atos, BSC), three active SMEs (Kalray, Semidynamics, Sipearl) and prominent research partners (BSC, CEA, Jülich Supercomputing Centre).

The focus of Mont-Blanc 2020 was processor design. It essentially addressed system-on-chip (SoC) design and processor intellectual property (IP) to enable the work of the European Processor Initiative (EPI), focusing on the challenge of achieving extremely high performance per watt. For the compute unit, we selected the Arm instruction set, with its Scalable Vector Extension (SVE) optimized for HPC and artificial intelligence (AI). It has particular technological relevance for high-end cores; more importantly, the availability of a dynamic software ecosystem was necessary to run real applications as required by our co-design methodology.

An important achievement of Mont-Blanc 2020 is the tools and methodology we selected and developed for processor simulation and virtual prototyping, i.e. the tools that allowed our researchers to test applications and evaluate future performance prior to silicon availability. We developed a unique co-design methodology for SoC infrastructure verification and optimization. Co-design is always a challenge, but we faced an additional test, which was to get hardware and software teams from different organizations to work together. We had to build

a bridge between the computer-aided design (CAD) tools used by our industrial partners and the open-source tools used by our academic partners. Our approach has increased the speed of simulation by a factor of 1,000 and even by 10,000 for some applications.

Many of the features we developed for our Simulation Framework are already used outside of the project. For example, Mont-Blanc 2020 was instrumental in the implementation of SVE instructions in gem5, which is part of the official open-source release 20.0 of gem5. Another example is the SVE-related improvements to the MUlti-scale Simulation Approach (MUSA) developed within Mont-Blanc 2020, which are used within EPI.

However, the top Mont-Blanc 2020 achievement is without doubt the IP developed for a low-power network on chip (NoC). NoC is critical in a SoC when targeting highly demanding applications. It is also very challenging: in manycore architectures you need to maintain low latency while increasing the number of cores as well as the throughput of each core. The NoC IP developed by Mont-Blanc 2020 will be included in the next-generation EPI processor. Our NoC and related NoC IPs are also integrated in Atos's IP portfolio that will serve future commercial and research projects.

To conclude, European sovereignty in the provision of HPC technology was part of Mont-Blanc's vision from the start. We aimed to contribute to the revival of the European SoC design ecosystem by creating an IP portfolio as well as boosting the skills necessary for chip design. Today we can say: mission accomplished!

PROJECT NAME: Mont-Blanc 2020
START/END DATE: 01/12/2017 – 31/03/2021
KEY THEMES: processor, low-power, HPC, exascale, system-on-chip
PARTNERS: France: Atos, Commissariat à l'Energie Atomique et aux Energies Alternatives, Kalray SA, Sipearl; Spain: Barcelona Supercomputing Center, SemiDynamics Technology Services SL; Germany: Forschungszentrum Julich GMBH; UK: Arm Ltd
BUDGET: €10.1M

montblanc-project.eu
@MontBlanc_Eu

The Mont-Blanc 2020 project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 779877.

EU-KOREA COLLABORATION: DECENTER

Artificial intelligence (AI) and the internet of things (IoT) are transforming industry and society by enabling fast and smart decision-making, with little or no human intervention. As the adoption of these technologies grows at an ever-quickening pace, we are also observing an increasing resort to cloud computing solutions for offloading the computational burden required to process large amounts of data produced by IoT devices, and by advanced AI models developed to deal with that data.

Unfortunately, cloud computing services, usually available in remote third-party infrastructures, often fall short in meeting the requirements of latency- and privacy-sensitive applications. Recently, the fog computing paradigm has been proposed as an effective means to bridge the gap between the cloud and IoT technology domains, making computing resources more easily available closer to where data is produced, hence reducing latency and avoiding the exchange of sensitive data with third-party entities.

The DECENTER project addresses these topics and provides a fog computing platform to orchestrate cloud-to-edge resources that provide all the necessary tools to create and operate AI-based workloads close to the IoT infrastructure, i.e. where the data is produced. With respect to cloud-based solutions, DECENTER enables real-time data analytics and low-latency actuations, while also ensuring privacy by design.

This platform is optimized for hybrid decentralized AI models, coping with data coming from different sources. It focuses on four innovation goals, aiming to advance the fog paradigm to its next evolutionary step from four different aspects that are complementary to each other:

- Develop a robust fog infrastructure for the deployment of AI applications;
- Ensure cross-border federation and interconnectivity of edge resources using blockchain technologies;
- Enrich the IoT ecosystem to process large quantities of heterogeneous data at the edge of the infrastructure;
- Develop decentralized AI models that exploit the full potential provided by fog computing.

DECENTER is being validated in four use cases:

- smart city crossing safety
- robot logistics
- smart and safe construction
- ambient intelligence

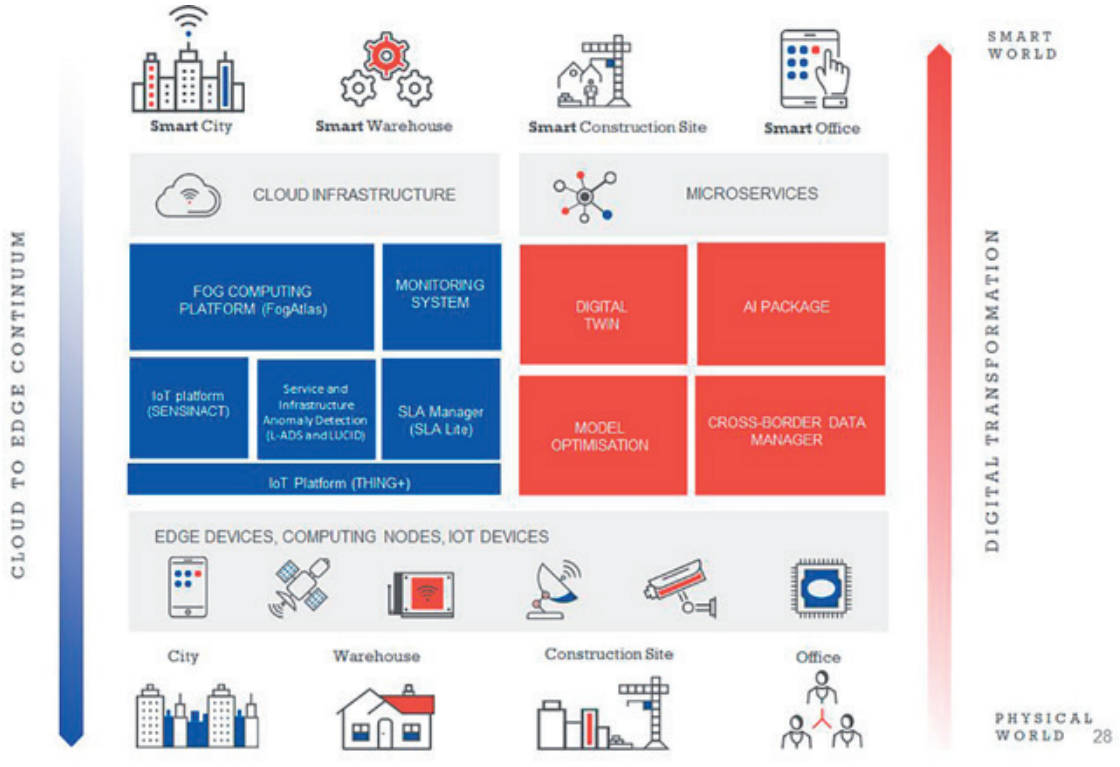
The DECENTER high-level architecture (see figure) defines all the necessary tools to create and operate AI-based workloads in a heterogeneous, distributed and opportunistically created fog computing infrastructure, covering the whole cloud-to-edge continuum. The DECENTER architecture includes platforms and services to support the entire cycle of creation and operation of AI applications. Services (in red) are introduced to support the creation of AI-based cloud-native applications starting from models that can be easily retrieved, managed and shared. The platforms (in blue) are then used to capture data from sensors and devices to orchestrate the fog computing resources according to the needs of the AI applications, to monitor their behaviour and to acquire and manage resources from third parties which can be necessary to cater to the requirements of the applications.

The DECENTER consortium consists of industrial, research, academic and governmental organizations from the European Union and the Republic of Korea. The project will come to an end in June 2021 and all results are available through its website.

PROJECT NAME: DECENTER: Decentralised technologies for orchestrated Cloud-to-Edge intelligence
START/END DATE: 01/07/2018 – 30/06/2021
KEY THEMES: artificial intelligence (AI), internet of things (IoT), cloud, fog, edge
PARTNERS: Italy: Fondazione Bruno Kessler, Comune di Trento; Spain: Atos, Robotnik; France: Kentyou, Commissariat à l'Energie Atomique et aux Energies Alternatives [participation period: M1-M24]; Slovenia: University of Ljubljana; Korea: Korea Electronics Technology Institute, Gluesys, Daliworks, LG U+, Seoul National University.
BUDGET: € 2.2M

decenter-project.eu
@decenterproject
facebook.com/decenterproject
bit.ly/CSWSpring21_DECENTER

DECENTER has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 815141, as well as being supported by Institute for Information & communications Technology Promotion (IITP) grant funded by the Korea government(MSIT) (no. 1711075689).



EVEREST: BUILDING THE ENVIRONMENT FOR HIGH PERFORMANCE DATA ANALYTICS

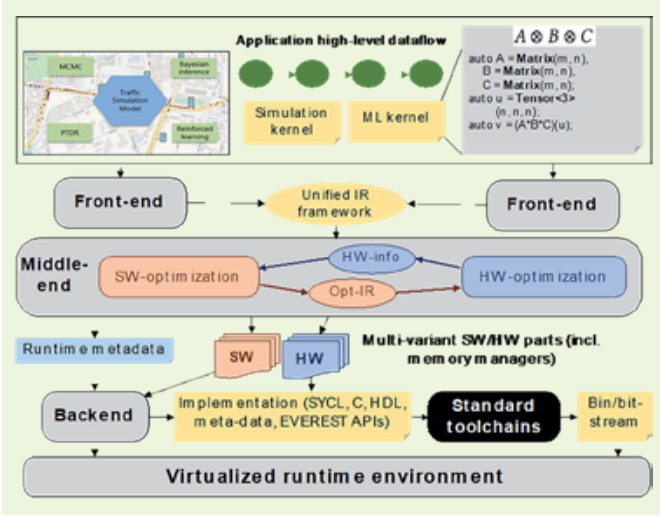
EVEREST DESIGN ENVIRONMENT FOR EXTREME-SCALE BIG DATA ANALYTICS ON HETEROGENEOUS PLATFORMS

Big data analytics aims to extract valuable knowledge from an exponentially increasing amount of data. To outperform traditional central processing unit (CPU)-based systems, designers are focusing on heterogeneous, reconfigurable platforms leveraging field-programmable gate arrays (FPGAs) for efficient and distributed computation closer to the data, combining them with artificial intelligence (AI) algorithms for knowledge extraction and decision making.

While these systems can improve energy efficiency and performance, fixed-function accelerators introduce programmability and scalability issues. The resulting big data computing systems must not only efficiently manage, elaborate, and move the data under security and privacy constraints, but also demand powerful and easy-to-use design environments to express functional and non-functional requirements.

To address these concerns, the H2020 EVEREST project aims to:

- Simplify the programmability of FPGA-based architectures for big-data applications. EVEREST will combine multiple domain-specific languages (DSLs) and compiler optimizations to pass more information to the compilation flow and down to a distributed runtime environment.
- Support a more 'data-centric' design approach. We leverage reconfigurable hardware to design innovative solutions, which move part of the computation towards the data. Hardware accelerators will be combined with reconfigurable memory managers to move the data more efficiently inside each node and between nodes.



- Enable efficient monitoring of the execution with a unified hardware / software paradigm. The runtime system will feature virtualization environments and dynamic load balancing to support distributed data management and secure computation.

EVEREST aims to integrate all contributions into a 'system development kit' (SDK) to facilitate application development on current and emerging platforms. The EVEREST SDK will be built on top of state-of-the-art programming models and emerging communication standards with novel domain-specific extensions to provide characteristics of algorithms and data, to better exploit data parallelism, to improve the dynamic control of the distributed execution, and to enforce security. High-level synthesis and domain-specific memory architectures will play a key role for hardware acceleration. A prototype target platform will include nodes with not only bus-attached but also disaggregated FPGAs.

The EVEREST approach will be validated on three industry-relevant applications:

- **Weather analysis-based prediction of energy production**. With the support of the EVEREST environment, we plan to combine high-resolution weather forecast ensemble and artificial intelligence tools to improve the prediction of the high-localized meteorological variations at hourly and sub-hourly scale.
- **Air-quality monitoring of industrial sites**. Thanks to the combination of high-resolution weather forecast ensemble and real-time data, industrial sites can forecast environmental impacts of their production activities and can decide to delay them or activate emission reduction treatments.
- **Traffic modelling framework for intelligent transportation in smart cities**. EVEREST will support traffic management systems with characterization of the road traffic by combining a traffic simulator, a traffic prediction model, and intelligent routing methods.

PROJECT NAME: dEsign enVironmEnt foR Extreme-Scale big data analyTics on heterogeneous platforms
START/END DATE: 01/10/2020-30/09/2023
KEY THEMES: data analytics, heterogeneous platforms, reconfigurable computing, artificial intelligence (AI), high-performance computing (HPC)
COORDINATOR: Christoph Hagleitner (IBM Zurich)
SCIENTIFIC COORDINATOR: Christian Pilato (Politecnico di Milano)

PARTNERS: Switzerland: IBM Research Zurich, Università della Svizzera italiana; Italy: Politecnico di Milano, Centro Internazionale di Monitoraggio Ambientale, Duferco Energia; Germany: TU Dresden; France: Virtual Open Systems, Numtech; Czech Republic: IT4Innovations; Slovakia: Sygic.
BUDGET: €5.04M

everest-h2020.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 957269.

EXA2PRO DELIVERS GREATER PRODUCTIVITY AND MAKES EXASCALE MORE ACCESSIBLE

April 2021 saw the close of EXA2PRO, a project dedicated to development productivity and performance portability for heterogeneous supercomputing systems. Advancing scientific progress in domains such as physics, energy and material science by developing and deploying applications in computing clusters of hundreds of thousand CPU cores is exciting, yet very challenging. EXA2PRO has therefore designed and developed a framework for enabling the efficient deployment of applications in supercomputing systems.

The goal of EXA2PRO was to increase the productivity of developing and deploying applications on heterogeneous computing systems and to promote and lower the barrier of access to exascale computing systems to the scientific community and industry.

The tools of the EXAPRO framework were evaluated in a wide variety of applications, generating impressive results. Success stories include:

- The EXA2PRO tools have been used to advance CO2 capture technologies, by enabling the generation of CO2 capture solutions 41% faster.
- The performance of a supercapacitor simulation code (MetalWalls) improved by 33% by applying the EXA2PRO runtime system.

More information, as well as the EXA2PRO framework, are available on the EXA2PRO website.

PROJECT NAME: Enhancing Programmability and boosting Performance Portability for Exascale Computing Systems (EXA2PRO)
START/END DATE: 01/05/2018 – 31/04/2021
KEY THEMES: HPC, performance portability, heterogeneous computing systems.
PARTNERS: Greece: Institute of Communication and Computer Systems, Ethniko Kentro Erevnas Kai Technologikis Anaptyxis, University of Macedonia; Sweden: Linkopings Universitet; France: Institut National de Recherche en Informatique et Automatique, Centre National de la Recherche Scientifique CNRS; Germany: Forschungszentrum Julich GMBH; UK: Maxeler Technologies Limited
BUDGET: €3.48M

exa2pro.eu

EXA2PRO has received funding from the European Union's Horizon 2020 Programme under grant agreement no. 801015.

INGENIOUS IOT LOGISITICS SOLUTIONS

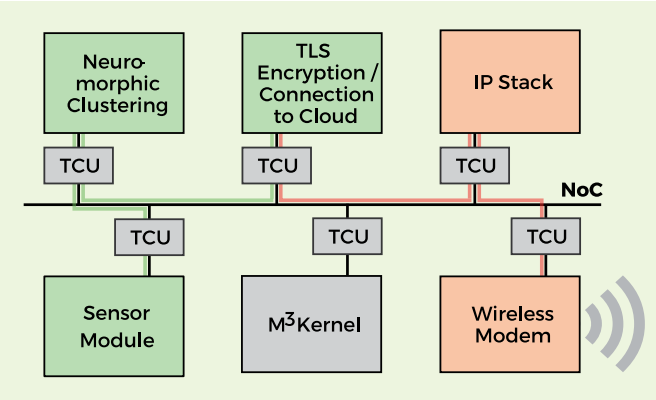
The goal of iNGENIOUS is to optimize logistics and the supply chain using a wealth of real-time data made available by the internet of things (IoT), which integrates with heterogeneous networks as well as data management and analytics technologies.

A key component of iNGENIOUS is a novel data virtualization layer (DVL) that aggregates into one unified data pool a myriad of data sources that have been, until now, locked into several, incompatible machine-to-machine platforms. In addition to enabling more comprehensive monitoring, DVL-provided information is used by machine learning (ML) applications to more accurately predict the arrival times of sea vessels and trucks in order to optimize container handling in ports.

The DVL also feeds real-time information into ML services that optimize resource assignment in the 5G network that connects IoT sensors, remote-controlled vehicles in the port area, or robots in automated factories and logistics centres. Furthermore, neuromorphic sensors employ ML techniques to process measurements at the edge, which avoids sending raw data over a network at high cost.

The second cross-layer aspect in iNGENIOUS is security. At the higher levels, the DVL logs anonymized events into multiple distributed ledger networks to ensure verifiable data integrity across the entire supply chain. But the most relevant part of the story for the HiPEAC community is probably about the lowest layer: the embedded computers that connect IoT devices to the network.

As a basis for constructing secure IoT devices, the Barkhausen Institute contributes a hardware/software co-design. The hardware part is a tile-based architecture where processor cores are connected to a network on chip (NoC). Tiles cannot access the NoC directly, but only through a small data movement engine called a trusted communication unit (TCU). The software part is a microkernel-based operating system (OS) called M3. The microkernel runs on one dedicated tile, while other parts of the OS and applications are assigned their own tiles. This microkernel approach makes the overall system harder to attack, because a security vulnerability in an isolated component will only compromise this one component, but not necessarily the entire OS and all applications.



The iNGENIOUS M3 architecture

M3 delegates communication control to the TCU, which will ship data across the network on chip (NoC) only if the microkernel configured a communication channel between two tiles. Outsourcing access-control enforcement to the TCU has another advantage. Not only is it possible to police general-purpose processor tiles running software, but hardware accelerators or input/output (I/O) devices can be connected to the NoC and managed in the same way as software components.

In iNGENIOUS, vibro-acoustic sensors and neuromorphic ML accelerators are integrated with a wireless modem into one IoT device. Sensor data is sent via the modem and new ML models can be received, but they must pass through mandatory TLS encryption. As the TLS component is isolated from the IP stack and modem using TCU-enforced communication control, a security problem in either of them cannot easily compromise the sensor, as would be possible in traditional system architectures. The iNGENIOUS project therefore addresses security as a cross-cutting concern from the IoT hardware up to the DVL in the cloud.

iNGENIOUS is optimizing maritime logistics via the IoT

PROJECT NAME: iNGENIOUS: Next-GENeration IoT sOlutions for the Universal Supply chain

START/END DATE: 01/10/2020-31/03/2023
KEY THEMES: sensors, SoC, modem, automation, tactile internet, 5G, heterogeneous networks, AI/ML, data virtualization, distributed ledger technologies, logistics, supply chain
BUDGET: €8M
COORDINATOR: David Gomez-Barquero, Universitat Politècnica de València
TECHNICAL MANAGER: Tim Hentschel, Barkhausen Institut
PARTNERS: Spain: Universitat Politècnica de València, Nokia Spain, Telefónica Investigación y Desarrollo, Sensorial XR, ASTI Mobile Robotics , ValenciaPort Foundation, Fivecomm, COSCO SHIPPING Lines (Spain); Germany: Barkhausen Institut, Technische Universität Dresden, NeuroControls; Italy: Ericsson Telecomunicazioni, Nextworks, Consorzio Nazionale Interuniversitario per le Telecomunicazioni, Autorità di Sistema Portuale del Mar Tirreno Settentrionale; Finland: Cumucore OY, AWAKE.AI Oy; Luxembourg: SES Techcom; France: Sequans Communications; Poland: Polsko-Japońska Akademia Technik Komputerowych; Ireland: ST Engineering iDirect (Ireland) Limited

ingenious-iot.eu
@ingenious_iot

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 957216.

TEXTAROSSA TO DEVELOP NEW HARDWARE ACCELERATORS, COOLING AND SOFTWARE FOR HPC

Launched on 1 April 2021 and co-funded by the European High Performance Computing (EuroHPC) Joint Undertaking, TEXTAROSSA is a three-year project to power innovation in the efficiency and usability of high-end high-performance computing (HPC) systems, both pre-exascale and exascale.

To achieve high performance and energy efficiency on exascale computing systems, a technology gap needs to be bridged. Increased efficiency in computation must be combined with extreme efficiency in hardware and new arithmetic, while methods and tools for the seamless integration of reconfigurable accelerators must be provided.

Uniting the expertise of 17 organizations located in five European countries, the TEXTAROSSA consortium will develop new hardware accelerators, innovative two-phase cooling equipment, advanced algorithms, methods and software products. These will be applicable both for traditional HPC domains and for emerging domains in high-performance artificial intelligence (HPC-AI) and high-performance data analytics (HPDA). The technologies developed will be tested on an integrated prototype system, mirroring and extending extending the European Processor Initiative's ARM64-based architecture, and on an OpenSequana testbed.

To assess the impact of the proposed innovations from node to system levels, TEXTAROSSA's technology will be tested on challenging HPC applications in domains such as general-purpose numerical kernels, high-energy physics (HEP), oil and gas, and climate modelling, as well as selected HPDA and AI applications.

NAME: TEXTAROSSA: Towards EXtreme scale Technologies and AcceleRatOrS for HW/SW Supercomputing Applications for exascale
START/END DATE: 01/04/2021-31/03/2024
KEY THEMES: high-performance computing (HPC), exascale, artificial intelligence (AI), data analytics, accelerators, cooling systems, algorithms

PROJECT COORDINATOR: Massimo Celino, Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA)
massimo.celino@enea.it

PROJECT TECHNICAL MANAGER: William Fornaciari, Politecnico di Milano
william.fornaciari@polimi.it

PARTNERS: Italy: ENEA, Consorzio Interuniversitario Nazionale per l'Informatica (CINI) (consortium comprising Politecnico di Milano, Università degli studi di Torino, Università di Pisa), E4 Computer Engineering, Istituto Nazionale di Fisica Nucleare (INFN), Consiglio Nazionale delle Ricerche (CNR), In Quattro, CINECA; Germany:

Fraunhofer; France: Inria, Atos, Université de Bordeaux; Poland: Poznan Supercomputing and Networking Center (PSNC); Spain: Barcelona Supercomputing Center (BSC), Universitat Politècnica de Catalunya-Barcelona Tech (UPC)

BUDGET: €6M (EU contribution €2M)

textarossa.eu

The TEXTAROSSA project has received funding from the European High-Performance Computing Joint Undertaking (JU) under grant agreement no. 956831.

PERMEDCOE: EXASCALE-READY CELL-LEVEL SIMULATIONS FOR EUROPEAN PERSONALISED MEDICINE

Per Med CoE — HPC/Exascale Centre of Excellence in Personalised Medicine

Coordinated by Barcelona Supercomputing Center (BSC), the HPC/Exascale Centre of Excellence in Personalised Medicine (PerMedCoE) was launched in October 2020.

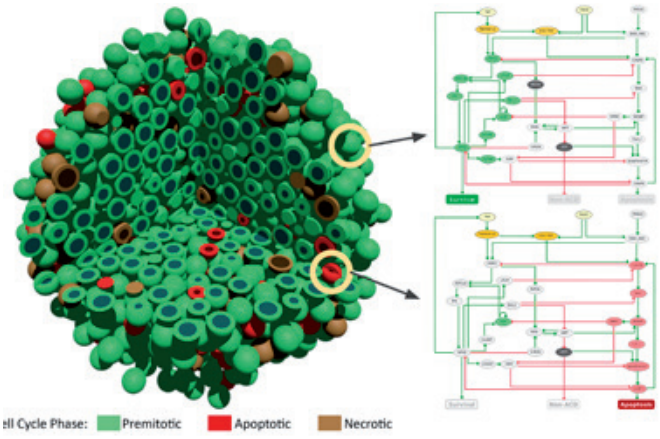
The next generation of exascale supercomputers will become a necessary tool in the treatment of diseases on an individual level, offering a step forward in personalized medicine. PerMedCoE will optimize codes for cell-level simulations in HPC/exascale and provide an efficient and sustainable infrastructure to support the development of personalized medicine by showcasing five HPC/exascale-upgraded use cases.

One of the most significant contributions of PerMedCoE will be to scale up cell-level simulations to HPC/exascale level, which will fill the gap between the molecular- and organ-level simulations provided by other Centres of Excellence (CoEs) such as CompBioMed and BioExcel, thus contributing to the European Personalised Medicine Roadmap.

'PerMedCoE will boost the competitiveness of European personalized medicine and aims to become the community hub for exascale-ready software in this domain,' says Alfonso Valencia, ICREA Research Professor, BSC Life Sciences Department Director and PerMedCoE Coordinator.

Personalized medicine opens up unexplored frontiers for treating diseases at the individual level combining clinical and omics information. However, the performance of current simulation software is still insufficient for tackling longstanding challenges such as patient-specific treatments. For this reason, this European centre of excellence has as its main objectives:

- To optimize key software for cell-level simulations to the new pre-exascale platforms to contribute to the European Personalised Medicine Roadmap.
- To integrate personalized medicine into the new European HPC/exascale ecosystem, by offering access to HPC/exascale-adapted and optimized software.
- To design and complete a comprehensive set of personalized medicine use cases to drive the development of cell-level simulations.
- To build the basis for its sustainability by coordinating personalized medicine and HPC communities, and reaching out to industrial and academic end-users with use cases, training, expertise and examples of best practice.



Example of the framework that enables multiscale simulations. Image by Miguel Ponce de León (PerMedCoE)

The centre will become the entry point to exascale-ready cell-level simulation software, able to transform personal omics data into actionable mechanistic models of medical relevance, supporting developers and end-users with know-how and best practice. It will also connect simulation software developers with HPC, HTC and HPDA experts at the CoEs POP and HiDALGO, and work with other biomedical consortia such as ELIXIR and LifeTime, also connecting pre-exascale infrastructures hosted by supercomputing centres such as BSC and CSC – IT Center for Science.

NAME: PerMedCoE: HPC/Exascale Centre of Excellence in Personalised Medicine

START/END DATE: 01/10/2020-30/09/2023

KEY THEMES: high performance computing, exascale, simulation software, code optimization

PARTNERS: Spain: BSC, Atos Spain, Fundacio Centre de Regulacio Genomica, ELEM Biotech; Finland: CSC-TIETEEN Tietotekniikan Keskus; France: Institute Curie; Germany: Universitatsklinikum Heidelberg, European Molecular Biology Laboratory, Max Delbrueck Centrum Fuer Molekulare Medizin in der Helmholtz-Gemeinschaft (MDC); Luxembourg: Universite du Luxembourg; Slovenia: Univerza V Ljubljani; Sweden: Kungliga Tekniska Hoegskolan.

BUDGET: €4.99M

permedcoe.eu
@PerMedCoE
linkedin.com/company/permedcoe

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement no. 951773.

AQMO: USING SMART SENSORS (AND CITY BUSES) TO PREDICT POLLUTION HOTSPOTS

The Connecting Europe Facility (CEF) project AQMO (2018-2020), coordinated by Université de Rennes 1 (France), developed an end-to-end solution for air quality measurement and numerical modelling of pollutant dispersion. The objective was to integrate micro-sensors and simulations on supercomputers or cloud facilities into a unified framework. The platform is now being deployed in the city of Rennes and will contribute to its open-data platform, RUDI.

Data collection is currently carried out by eight buses equipped with AlphaSense OPC-N3 sensors and a multimodal communication device (LoRaWan and 4G). The sensors are located at the front of the bus. The buses in question were chosen to maximize geographical coverage.

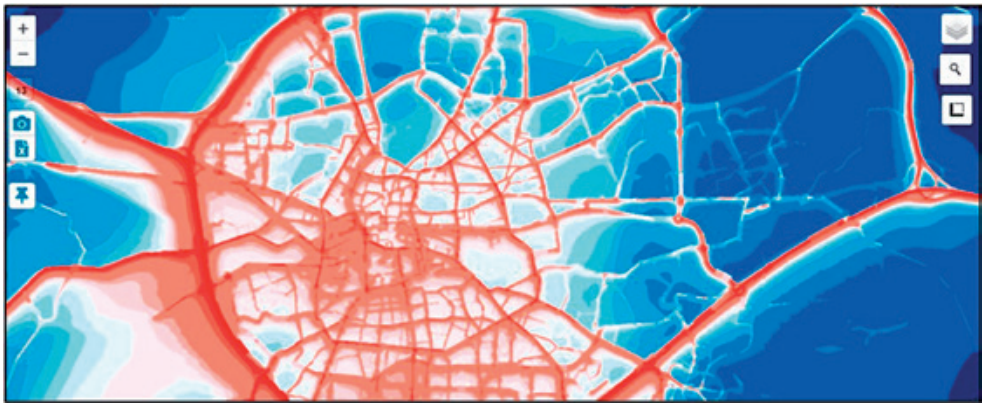
The main challenge in AQMO consisted of integrating a large set of technologies, including 3D printing and printed circuit board (PCB) design, in a coherent framework. A software-defined network (SDN) is deployed to integrate all buses in a single network. In addition, the platform includes a workflow management tool in order to implement data analysis at the edge.

The numerical simulation of pollutant dispersion allows the mapping and forecasting of the impact on air quality of different emitters, such as motor traffic, as well as contrasting one against another. The advantage of this is the ability to provide a cartographic vision, as well as in determining the impact of what is not measured, such as future scenarios, or alternatives from past situations. It is thus very well adapted to the 'what if...' situation analysis. A simulation result is illustrated in the figure below. The numerical simulation is set up as a service that allows its integration in the workflow.

So far, the campaign has allowed the identification of potential new pollutant emission zones. They will be explored in more depth in 2021. AQMO offers an operational and extensible solution, ready to be deployed in other urban areas. Its design is extensible to allow more sensors and more processing tasks. It is a living use case of 'augmented transportation' in which vehicles provide not only a means of transport but also urban environmental data collection.

Read more: aqmo.irisa.fr
The data collected are documented and available at: data.irisa.fr
RUDI open data platform: rudi.datarennes.fr

The AQMO project received funding from the Connecting Europe Facility of the European Union under grant agreement n° INEA/CEF/ICT/A2017/1566962.



A view of a numerical simulation result with SIRANE (Urban Air Pollution Modelling Software)

For this edition's Career Talk, we caught up with John D. Davis, PhD, director of the Laboratory for Open Computer Architecture at Barcelona Supercomputing Center (BSC) and coordinator of the MareNostrum Experimental Exascale Platform (MEEP). John's career has taken him from Washington State to Catalonia, via multinational technology giants and small startups.

Career talk: John D. Davis

MEEP MareNostrum Experimental Exascale Platform

LOCA European Laboratory for Open Computer Architecture

How did you get into high-performance computing (HPC)?
I basically fell into HPC. After I completed my undergraduate degree at the University of Washington in Seattle, I wanted to be near my family. As a result, I ended up working at the University of Maryland, College Park, in the High-Performance Computing Systems lab, for two years.

It was a great experience that exposed me to HPC in the mid to late 1990s. At the time, I was interested in computer architecture, so the job offered me the opportunity to approach the work from the software perspective, running parallel codes on Cray, IBM, and SGI machines and/or combinations of many machines.

Afterwards, I attended Stanford, where I earned both my master's and PhD degrees with a focus on computer architecture. Then, I spent about seven years at Microsoft Research (MSR) in Silicon Valley, with research topics on everything from processor design to data-centre design, domain-specific accelerators, and emerging non-volatile memories. The data-centre design and domain-specific accelerators touched on a variety of HPC topics.

Subsequently, I left MSR to work for an enterprise storage company to build a large-scale distributed storage system. The goal was to get to petabytes per rack, ten times the density at the time, using all NAND flash memory. Once that product went to market, I went to another startup based on a research idea formed at MSR. The goal was to exploit the intermediate representation of data flow graphs to transparently target different types of accelerators. The technology used just-in-time compilation, runtimes, and advanced language features to retarget high-level, data-parallel codes to runtime-optimized code, graphics processing units (GPUs), or accelerators on field-programmable gate arrays (FPGAs).

The next stop was BSC and working on HPC research projects related to an open HPC ecosystem, continuing to embrace open-source software and extending it to open-source hardware, like RISC-V.

How does working in Europe for a publicly-funded research centre compare to working in the private sector in the United States? What made you decide to make the switch?
I worked in the public sector at the University of Maryland, which was the most similar experience I have compared to BSC. Sometimes in the public sector, some rules exist that one might not understand or might not be viable in practice. This could be complicated to change since many of these rules involve administration and funding. Some rules, if not carefully revised, could lead to inefficiencies and a waste of resources.

I also have worked for both large and small companies in the private sector. For instance, in large companies, you could also face a few restrictive policies and/or rules, but sometimes it might be possible to change them. Therefore, there are more systems available to work efficiently. There are rules in small startups, but usually they are required by the government and not imposed by the company. The goal of start-ups is to remove friction so you can get as much done as possible.

From a personal perspective, I wanted a change of pace and to expose my family to life in Europe. Coming from California, Spain made the most sense with the hope of acquiring some Spanish language skills. I was aware of BSC from my computer architecture background and reached out to see if there were some opportunities to work in synergy and become part of its future.

How did you get involved with the RISC-V HPC Special Interest Group (SIG), which you chair?

BSC has a history of identifying architectures that can be extended to HPC, like in the case of Arm. This time, we wanted to do the same thing for RISC-V.

At BSC, we are doing several projects based on RISC-V. This is an architecture and ecosystem that is starting in the microcontroller/embedded/internet of things (IoT) domain. Instruction set architecture (ISA) features and ecosystems are different in HPC vs. IoT, and there was no voice in the RISC-V ecosystem for HPC. Thus, we approached the RISC-V foundation to start the Special Interest Group: High-Performance Computing (SIG-HPC). I began by writing the group documentation and then formed the group to discuss the major items needed to support HPC in the RISC-V ecosystem.

What can you tell us about LOCA, the European Laboratory for Open Computer Architecture which is hosted at BSC?

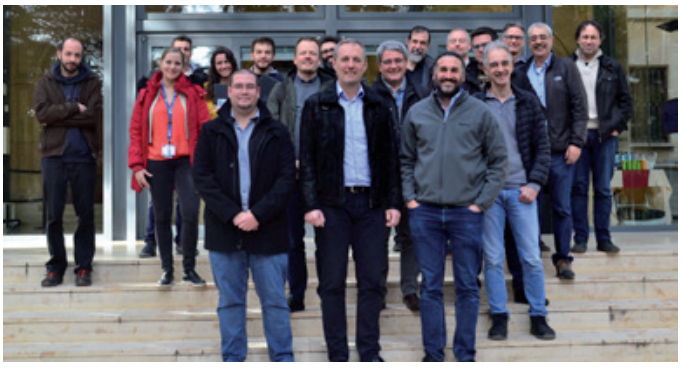
The European Laboratory of Open Computer Architecture is a result of the confluence of two different observations:

1) A gap analysis of skills and capabilities at the BSC and more broadly in Europe.

2) Defining a mechanism to enable chip research, development, and technology transfer with global partners.

BSC is a unique supercomputing centre with several application and software departments and a team dedicated to supercomputer operations. We were building software and doing simulations but missing the piece that builds hardware that targets HPC. Furthermore, across Europe, I could not point to academic or industrial partners that provided this hardware expertise to match the excellent European software ecosystem.

The second question was how to create something that could do this. We needed a mechanism and a research sandbox that combined academia and industry with the goal of building HPC systems and research vehicles using open-source technology that would be unencumbered by geopolitics. Thus, a lab centred around open source technology seemed like a good place to start. We could invite industry veterans to work with researchers and



John with the MEEP team

© Photo credit: BSC

students to build cutting-edge HPC co-designed hardware and software systems. LOCA takes a holistic few research projects to build a roadmap to European digital sovereignty based on the available research programs and industrial collaborations.

What would you say are your personal career highlights?

I have had the opportunity to work with some brilliant people and it is an extraordinary experience to see all the things that you can achieve together. I have built successful teams that have made successful products. I have conceived and written some very good research papers, and, in the past years, I have written several successful research proposals.

What are your plans for the next five to ten years?

- Build LOCA to enable HPC accelerators and central processing units (CPUs).
- See BSC technology in European HPC systems.
- Contribute to BSC's growth and development.
- Bring significant information technology (IT) opportunities back to Spain and Barcelona.

If you had a time machine, what advice would you give to yourself in the early days of your research career?

A few key things come to mind and have a common theme! I'd tell myself to:

- Build more.
- Be more proactive.
- Take more risks.
- Have more confidence.

FURTHER INFORMATION:

MareNostrum Experimental Exascale Platform (MEEP)

meep-project.eu

LOCA press release

bit.ly/BSC_LOCA_annoucement

The MEEP project has received funding from the European High-Performance Computing Joint Undertaking (JU) under grant agreement no. 946002. The JU receives support from the European Union's Horizon 2020 research and innovation programme and Spain, Croatia, Turkey.

HiPEAC jobs

With the pandemic meaning that the jobs market is more uncertain than ever before, but also having shown that technology is woven into the very fabric of our 21st century lives, computing systems specialists are in a unique position. The HiPEAC Jobs team poses the big question:

What are companies looking for in students?

The 2021 HiPEAC conference took place online but HiPEAC continued its efforts to provide a range of sessions to the participating students, with the usual science, technology, engineering and mathematics (STEM) student day activities spread throughout the conference.

The main goal was to help participants to develop their career perspectives by giving them access to information that will promote their professional growth. This was done through:

- a curriculum vitae (CV) and job interview workshop
- a free pass to the Industrial Session
- a 'job fair' exhibition, where students had the chance to network with multiple companies. HiPEAC Jobs also set up job interviews between companies and selected students
- a discussion session, which allowed specialists to give their opinions on trending topics in career development

"The main attributes that tech companies look for are teamwork, open-mindedness, willingness to learn, adaptability, curiosity and engagement, as well as motivation to contribute and make a difference"

Insights from industry

So what did we learn from the discussion session, which was focused around the key question of 'What are companies looking for in students'?

The session had guest speakers from a range of companies in different fields of computing:

- Katie Daines, Talent Acquisition at Arm
- Jonathan Durnford-Smith, Recruiting Manager at Deepmind
- Marina Bujosa and Vanessa Sanchez, Human Resources Department, Huawei Research Zürich
- Jennie Zhang, Co-Founder and Chief Operating Officer at MonetDB Solutions
- Phil Harris, Group Leader of Raytheon Technologies' Embedded Systems & Networking Research Center
- Vincent Hindriksen, Managing Director and Founder, Stream HPC

The first topic discussed was the **key differentiating factors that companies look for in student applications** to job vacancies. Most speakers agreed that getting any kind of work experience during university is a huge advantage. Highlighting personal projects or portfolio work on your CV is highly recommended. Indeed, by making use of platforms like GitHub, students can now easily share their work with recruiters. The main attributes that tech companies look for in new staff are teamwork, open-

mindedness, willingness to learn, adaptability to multiple scenarios and environments, curiosity and engagement, as well as the motivation to contribute and make a difference to the company.

On the other hand, on the topic of **'red flags' in applications and interviews**, some speakers highlighted that dishonesty and over inflation of a candidate's CV and past experience are easy to spot – if this happens the candidate will have no opportunity to continue the application process. Small details are also extremely important, like showing up late to the interview or having a track record of conflicts in previous employment or placements.

Integration in the company structure was a topic that split the speakers, as each company has their own integration strategy. Global companies like Huawei, with thousands of employees, have multiple integration programmes and activities for newcomers on how to deal with diversity at work. Being a Chinese company, they also want to share and promote the Chinese work philosophy with their employees. The speaker from Raytheon highlighted that a postdoctoral employee with prior work experience has different needs to a master's student, and because of that, they adapt their mentoring and integration processes to each individual.

DeepMind, a Google company, gives their new joiners the opportunity to adapt to the company culture and ways of working in the first few months. Arm makes use of activities outside of work, such as hackathons and talks, as well as Facebook and Slack channels to create a sense of community amongst their groups of trainees. StreamHPC's Vincent Hindriksen noted that only 5% of the applicants who reach the second stage of the recruitment process ask for details on the onboarding strategy within the company. This is a crucial piece of information that he considers really important for both parties, the applicant and recruiter, to discuss and understand if there is a possible fit.

Managing **expectations versus delivery in a professional environment** is particularly important for young applicants with no professional experience. There was an overall consensus that everyone, when faced with difficulties, should always be open to do two things: ask for help and network. In any company, big or small, most people have a positive mindset and are open to providing help and support to colleagues. There is a strong likelihood that someone in the company will have faced the same difficulties and will therefore know the answer to the problem, so it is completely acceptable to reach out and ask questions when difficulties arise.

As for the trending topics of **professional opportunities after COVID and remote working**, the speakers agreed that each person must define their own personal strategy and identify how they work best. Communication and team spirit are really important during these times; organizations should provide a forum for people to express themselves on how they're working and what they're finding most challenging, in order to adapt to their employees' needs. Most companies involved in technology made a smooth transition to working remotely because their workers don't need to be in the office and, although it's a personal decision, they concurred that remote working is here to stay and will be acknowledged by the industry in the future.

Takeaway messages

This session proved to be really valuable in understanding the thought process of people in industry who are responsible for recruiting young applicants. The key messages seem to be:

- Be proactive and honest.
- Find out about the company and its practices during the recruitment process and show motivation to contribute to its development and future projects.
- Share your work, ideas and questions.
- Don't be afraid to ask for help.

If you find this content interesting, make sure to follow HiPEAC on social media and participate in future events. Check out the HiPEAC Jobs career centre to keep up to date with all our activities.

hipeac.net/jobs/#/career-center
@hipeacjobs
hipeac.net/linkedin

Want to expand your horizons while gaining new skills? A HiPEAC internship is a great way to do so – check out the full list of opportunities on the HiPEAC Jobs portal: hipeac.net/internships
In this issue, Lahiru K Rasnayake explains how he's taken advantage of the programme to carry out two remote internships.

HiPEAC internships: your career starts here

NAME: Lahiru K Rasnayake
ROLE: PhD Student
UNIVERSITY: Norwegian University of Science and Technology (NTNU)
SUPERVISOR: Magnus Själander
RESEARCH AREA: Improving deep learning performance in field-programmable gate arrays (FPGAs) (particularly quantized neural networks)

Internship 1:
HOST ORGANIZATION: Dividiti dividiti.com
RESPONSIBILITIES: adding deep-learning models for benchmarking embedded systems (for MLPerf v0.7 submission) using the ck (collective knowledge) framework cknowledge.io

Internship 2:
HOST ORGANIZATION: IOBundle iobundle.com
RESPONSIBILITIES: working with IOB-SoC, a PicoRV-32 based SoC template github.com/IObundle/iob-soc

My supervisor first mentioned HiPEAC internships to me. With the COVID-19 situation, I understood that it was good to apply for a remote internship and hence applied to the opportunity available at dividiti. The vacancy advert mentioned MLPerf submissions and after having a look, I found out it was important to my research domain and hence jumped at the opportunity.

The eye-opening experience of this internship propelled me to try a second internship at IOBundle, which ended in February. This internship involved working with IOB-SoC, a PicoRV-32 based SoC template.

My main takeaway from these internships: if you are starting out as a PhD student and have little experience of working with industry, getting to know possible workflows and tools can be hard to do while studying. It's easier to see out of the 'PhD box' if you take an opportunity like an internship, which HiPEAC facilitates.

"Getting to know possible workflows and tools can be hard to do while studying. It´s easier to see out of the ´PhD box´ if you do an internship"

At **dividiti**, the task was to add several deep-learning models to the collective knowledge framework. I was involved in adding the Mobilenet V2, Mobilenet V3 and Efficientnet-Lite model which was tested on the Raspberry Pi 4, and Nvidia TX1.

At **IOBundle**, first I had to take some time to get familiar with the IOB-SoC template. This involved getting to play with verilog code and getting familiar with the RISC-V toolchain. I then added verilator support to this template.

Career benefits

The most important thing about these internships is that they helped me to see the areas I could significantly improve upon to be more effective in terms of technical productivity. In research, at least in my experience, there's little time available to devote to being technically productive as there is so much reading and other work to do. Internships provide a way to directly encounter these technical weaknesses so that they can be addressed.

Another key benefit is that it allowed me to see other ways of approaching my research domain rather than the techniques I have been currently using. Now I can see how to use different tools to approach my research question rather than the tools that I have been using and then I can see what tools enable what questions and how fast I can arrive at the answers to those questions. Also, having a diverse set of research tools useful for different sub-domains means that I can use them in an interconnected way to achieve different insights.

The other key benefit is getting to know the culture around communicating effectively. Much more than technical skills, this is very important especially in remote jobs. The different styles of communication tools (Slack, G-Suite tools, etc.) and what can be communicated through them affect when, what and how people communicate with each other. What's more, because of the increasing diversity of people involved, being very understanding and flexible in communication becomes very important.

As a final note, I would like to deeply thank my supervisor Magnus Själander at NTNU for pointing out the internship opportunities at HiPEAC. I also deeply thank Anton Lokhmotov, formerly at dividiti, now at KRAI (Cambridge, United Kingdom) and Jose T. de Sousa at IOBundle (Lisbon, Portugal) for hiring me as an intern for these amazing opportunities.

"The HiPEAC internship programme targets graduate students who are not formatted according to industry standards and can think freely about a problem"

Jose T. de Sousa, founder of IOBundle, added: "The HIPEAC internship programme is an excellent way to meet potential future employees and explore new directions for your company by doing things that you normally do not have time to do. Moreover, it targets graduate students who are not formatted according to industry standards and can think freely about a problem.

"This was the case of Lahiru's internship. After a preparation period in which he got used to our technology, we asked him to integrate Verilator, a well-known open-source Verilog simulator, into our development flow. While doing this, he discovered some exciting new tools that allow chip verification using a Python framework, namely the CocoTB framework, now being disseminated through FOSSI. This proved to be an exquisite solution, and we will surely pursue this line of work."

Lahiru's internships took place at dividiti, based in Cambridge, and IOBundle, based in Lisbon © *Konstanttin on Dreamstime.com & Steffen Zimmermann from Pixabay*

HiPEAC collaboration grants are available to PhD students and junior postdoctoral researchers, and support a three-month collaborative visit within the HiPEAC network. Stefano Corda is a PhD candidate in the Electronic Systems group at the Department of Electrical Engineering of Eindhoven University of Technology. In this article, he tells us about his motivation for taking part in the scheme.

Stargazing made simpler, thanks to transprecision computing

NAME: Stefano Corda
ROLE: PhD Student
UNIVERSITY: Eindhoven University of Technology
SUPERVISORS: Professor Henk Corporaal and Dr. Roel Jordans
RESEARCH AREA: HPC application profiling, development of run-time management systems for NMC and re-configurable architectures
HOST INSTITUTION: Center for Advancing Electronics Dresden, Dresden Technical University
COLLABORATION DATES: 31.01.2021 - 30.04.2021

A collaboration is an excellent opportunity to carry out research in a new environment that may help generate new ideas as well as expand professional networks. I chose to apply for the HiPEAC collaboration grant to work with a group I know from a previous project (H2020 NeMeCo) and which has expertise in areas that can help me to improve my PhD research.

I collaborated with Professor Akash Kumar, Chair of Processor Design at the Center for Advancing Electronics Dresden (cfaed) at Dresden Technical University in Germany. I investigated transprecision and approximate computing on reconfigurable architectures for radio-astronomical imaging.

Modern radio telescopes like the Square Kilometer Array (SKA) will need to process in real time exabytes of radio-astronomical signals to construct a high-resolution map of the sky. Radio astronomy image processing consists of a set of algorithms, which run iteratively and have different compute requirements at each iteration. Adaptive approximate computing tries to adapt the data or operation precision at runtime based on the changing application requirements, reducing execution time and power consumption. Furthermore, near-memory computing, a new computation paradigm that tries to compute the data where they reside, is promising in terms of improving big-data application performance.

During my collaboration, I looked at how radio-astronomical imaging algorithms may benefit from reduced precision and approximate computing on a re-configurable architecture. I worked on field-programmable gate array (FPGA) design on one of the latest Xilinx FPGAs, the Alveo U50, which has high-bandwidth memory (HBM), and can be employed for exploring near-memory computing optimizations. The project applied the concepts of adaptive approximate computing and near-memory computing to impact the performance of radio-astronomy image processing profoundly.

For me, the main benefits of a collaboration come from working with a different research group. The team in Dresden has extensive experience in reconfigurable architectures, approximate computing and runtime. An essential aspect of the collaboration is the two-way exchange of expertise and knowledge. Indeed, a new environment helps stimulate new ideas and collaborations.

A collaboration with another research group gives me something extra on my CV: it is an additional experience, and it shows my ability to work in a different environment. Furthermore, the experience and knowledge I am acquiring during this project will enrich my skill set for my PhD and future career. I would like to thank Professor Kumar and the team at cfaed for this fantastic experience.

Xilinx Alveo U50, kindly provided by the Xilinx XUP Donation Program

HiPEAC

Photo credit: Amine Naji

ACACES 2021

Fiuggi, 12-18 September 2021

Seventeenth international summer school on Advanced Computer Architecture and Compilation for High-Performance and Embedded Systems

Featuring: TETRAMAX innovation track • RISC-V: from open ISA to open architecture to open hardware • Real-time systems theory and practice • Whole systems energy • Challenges and opportunities in an era of smart CPS • How to finance your innovation • ...and much more!

acaces.hipeac.net/2021