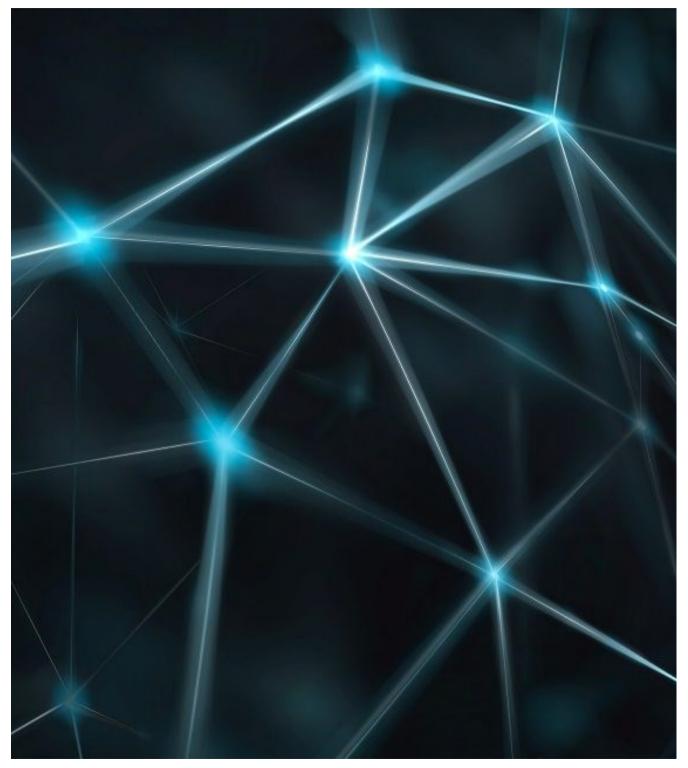


NEWSLETTER

Issue 3 | June 2023











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S EDITORIAL

Dear readers,

Launched in April 2021, this 3-year energy efficiency of sparse computa-2019 call of Extreme Scale Computing and deep learning. and Data Driven Technologies for research and innovation actions.

providing efficient algorithms and platforms. coeherent tools specifically designed for maximizing the performance and

project is funded by the European tions on emerging HPC systems, while High Performance Computing Joint also opening up new usage areas for Undertaking (EuroHPC JU) under the sparse computations in data analytics

SparCity delivers a coherent collection of innovative algorithms and tools for The SparCity project aims at creating a enabling both high efficiency of sparse supercomputing framework that is computations on emerging hardware

> The SparCity Coordination, Didem Unat



In-person Meeting | September 1-3, 2022 (Istanbul, Turkey)

..... PAST EVENTS

SIAG Supercomputing Spotlights Webinar | February 15, 2023

entitled "Supercomputing Software for Moore and Beyond" at Supercomputing Spotlights, a new webinar series. This is an outreach initiative of SIAG/Supercomputing.



SIAM Meeting | February 27, 2023

Dr Johannes Langguth from Simula Research Laboratory had a lecture: "ML Accelerator Hardware: A New Model For Parallel Sparse Computations?" at the SIAM Meeting, Amsterdam, The Netherlands. You can find the abstract here.

EuroHPC Summit | March 20-23, 2023



The SparCity project was represent at the EuroHPC Summit in Gothenburg, Sweden. In this Summit members from all areas of the European HPC community, from researchers to

industry to decision makers, congre- ISC 2023 | May 21-25, 2023 gated to share in discussions about Prof. Didem Unat, Dr Are Magnus oral communication and a poster gy providers and users. session.

SAB Member visit at Koc University | May, 2023

Prof. Paul Kelly from Imperial College London and one of the SparCity Scientific Advisory Board members visited Koç University for a couple of days. Prof. Didem Unat's team had the chance to present our project, among others, and discuss several ideas and ongoing steps.



HPC student Club at Istanbul Technical University | May 4, 2023 Prof. Didem Unat gave a Seminar about SparCity and other projects at the HPC student Club at Istanbul Technical University. This initiative included 20 students.

Student club at Middle east technical University | May 5, 2023

Prof. Didem Unat gave a similar seminar about SparCity and other projects at the Student club at Middle east technical University. This initiative included 30 students.

Prof. Didem Unat gave a webinar the state of play of European HPC, its Bruaset and Dr Sara Tanqueiro were achievements and European priori- present at the ISC High Performance ties going forwards. Dr Johannes 2023. This international conference Langguth from Simula Research La- and exhibition fosters the growth of boratory presented the project in an a global HPC community of technolo-

> Prof. Didem presented the SparCity project at the EuroHPC Booth (see more in the "Communication, Dissemination & Outreach" section.



RISC-V HPC23 Workshop | Mav 25, 2023

Alexandre Rodrigues from INESC-ID participated in the first international workshop on RISC-V for HPC. The goal of this workshop is to continue building the community of RISC-V in HPC, sharing the benefits of this technology with domain scientists, tool developers, and supercomputer operators.

COMMUNICATION, DISSEMINATION & OUTREACH

SparCity Video

April. 2023

We released the SparCity promotional video, which presents the our project in a nutshell. Watch now to learn how we're revolutionizing HPC in Europe!



#MeetTheTeam and #CodeVideos Series

We published on YouTube, project website and social media new #MeetTheTeam videos with Eren Yenigül and Tuğba Torun from Sabanci University.

We also released new #CodeVideos about SparseBase, Cardiac Simulations, Epistasis and Yloc.

New videos will be released every month where you can learn more about a different team member and the work developed within SparCity.

#MeetTheTeam videos #CodeVideos

PUBLICATIONS

and Contention-Constrained Point-to Computational Physics. -Point MPI Communication. IEEE DOI: 10.3389/fphy.2023.979699 Transactions on Parallel and Distributed Systems.

DOI: 10.1109/TPDS.2023.3253881

Mesh Computation on Massively DOI: 10.1002/cpe.7707

ISC 2023

May 22-24, 2023

Our project was present at the EuroHPC-JU Booth at ISC 2023 in Hamburg. Prof. Didem Unat and Dr Sara Tanqueiro had the opportunity to share our project with the scientific academia and industry. Thanks to EuroHPC-JU for organising the participation of all projects in this conference.

SEA



Muhammad Aditya Sasongko, Milind Chabbi, Paul H. J. Kelly and Didem Unat (2023). Precise event sam-♦Luk Burchard, Kristian Gregorius pling-based data locality tools for Hustad, Johannes Langguth and Xing AMD multicore architectures. Con-Cai (2023). Enabling Unstructured- currency Computat Pract Exper.

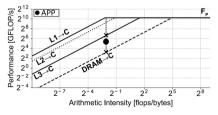
♦Andreas Thune, Sven-Arne Reine- Tiled AI-Processors: An Example of ♦Sergej Breiter, Josef Weidendorfer, mo, Tor Skeie and Xing Cai (2023). Accelerating In-Silico Cardiac Simula- Minh Thanh Chung and Karl Fürlinger Detailed Modeling of Heterogeneous tion. Front. Phys. Sec. Statistical and (2023). A Profiling-Based Approach to Cache Partitioning of Program Data. Parallel and Distributed Computing, Applications and Technologies. PDCAT 2022. Lecture Notes in Computer Science, vol 13798. Springer, Cham.

DOI: 10.1007/978-3-031-29927-8 35

RESOURCES

Roofline Models

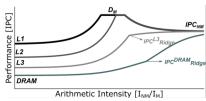
Roofline models are tools for assessing the maximum efficiency of general-purpose and domain-specific architectures, such as multi-core, many -core, and accelerator processor designs. Such models combine information about the maximum compute performance and peak memory bandwidth of the architecture with the arithmetic intensity represented as the ratio of the number of floatingpoint operations performed relative to the number of bytes of transferred across different levels of the memory hierarchy. By depicting these relationships in an intuitive plot, one can easily judge whether a specific kernel is bounded by the available memory bandwidth or compute performance, and which optimisations to apply in order to fully exploit the architecture capabilities. To aid in this process, the Cache-aware Roofline Model^[1] includes several compute and memory ceilings, typically representing the maximum perfor-mance achievable with different parallelisation and SIMD vectorization strategies, as well as strategies for efficient memory transfers and data reuse for different levels of the memory hierarchy.



While roofline models have been around for more than a decade, they have until now had an unleashed potential for accurate estimation of

the achievable performance of spar- Moving into the field of domainse kernels. Such sparse kernels are specific processors designed bottomalgorithmic com-ponents that expli- up for AI workloads, the Graphcore citly take advantage of the sparse IPU Roofline Model addresses all nature of the underlying data and main IPU architecture characteristics thereby optimize the kernel's meand computational mory usage burden by clever implementations.

In SparCity, specially crafted microbenchmarks and advanced tools for ComDetective system monitoring are tightly coupled in order to extract the characteristics of a targeted computer system running sparse computations. This allows the construction of realistic upper bounds for the memory bandwidth and compute performance for such workloads. These bounds can differ substantially from the theoretic upper bounds found in the system manuals and factsheets, which are usually derived under idealised assumptions. This has led to the introduction of the Sparse Cache-Aware Roofline Model, which explicitly adapts the upper bounds to sparse kernels and takes into account kernel-specific reuse of data across different levels of the memory hierarchy. SparCity has also proposed the Mansard Roofline Model^[2], which uncovers a minimum set of architectural features that must be considered to provide insightful, but yet accurate and realistic, modeling of performance upper bounds for modern processors.



and execution phases in order to accurately estimate the performance, power consumption and energy efficiency for intile computations.

ComDetective is a communication matrix generation tool that leverages hardware features in commodity CPUs to detect inter-thread data movement, while avoiding the drawbacks of prior work by being more accurate and introducing low overheads. time and space https://github.com/ParCoreLab/ParCoreTools

Reusetracker

ReuseTracker is a tool measuring the reuse distance – a widely used metric for data locality - in parallel sharedmemory applications by taking into account the cache coherence. It can help programmers optimize their code by mapping the detected reuses to their locations in source code and improving the data locality of their applications.

https://github.com/ParCoreLab/ParCoreTools



References: [1] A. Ilic, F. Pratas, and L. Sousa, "Cache-aware roofline model: Upgrading the loft." IEEE Computer Architecture Letters 13.1 (2014): 21-24. [2] D. Margues, A. Ilic, and L. Sousa. "Mansard roofline model: Reinforcing the accuracy of the roofs." ACM Transactions on Modeling and Performance Evaluation of Computing Systems 6.2 (2021): 1-23.



 EuroHPC Collaboration Meeting, Turin June 6-7, 2023

 SparCity In-person Meeting, Lisbon, Portugal June 15-16, 2023

WEBSITE



REPOSITORY

Control SparCity project			
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ular repositories			
sansebase sense data processing library with a generic, HPC-centric o FC++ ☆ 13 ♀ 1	(Nable) Inign	sparcitywu	Public
atasets	Public	Common-Test-Environment	Public
stasets		Common Test Environment definition including har algorithms	dware, datasets and
		Shell	

https://github.com/sparcityeu

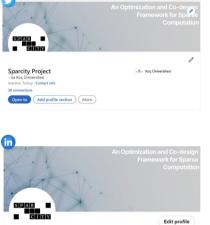
MORE INFORMATION

https://sparcity.eu sparcity-project-group@ku.edu.tr

European High-Performance Computing Joint Undertaking under grant agreement No 956213.

 First Workshop on Tools for Data Locality, Power and Performance (TDLPP 2023) EuroPar 23, Limassol, Cyprus August 28 - 29, 2023 Know more here

SOCIAL MEDIA



SparCity Project

SparCity: An Optimization and Co-design Framework for Sparse Computation, an 111 project

◎ Istanbul, Turkey & sparcity.eu III Joined April 2021 22 Following 84 Follower

Future is Sparse: Methods and **Tools for Sparse Computations** SC 2023, Denver, Colorado November 12 - 17, 2023 Know more here

PROMOTIONAL MATERIALS

SparCity released new promotional material

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Objectives Objec	# Future is Sparse	outcomes of t	his project are a	series of open-source
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This project has received funding from the Koc University and Sabanci University are su- Simula and Graphcore are supported by the pported by the Turkish Science and Technology Research Centre Grant No 120N003 and 220N254, respectively.

Research Council of Norway. Ludwig-Maximilians-Universität München (LMU) is supported by the German national Funding agency (BMBF). INESC-ID is supported by Fundação para a Ciência e a Tecnologia (FCT).