

**CONTACT
INFORMATION**

Centre for Informatics and Computing
Ruder Bošković Institute
Bijenička cesta 54
10 000 Zagreb, Croatia

Mobile: +385 98 9611 483
Office: +385 1 456 1091
E-mail: ddauid@irb.hr

**RESEARCH
INTERESTS**Parallel computing

- High-performance computing, parallel and distributed computing
- Scalability and performance portability
- Block-oriented algorithms and out-of-core programming
- Hybrid computing based on accelerators (GPUs)
- Algorithm optimisation

Applied mathematics

- Dense and sparse linear algebra, eigensolvers
- Macromolecular motion simulations
- Electron structure calculation

**WORK
EXPERIENCE**Head of Centre, Ruder Bošković Institute (01/2024 – present)

- Led the Centre for Informatics and Computing, overseeing a diverse group of 10 professionals, including PhD students, postdocs, technical associates, and research advisors. Responsibilities included defining the research directions, managing staff, mentoring junior researchers, coordinating with the General Director of the Institute and other divisions heads, ensuring the smooth execution of active research projects, and managing the overall functioning of the Centre.
- Continued involvement in ongoing research projects, including the development of the ChASE eigenvalue library, CholeskyQR-based QR factorization, and analysis of large-scale eigensolvers on Fugaku and Wisteria supercomputers.
- Played a key role in the preparation of the national project proposal "National Centre of Competence for Data Science and Cooperative Systems - Phase 2", serving as a coordinator for the research activity "Distributed and parallel computing".
- Lead researcher for the Institute's participation in the LimitX project, an Open call project of the Horizon Europe project Inno4Scale. Currently engaged in analysing properties of matrices generated by the DFT codes, developing an AI-based predictor of matrix spectral properties and prototyping a recommender system for selecting optimal preconditioner and solver for specific DFT problems (future research).

Senior Research Associate, Ruder Bošković Institute (02/2023 – 12/2024)

- Engaged in the preparation of project proposals submitted to Horizon Europe, Digital Europe and national programme calls.
- Mentoring a PhD student and supervising a postdoctoral researcher within the National Science Foundation project "HybridScale".
- Led the design and implementation of a novel **QR factorization algorithm** specifically tailored for extremely ill-condition tall-and-skinny matrices on distributed multi-GPU systems. Achieved significantly improved performance, scalability and numerical stability compared to state-of-the-art solutions. Speedup compared to ScaLAPACK - 6x CPU-only, 80x CUDA-GPU. The development is based on NVIDIA's NCCL communication library and math libraries CuBLAS and CuSolver.

- Collaborated with the Juelich Supercomputing Centre, Universities of Tokyo and Kobe, and Riken Research Center to develop and extend the ChASE library, conducting comprehensive performance analysis on ARM-based computer systems Wisteria and Fugaku. This collaboration provided me with valuable hands-on experience with massively parallel ARM-based systems.

External Associate, Amphinity Technologies Ltd. (11/2018 - 10/2022)

- Served as an external advisor, contributing expertise to the design of workflow for digital signal processing software. Focused on leveraging Nvidia technologies to achieve signal processing speed of up to 1Gb/s across various signal modulations.
- Developed and implemented a suite of CUDA kernels (in C++) for critical signal processing algorithms, including Automatic Gain Control (AGC), timing offset estimation using Gardner, the Mueller & Müller timing synchronization algorithm and LDPC (Low-Density Parity-Check) decoder. These CUDA-based implementations demonstrated significant performance improvements, particularly when processing streaming input signals on GPUs, simulating real-world scenarios.
- Organized and conducted several short training sessions for the company employees, covering the CUDA programming model and performance analysis tools such as Nsight Compute and Nsight Systems.

Research Associate, Ruđer Bošković Institute (10/2017 – 02/2023)

- Applied and integrated HPC tools and linear algebra algorithms into computational chemistry, theoretical physics and material science software.
- Worked as a coordinator and principal investigator on the Croatian Science Foundation installation project "HybridScale" (01/2021 - 01/2026). The primary research focus involves designing and developing scalable numerical linear algebra algorithms, particularly eigensolvers and matrix factorizations with their applications in Natural Science codes (theoretical physics, material science) customized for large-scale heterogeneous computing systems.
- Led the development of an efficient algorithm for computing CIS-type wavefunction overlaps, focusing on implementing a structure-aware updated LU factorization and re-designing the algorithm in terms of BLAS-3 math operations. Achieved 10x speedup compared to the original multithreaded version.
- Led the distributed multi-GPU parallelisation of the Python-based entanglement cooling algorithm for simulating the quantum entanglement. Emphasized efficient utilisation of multiple GPUs through a large number of small GEMM operations, leveraging Nvidia MPS, MPI and cuPy. Achieved a notable speedup of up to 35x compared to the parallel CPU-only version while enabling simulation of much larger spin systems (up to 2^{21} states).
- Contributed in the development of the ChASE (Chebyshev accelerated Subspace eigensolver for dense eigenproblems) library, focusing on advanced parallel GPU implementation and optimization for distributed multi-GPU systems. Achieved the scalability of the code to up to 1000 nodes (4000 A100 GPUs).
- Participated in the preparation and execution of 9 research projects funded by Horizon2020, national and international funding programs, contributing expertise to advance scientific research and transfer knowledge and innovations to SMEs.

Senior Research Assistant (postdoc), Ruđer Bošković Institute (11/2014 – 10/2017)

- Contributed to the integration and porting of legacy code (FLEUR) onto heterogeneous CPU-GPU and multi-GPU platforms, resulting in up to 12x speedup compared to the original code. Focused on optimising numerical libraries for matrix multiplication and factorisation, crucial for generating Hamiltonian and Overlap matrices, for multi-GPU shared-memory systems.

- Participated in the simulation of complex macromolecular simulations on hybrid CPU-GPU systems, achieving between 2 - 5× speedup. Focused on development of out-of-core eigensolvers for multi-GPU platforms.
- A member of research group investigating the application of Nvidia dynamic parallelism to reduce execution time and energy consumption of the Conjugate Gradient method for the iterative solution of sparse linear systems.
- Engaged as a researcher on four EU FP7/H2020 projects (SCI-BUS, EGI-Engage, INDIGO-DataCloud, SESAME-Net) with a primary focus on developing cloud-based solutions for digital humanities.

Research Assistant, Ruđer Bošković Institute (05/2009 – 10/2014)

- Development of high-performance eigensolvers tailored for solving dense generalized eigenproblems on multithreaded and hybrid GPU architectures. Utilised Krylov subspace methods and multistage reduction to tridiagonal form.
- Designed and implemented out-of-core techniques and algorithms for GPUs to enhance memory management and enabling efficient processing of large matrices.
- Researcher on EU FP7 projects SEEGRID-SCI and EGEE-III, focusing on code development and the adaptation of the meteorological prognostic model WRF-ARW for cluster and grid computing systems.
- Led the design and implementation of local search operators for solving the Travelling Salesman Problem on Nvidia GPUs using CUDA. Developed a novel parallel iterated local search approach with 2-opt and 3-opt operators, resulting in 20x speedup (collaboration with Faculty of Transport and Traffic Sciences, University of Zagreb).

Technical Associate, Ruđer Bošković Institute (05/2008 - 04/2009)

- Communication and coordination of task distribution with other project partners from Croatia (two faculties) on the two EU FP7 projects: EGEE-III and SEEGRID-SCI.
- Deployed the WRF-ARW meteorological prognostic model on the SEE-GRID and EGEE grid infrastructures, analyzed the performance, and optimized the execution.
- Developed bashed scripts for easy submission, jobs monitoring and data management on the Grid-based distributed environment for less experienced end-users.

EDUCATION

Ph.D in Computer Science, 09/2008 - 10/2014

University of Zagreb, Faculty of Electrical Engineering and Computing, Croatia

- PhD thesis title: *Solving large dense symmetric eigenproblem on hybrid architectures*
- Supervisors: Associate Professor Domagoj Jakobović, PhD and Professor Karolj Skala, PhD.D.

M.Sc. in Mathematics, 09/2003 - 04/2008

University of Zagreb, Faculty of Science, Dept. of Mathematics, Croatia

- Master thesis title: *Acceleration of the one-sided Jacobi algorithm for finding matrix eigenvalues using sorting algorithms*
- Supervisor: Professor Sanja Singer, PhD

RESEARCH PROJECTS

Ruđer Bošković Institute, Zagreb Croatia

- **National Competence Centres in the framework of EuroHPC phase 3 (EU-ROCC3)**, Digital Europe, European Commission, (04/2026 – today)
- **National Competence Centres in the framework of EuroHPC phase 2 (EU-ROCC2)**, Digital Europe, European Commission, (01/2023 - 12/2025)

- **Scalable high-performance algorithms for future heterogeneous distributed computer systems (HybridScale)**, Croatian Science Foundation, Installation grants 01/2021 - 01/2026 Coordinator and principal investigator. Design, development, optimization, fine-tuning and performance analysis of linear algebra algorithms on distributed heterogeneous computing systems (HPC, supercomputers). Applications of novel HPC linear algebra kernels in physics, computational chemistry and biomedicine scientific software.
- **Trusted and reliable content on future blockchains (TruBlo)**, H2020 Framework Programme, European Commission, (06/2022 - 02/2023) Participate in the experiment "Democratising Academic Publishing" (DAP). Participate in the design and elaboration of the new publishing platform based on the Blockchain technology and HashNet consensus algorithm.
- **National Competence Centres in the framework of EuroHPC (EUROCC)**, H2020 Framework Programme, European Commission, (09/2020 - 12/2022) Consultancy and support for small and medium enterprises and academia, build national competence centre for HPC, AI and big data. Participating in technology transfer and organising training events in the domain of HPC computing.
- **Computational models of flow, flooding and pollution dispersion in rivers and coastal waters (KLIMOD)**, European Regional Development Fund, European Commission, (03/2020 - 03/2023) Machine learning prediction of coastal water quality using feature interpretation and spatio-temporal analysis.
- **National Initiatives for Open Science in Europe (NI4OS)**, H2020 Framework Programme, European Commission, (09/2019 - 02/2023) Integration and adoption of two RBI's thematic services (Revigo and PorTraits) in the EOSC. Publication of the services in the EOSC Marketplace.
- **Optimisation of Materials Science algorithms on hybrid HPC platforms (HoMSa)**, CRO-GER bilateral project between Juelich Supercomputing centre (JSC) and Ruder Bošković Institute, funded by the Ministry of Science, Education and Sports of the Republic of Croatia (01/2019 - 12/2021) Project leader. Development of scalable eigenvalue solver based on Chebyshev polynomial filter (ChASE library). Improving performance scalability on large-scale distributed GPU-based systems. Code testing and performance analysis (weak and strong scalability) on the Juelich supercomputers NVIDIA partitions of Jureca and Jewels Booster.
- **Integrating and managing services for the European Open Science Cloud (EOSC-Hub)**, H2020 Framework Programme, European Commission (01/2018 - 03/2021) Maintaining and disseminating cloud-based thematic services with applications in the digital arts and humanities research community.
- **Advanced Methods and Technologies in Data Science and Cooperative Systems (DATACROSS)**, Operational Programme Competitiveness and Cohesion 2014-2020 (11/2017 - 12/2023) Participating in the research topic RA3 on the development of new heterogeneous computer systems and platforms designed for efficient analysis of large data sets.
- **Light on Molecules: Exploration of Coupled Electron and Nuclear Dynamics**, Croatian Science Foundation (03/2017 - 03/2021) Optimisation and acceleration of nonadiabatic molecular simulations on hybrid GPU-based systems. Participated in the implementation of a novel algorithm based on updated LU factorisation and re-design of the existing algorithm for computing CIS-type wavefunction in terms on BLAS-3 math operations. The novel optimised algorithm achieved 10x speedup compared to the original version.
- **High-performance tensor contractions on hybrid computing architectures**, CRO-GER bilateral project between RWTH Aachen, Ruder Bošković Institute and Faculty of Mechanical Engineering and Naval Architecture The University of Zagreb, funded by the Ministry of Science, Education and Sports of the Republic of Croatia (01/2016 - 12/2017)

- **INDIGO-DataCloud – INtegrating Distributed data Infrastructures for Global ExpLOitation**, H2020 Framework Programme, European Commission, 04/2015 - 09/2017
- **SESAME-NET – Supercomputing Expertise for SmAll and Medium Enterprise Network**, H2020 Framework Programme, European Commission, 06/2015 - 05/2017
- **EGI-Engage – Engaging the EGI Community towards an Open Science Commons**, H2020 Framework Programme, European Commission, 03/2015 - 08/2017
COST Programme, European Commission, 03/2014 - 03/2018
- **SEE-GRID eInfrastructure for regional Science (SEEGRD-SCI)**, 7th Framework Programme (FP7), European Commission (05/2008 - 04/2010)
- **Enabling Grids for eScience (EGEE-III)**, 7th Framework Programme (FP7), European Commission (05/2008 - 04/2010)

- AWARDS**
- 2015 Best paper award, event *38th International Convention on Information and Communication Technology, Electronics and Microelectronics*, Opatija, Croatia. Paper title: “*Cloudflow - A Framework for MapReduce Pipeline Development in Biomedical Research*”. Authors: Lukas Forer, Enis Afgan, Hansi Weißensteiner, **Davor Davidović**, Günter Specht, Florian Kronenberg, Sebastian Schönherr.
- 2014 Silver Plaque “Josip Lončar” for the PhD thesis “*Solving large dense symmetric eigenproblem on hybrid architectures.*”, an annual award by the Faculty of Electrical Engineering and Computing, The University of Zagreb, to doctoral students in recognition of outstanding doctoral dissertations.

- TECHNICAL SKILLS**
- **Operating systems:** Unix/Linux, Windows
 - **Development environments:** Eclipse, Netbeans, PyCharm, Nsight
 - **Programming Languages:** C/C++, Python, Java, Fortran
 - **Mathematical and statistical computing:** Matlab, Mathematica, Octave, Numpy
 - **Computational libraries:** CUBLAS, CUBLASxt, MAGMA, LAPACK, BLAS, ScaLAPACK, MKL
 - **Parallelization models:** MPI, OpenMP, CUDA, HIP
 - **Virtualization technologies:** Docker, Amazon AWS, VMware, VirtualBox
 - **Others:** Queuing systems and workload managers (SGE, SLURM, PBS), library managers (module, Spack)

ORGANIZATIONAL SKILLS Perennial teamwork experience acquired by working in an international team within EU projects
Project leadership experience gained during the EGI-Engage project (task leader) and as a project coordinator on two bilateral Croatian-German research projects and 5-year installation research project HybridScale funded by the Croatian Science Foundation (HRZZ).

SOCIAL SKILLS Communicative, Easily approachable

HOBBIES Mounting hiking, Travelling

LIST OF PUBLICATIONS Croatian Scientific Bibliography:
<https://www.bib.irb.hr/pregled/znanstvenici/315432>