

Mikhail Kurnosov

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Location Novosibirsk, Russia

Positions and Experience

Siberian State University of Telecommunications and Information Sciences

Computer Systems Department, Novosibirsk, Russia

- 📅 2023 – present Chairman of the Dissertation Council
- 📅 2012 – present Director of Parallel Computing Technologies Center
- 📅 2005 – present Professor

- Research on RISC-V based VLIW DSP ISA (Yadro, R&D cooperation) 2024-2025
- Performance Analysis of HPC Applications in Presence of Network Congestion 2021-2023
 - Development of software tools for analyzing MPI communication patterns and MPI traffic characteristics of open-source HPC applications, mini-apps and benchmarks in presence of network congestion: LAMMPS, NAS Parallel Benchmarks, Mantevo mini-apps, HPCG (C99, x86-64, ARMv8)
 - Profiling tools for MPI 3.1 applications (C/C++, Fortran), message size statistic, communication matrices for P2P and RMA operations (C99, Python, gnuplot, graphviz)
 - Traffic generation software for congesting multi-stage InfiniBand networks (C99, MPI, incast P2P/RDMA, all-to-all)
 - Congestion monitoring tools for InfiniBand multi-switch network (Python, iverbs, InfiniBand PerfCounters)
- Shared Memory Based Collective Communication Algorithms 2020-2024
Development of shared memory based algorithms for MPI collective communication operations: broadcast, allreduce/reduce, barrier: copy-in-copy-out, ZeroCopy using Linux CMA and kernel-assisted XPMEM/KNEM (Open MPI, C99, HWLOC, PMIx, GNU/Linux, x86-64)
- Collective Operations for Clusters with Multi-stage Networks (Huawei cooperation) 2022-2024
Development of topology-aware collective communication algorithms for multi-level network topologies (fat tree, spine-leaf, kD torus topologies) and memory hierarchies: L2/L3 caches, sockets/packages, NUMA nodes (Open MPI, C99, HWLOC, PMIx, GNU/Linux, ARMv8)
- Topology-aware Collective Operations MPI 3.1 (Huawei cooperation) 2021-2022
Component with collective algorithms for Open MPI library. Key features: dynamic construction of collective schedules for nonblocking operations MPI 3.1 (directed acyclic graphs), asynchronous execution of send/recv/reduce operations on data readiness (C99, InfiniBand/RoCE, x86-64, ARMv8)
- Hierarchical Algorithms for MPI Collective Operations (Huawei cooperation) 2018-2021
OpenMPI-based library of MPI blocking collective operations. Two-level topology: intra-node shared memory and inter-node communication network (C99, HWLOC, PMIx, InfiniBand, GNU/Linux, x86-64, ARM)
- The Open MPI Project (<https://github.com/open-mpi/ompi>) 2016-2018

Contribution to open source high performance message passing library — implementation of MPI collective communication algorithms: blocking, non-blocking operations (C99, GNU/Linux)

- Performance Analysis and Optimization 2008-2017
 - Experimental analysis of autovectorizers of C/C++ compilers on x86-64 and Xeon Phi (Intel C/C++, GCC C/C++, LLVM/Clang, PGI C/C++, modified Extended Test Suite for Vectorizing Compilers, Intel RAPL)
 - MPIPerf project (<https://github.com/mkurnosov/mpiperf>) — benchmark for MPI 3.0 collective and point-to-point communication routines (C99, GNU/Linux)
 - MPI Process Placement Tool (TopoMPI): optimizes the placement of MPI processes across cluster processor cores in order to localize communications through node's system memory (graph partitioning, communication profiling, C99, MPI Profiling Interface)
- Design and Administration of HPC Clusters 2005-2010

NIS/LDAP, NFS, SLURM/TORQUE, InfiniBand, custom GNU/Linux distro for diskless boot
- Courses 2006-present

Parallel programming (MPI, OpenMP, SIMD), Software performance optimization courses (branch-less code, ILP, caches, TLB, huge-pages, NUMA balancing and memory policy, code vectorization: AVX2/AVX512), compilers, distributed computing (MapReduce), data structures and algorithms

Supervising: bachelors, masters and PhD students (three candidate of science, PhD)

Huawei

Kunpeng Math Library, Novosibirsk, Russia

🏠 2023 — 2024 (part-time) Expert

Optimization of scalable solvers for sparse linear systems (MPI, OpenMP, SIMD, ARM64; C++)

Performance analysis and optimization of HPC and AI applications (OpenFOAM, Tensorflow DLRM)

Rzhanov Institute of Semiconductor Physics Siberian Branch of Russian Academy of Sciences

Computer Systems Laboratory, Novosibirsk, Russia

🏠 2006 – present (part-time) Senior Research Scientist

Design and Optimization of Parallel Programs (C, MPI, OpenMP, CUDA, SIMD-vectorization):
molecular dynamics

Yandex, School of Data Analysis

Novosibirsk, Russia

🏠 2014 – 2016 Lecturer

Parallel and Distributed Computing Course (C++11 threads, OpenMP, MPI, MapReduce, Hadoop, distributed algorithms)

Intel, Threading Tools

Nizhny Novgorod, Russia

🏠 2006 Software Engineer (Intern)

Porting GNU/Linux version of Intel Thread Profiler runtime library to the Intel Pin – dynamic binary instrumentation tool (C/C++, Pin probes, POSIX threads, GNU/Linux)

Republican Center of Children's Creativity

Gorno-Altaysk, Russia

🏠 1998 – 2005 Software Engineer

▪ Educational Programming Language Rapira++ (<https://github.com/mkurnosov/rapiraxx>)

Development of interpreter for educational programming language Rapira++ with: modifiable

syntax (Russian and Altay keywords), basic OOP constructions, IDE with visual programming tools (Delphi, Windows)

- Client-Server Software for Monitoring and Remote Control of Application on Windows-based Workstations (C, DLL injection, Win32 API, network sockets, MySQL)
- Teaching (high school students): RapiRA++, Visual Basic, Delphi, JavaScript; D-Link network technologies (TCP/IP, Ethernet switches: VLANs, Spanning Tree, QoS; WiFi protocols)

Education

- 2016 **Doctor of Science**, Siberian State University of Telecommunications and Information Sciences, Novosibirsk, Russia
- 2005 – 2008 **Candidate of Science (PhD)**, Siberian State University of Telecommunications and Information Sciences, Novosibirsk, Russia
- 2000 – 2005 **Diploma in Mathematics**, Gorno-Altaysk State University, Gorno-Altaysk, Russia

Professional Awards

- 2023 Award “Master Of Communications”, Ministry of Digital Development, Communications and Mass Media of the Russian Federation
- 2021 Diploma of the Minister of Digital Development, Communications and Mass Media of the Russian Federation
- 2019 Certificate of Honor of the Governor of the Novosibirsk Region
- 2017 Diploma of city administration of Novosibirsk
- 2012 Award of the Government of the Russian Federation in the field of education
- 2009 Award of Administration of Novosibirsk Region
- 2008 Intel Scholarship in Recognition of Academic Progress and Active Scientific Work
- 2007 Alcatel-Lucent Scholarship
- 2007 Scholarship of the Government of the Russian Federation
- 2004 Scholarship of the Russian Federation President

Attended Schools and Workshops

- 2009 Architecture of High-Performance Computer Clusters, Institute for System Programming of RAS, Moscow, Russia
- 2007 Intel Multicore Programming for Academia, Intel, Nizhny Novgorod, Russia
- 2007 Java Programming, Sun Java Academy, Sun Microsystems, Novosibirsk, Russia
- 2006-2008 Russian-German Schools on Parallel Programming and High-Performance Computing Systems, Institute of Computational Technologies SB RAS, Novosibirsk, Russia

Selected Publications (mostly in Russian)

- ПИИЦ SPIN-код: 3863-6910 • ORCID: orcid.org/0000-0002-7808-1635
- Scopus Author ID: 23667793600 • ResearcherID: C-9586-2016

Book Chapters

1. Khoroshevsky V., Kurnosov M. et al. Computational Methods, Algorithms and Hardware and Software Tools for Parallel Modelling of Natural Processes. Chapter 2, SB RAS, 2012. – 355 p. (in Russian, ISBN 978-5-7692-1237-6).
2. Kurnosov M. Introduction to Data Structures and Algorithms. – Novosibirsk, 2015. – 179 p. (in Russian, ISBN 978-5-9906983-4-5)
3. Kurnosov M., Paznikov A. Theory of Distributed Computer Systems Functioning Organization. – Novosibirsk, 2015. – 52 p. (in Russian, ISBN 978-5-9906983-5-2).

Dissertation (thesis)

1. Kurnosov M. *Algorithms for Functioning Organization of Hierarchical Distributed Computer Systems* (Doctor of Science), Siberian State University of Telecommunications and Information Sciences, Novosibirsk, Russia, October 2016.
2. Kurnosov M. *Models and Algorithms of Mapping Parallel Programs into Distributed Computer Systems*, Ph.D. Dissertation (Candidate of Science), Siberian State University of Telecommunications and Information Sciences, Novosibirsk, Russia, December 2008 (Advisor: Corresponding Member of RAS Prof. V.G. Khoroshevsky).

Selected Refereed Journal Articles

- Romanyuta A., Kurnosov M. *ALGORITHMS FOR MPI ALL-TO-ALL EXCHANGE USING SHARED MEMORY* // J. Problems of Informatics. 2024. 3. DOI: 10.24412/2073-0667-2024-3-72-81.
- Pavskii K., Revun A., Rudin S., Kurnosov M. et al. Parallel Simulation Methods of Heteroepitaxial Growth on Multiprocessor Systems with Shared Memory // J. Optoelectron. Instrument. Proc. 2024. DOI: 10.3103/S8756699024700638.
- Romanyuta A., Kurnosov M. *Shared memory based MPI Reduce and Bcast algorithms* // Journal of Numerical Methods and Programming. Vol. 24, Issue 4. 2023. <https://doi.org/10.26089/NumMet.v24r424s>
- Kurnosov M. *MPI Reduction and Broadcast Algorithms for Computer Clusters with Multistage Interconnection Networks* // Journal “Vestnik SibGUTI”, 2023, No. 3, 13 p. (in Russian).
- Kurnosov M. *Barrier Synchronization Hierarchical Algorithm for Multicore Shared-memory Systems* // Journal “Vestnik SibGUTI”, 2022, No. 2, pp. 4-11 (in Russian).
- Kurnosov M., Tokmasheva E. *Barrier Optimization on Asymmetrical NUMA Subsystems* // Journal “Vestnik SibGUTI”, 2021, No. 1, 15 p. (in Russian).
- Kurnosov M., Tokmasheva E. *Shared Memory based MPI Broadcast Algorithms* // Journal “Vestnik SibGUTI”, 2020, No. 1, pp. 42-59 (in Russian).
- Kurnosov M. *Analysis and Optimization of Pipelined Broadcast Algorithms* // Journal “Vestnik SibGUTI”, 2019, No. 2, pp. 43-56 (in Russian).
- Peryshkova E., Kurnosov M. *Modeling Network Contention Effects on Process Allocation in Computer Systems* // Journal “Vestnik Tomskogo gosudarstvennogo universiteta. Upravlenie vychislitel'naja tehnika i informatika” (Tomsk State University Journal of Control and Computer Science), 2019, No. 47, pp. 93-101 (in Russian).

- Kurnosov M. *Analysis and Optimization of a k-chain Reduction Algorithm for Distributed Computer Systems* // Journal “Numerical Methods and Programming”, 2017. – Vol. 17. – pp. 318-328 (in Russian).
- Kulagin I., Kurnosov M. *Instrumentation and Optimization of Transactional Sections Execution in multithreaded Programs* // Proc. of the Institute for System Programming. – 2015. – Vol. 27 (6). – pp. 135-150 (in Russian).
- Kulagin I., Paznikov A. Kurnosov M. *Heuristic Algorithms for Optimizing Communications in Parallel PGAS-programs* // Journal “Vestnik SibGUTI”, 2014, No. 3, pp. 52-66 (in Russian).
- Pavsky K., Kurnosov M., Polyakov A. *Software Tools for Optimizing Parallel Modeling of Nanostructures with Quantum Dots* // Journal “Avtometriya”, 2014, Vol. 50(3), pp. 56-61 (in Russian).
- Kurnosov M., Paznikov A. *Heuristic Algorithms for Mapping Parallel MPI Programs into Multicluster Computer and Grid Systems* // Journal “Vichislitelnie metodi i programirovanie”, 2013, Vol. 14(2), pp. 1-10 (in Russian).
- Kurnosov M. *MPIPerf: a Toolkit for Benchmarking MPI-libraries*. Journal “Vestnik NNGU”, 2012, No. 5(2), pp. 385-391 (in Russian).
- Kurnosov M., Paznikov A. *Modelling of Decentralized Algorithms for Scheduling Jobs in Grid Systems* // Journal “Problemi informatiki”, 2012, No. 2, pp. 45-54 (in Russian).
- Kurnosov M., Paznikov A. *Decentralized Algorithms for Scheduling Parallel Tasks in Geographically-distributed Computer Systems* // Journal “Vestnik TGU. Upravlenie, vichislitel'naya tehnika i informatika”, 2012, No. 1(18), pp. 133-142 (in Russian).
- Kurnosov M. *Allgather Algorithms for Hierarchical Distributed Computer Systems* // Journal “Vestnik Komputernih i Informacionnih Tehnologiy”, 2011, No. 5, pp. 27-34 (in Russian).
- Kurnosov M. *Optimization of Collective Communications Routines in Computer Systems with Hierarchical Networks* // Journal “Vestnik TGU. Upravlenie, vichislitel'naya tehnika i informatika”, 2011, No. 2(15), pp. 61-71 (in Russian).
- Kurnosov M., Paznikov A. *Algorithms and Software Tools for Decentralized Scheduling of MPI Programs in Multicluster Computer Systems*. Journal “Vestnik TGU. Upravlenie, vichislitel'naya tehnika i informatika”, 2011, No. 3(16), pp. 78-85 (in Russian).
- Kurnosov M. *Structure-oriented Method for Optimizing MPI Collective Communications in Distributed Computer Systems* // Journal “Vestnik SibGUTI”, 2010, No. 2(10), pp. 54-65 (in Russian).
- Kurnosov M., Paznikov A. *Decentralized Scheduling of Parallel Tasks in Geographically-distributed Computer Systems* // Journal “Vestnik SibGUTI”, 2010, No. 2(10), pp. 79-86 (in Russian).
- Khoroshevsky V.G., Kurnosov M.G. *Algorithms for Assigning Parallel Program Branches to Computer System Processor Cores* // Optoelectronics, Instrumentation and Data Processing. – 2008. – Vol. 44, No. 2. – P. 135-143.

Conference/Workshop Proceedings

- Romanuta A., Kurnosov M. *Shared Memory-based Algorithms for MPI Irregular Collective Operations* // Proc. of the IEEE International Multi-Conference on Engineering, Computer and Information Sciences (SIBIRCON), 2022.
- Kurnosov M., Tokmasheva E. *Optimizing Barrier Algorithms on Asymmetric Subsystems of NUMA Machines* // Proc. of the IEEE Ural Symposium on Biomedical Engineering, Radioelectronics and Information Technology (USBREIT-2021), online, 13-14 May, 2021, 5 p.

- Kurnosov M., Tokmasheva E. *Shared Memory based MPI Broadcast Algorithms for NUMA Systems* // Russian Supercomputing Days: Proceedings of the International Conference, 2020. – P. 1-12.
- Kurnosov M., Berlizov D., Tkacheva T., Tokmasheva E. *Analysis and Optimization of Pipelined Broadcast Algorithms on Gigabit Ethernet and InfiniBand Networks* // Proc. of the 15th Int. Asian School-Seminar Optimization Problems of Complex Systems (OPCS), 2019. – pp. 86-91. ISBN 978-1-7281-2986-0.
- Peryshkova E., Kurnosov M. *Experimental Study of Network Contention Effects on All-to-All Operation* // Proc. of the 14th International Scientific-Technical Conference Actual Problems of Electronic Instrument Engineering (APEIE-2018), 2018. – Vol. 6 – P. 506-510.
- Moldovanova O., Kurnosov M. *Automatic SIMD Vectorization of Loops: Issues, Energy Efficiency and Performance on Intel Processors* // Russian Supercomputing Days: Proceedings of the International Conference, 2017. – P. 55-66.
- Paznikov A., Kurnosov M., Kupriyanov M. *Algorithms of Collective Operations for Distributed Arrays in Partitioned Global Address Space* // 2017 IEEE II International Conference on Control in Technical Systems, Saint Petersburg, Russia, 2017, pp. 5-8.
- Moldovanova O., Kurnosov M. *Auto-Vectorization of Loops on Intel 64 and Intel Xeon Phi: Analysis and Evaluation* // Proc. of the 14th International Conference on Parallel Computing Technologies (PaCT-2017), 2017. – Springer LNCS 10421. – P. 143-150.
- Kurnosov M. *Dynamic Mapping of All-to-All Collective Operations into Hierarchical Computer Clusters* // Proc. of Int. scientific-technical conference on Actual Problems of Electronic Instrument Engineering (APEIE-2016), 2016. – Vol. 1, Part 2. – 475-478.
- Kulagin I., Kurnosov M. *Optimization of conflict detection in parallel programs with transactional memory* // Proc. of 10th Annual International Scientific Conference on Parallel Computing Technologies (PCT-2016). – pp. 582-594.
- Kulagin I., Paznikov A., Kurnosov M. *Heuristic Algorithms for Optimizing Communications in Parallel PGAS-programs* // Proc. of the 13th International Conference on Parallel Computing Technologies, 2015. – Springer Lecture Notes in Computer Science. Vol. 9251. – pp. 405-409.
- Kurnosov M., Paznikov A. *Efficiency Analysis of Decentralized Grid Scheduling with Job Migration and Replication* // 7th International ACM Conference on Ubiquitous Information Management and Communication (ICUIMC-2013), Malaysia, 2013. – 7 p.
- Khoroshevsky V., Kurnosov M. *Mapping Parallel Programs into Hierarchical Distributed Computer Systems* // Proceedings of 4th International Conference “Software and Data Technologies (ICSOFTE 2009)”, - Sofia: INSTICC, 2009. - Vol. 2. - P. 123-128.
- Kurnosov M.G. *MPIPerf: a Toolkit for Benchmarking MPI-libraries* // Proc. of International conf. “Parallel Computational Technologies”, Novosibirsk, Russia, 2012, pp. 212-223 (in Russian).
- Kurnosov M.G. *Topology-aware Collective Communication Algorithms for Distributed Computer Systems* // Proc. of Conference “Supercomputer technologies: development, programming, application” (SCT-2010), Divnomorskoe, Russia, 2010, Vol. 2, pp. 62-66 (in Russian).
- Kurnosov M.G. *Structure-oriented Subsystems Allocation in Computer Systems* // Proc. of conference “High-performance parallel computing on clusters”, Kazan, Russia, 2008 (in Russian).
- Khoroshevsky V., Kurnosov M. *Modelling of Algorithms for Mapping Parallel Applications into Structures of Computer Systems* // Proc. of international conf. “Simulation-2008”, Kiev, Ukraine, 2008, Vol. 2, pp. 435-440 (in Russian).

- Kurnosov M. *Parallel Algorithm for Mapping Communication Graph of MPI Task into Computer System* // Proc. of international conf. “Parallel Computational Technologies”, Chelyabinsk, Russia, 2008 (in Russian).
- Kurnosov M. *Experience in Building Computer Clusters with a Remote Diskless Boot* // Proc. of conference “High-performance parallel computing on clusters”, Nizhny Novgorod, 2005, pp. 149-154 (in Russian).

Research Grants (principle investigator)

1. RISC-V based VLIW DSP ISA (R&D contract), *Yadro*, 2024-2025.
2. Topology Representation and Collective Communication Algorithms in HPC Heterogeneous Clusters Networks (R&D contract), *Huawei*, 2022-2023.
3. Concurrent Traffic Model and Performance Optimization (R&D contract), *Huawei*, 2021-2022.
4. Topology-aware MPI collectives for Huawei ARMv8-based systems (R&D contract), *Huawei*, 2019-2020.
5. Models and methods of analyzing and organizing of multiprogram execution of parallel programs on large-scale computer systems, *Russian Foundation for Basic Research*, 2018-2020
6. Models, algorithms and software for optimizing PGAS-programs, *Russian Foundation for Basic Research*, 2015-2017
7. Algorithms and system software for optimizing functioning of hierarchical computer systems, *Russian Foundation for Basic Research*, 2015-2016
8. Models, Methods and Software for Efficient Execution of Parallel Programs on Multiarchitectural Computer Systems, *Russian Foundation for Basic Research*, 2011-2013
9. Topology-aware Algorithms and Software for Functioning Organization of Distributed Computer Systems, *Russian Foundation for Basic Research*, 2008-2010
10. Development of Tools for Mapping Parallel MPI Programs into Multicore Computer Clusters, *Foundation for Assistance to Small Innovative Enterprises*, 2008-2009
11. Grant of Novosibirsk’s Administration, 2009