COLFAX
Customized Solutions

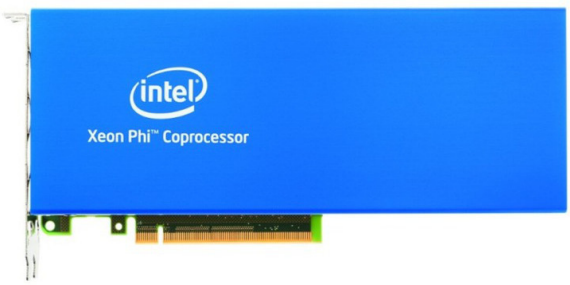
Colfax International Consulting Services

Address: Colfax International
750 Palomar Ave
Sunnyvale, CA 94085, USA

Telephone: 1-408-730-2275

Email: consulting@colfaxresearch.com

Web: colfaxresearch.com
colfax-intl.com



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Colfax Consulting Services

Colfax offers consulting services on software optimization for enterprises, research labs, and universities. Our consultants have in-depth knowledge of the available hardware solutions, software development tools and optimization practices, backed by years of experience in academic research and Ph. D. degrees in computational disciplines.

We can help you to:

- Optimize your existing application to take advantage of all levels of hardware parallelism, from vectors to cores to clusters and heterogeneous systems.
- Future-proof your application for upcoming innovations in computing solutions.
- Accelerate your application using coprocessor technologies.
- Investigate the potential system configurations that satisfy your cost, power and performance requirements.
- Take a deep dive to develop a novel approach to solving your computing problem.
- Educate your research and engineering specialists on the best known methods of modern computing.

The expertise of our consultants is continuously refined and shared with the community in Colfax Research publications and intensive courses on the parallel programming of modern multi-core processors (Intel Xeon family) and many-core specialized platforms (Intel Xeon Phi processors and coprocessors).

For more details, contact us at consulting@colfaxresearch.com to discuss what we can do together.

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Past Projects

Selected results of Colfax Research engagements in external collaborations[1]:

1) We have consulted Prof. Valerie Halyo of Princeton University on the implementation of a tracker algorithm for LHC-based experiments. As a result of our involvement, the track detection performance was improved 250x with respect to prior art. We helped to identify that due to the nature of memory access pattern in the applications, between multi-core CPUs, manycore coprocessors and GPGPUs, the best performance is achieved in the multi-core CPU. (link)

2) We have been engaged with Dr. Troy Porter of Stanford University in the improvement of an astrophysical application HEATCODE. We accelerated the legacy implementation by a factor of 125x on the CPU. The same code could be used on Xeon Phi coprocessors for an additional 1.9x boost per coprocessor used. (link)

3) We have assisted Dr. Clifford Addison of University of Liverpool in achieving distributed-memory scalability of a shallow water equation solver. Our contribution helped to achieve 97% parallel efficiency (strong scaling) across eight coprocessors, with demonstrated weak scaling efficiency for greater problem sizes. (link)

4) We have participated in a project with Dr. Pablo Saz Parkinson (UC Santa Cruz) to accelerate a semi-coherent computational technique for identifying pulsars in gamma-ray sources based on FFT ("blind search"). Colfax's involvement led to considerable improvement in the scalability and performance of the blind search implementation. Results not published because the work is ongoing, however, some by-products of this collaboration are public. (link)

5) We have assisted Mr. Peter Newman of Carestream Health in evaluating the ANSYS Mechanical software tool on heterogeneous architectures. The information obtained in this project led to significant cost savings to the customer compared to his original system configuration plan. (link)

6) We have been engaged by Intel to assist Intel Parallel Computing Centers at the Hartree Centre and at Edinburgh Parallel Computing Centre with outstanding code modernization challenges (link)

[1]This document only lists projects not covered by client confidentiality agreements

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Principal Consultant: Andrey Vladimirov

Andrey Vladimirov, Ph. D., is Head of HPC Research at Colfax International. His primary interest is the application of modern computing technologies to computationally demanding scientific problems.

Before to joining Colfax, A. Vladimirov was involved in computational astrophysics research at Stanford University, North Carolina State University, and the Ioffe Institute (Russia), where he studied cosmic rays, collisionless plasmas and the interstellar medium using computer simulations.

He is the lead author of a book on parallel programming and optimization[2], a regular contributor to the online resource Colfax Research[3], an author of invited papers in industry-leading publications[4,5], and an author or co-author of over 10 peer-reviewed publications in the fields of theoretical astrophysics and scientific computing. Selected publications:

- "Parallel Programming and Optimization with Intel Xeon Phi Coprocessors" (2015, Colfax International)
- "Are You Realizing the Payoff of Parallel Processing?" (2015, Intel Communities)
- "Profiling-Guided Optimization" (2014, chapter in "High Performance Parallelism Pearls")
- "First evaluation of the CPU, GPGPU and MIC architectures for real time particle tracking based on Hough transform at the LHC" (2014, JINST)
- "Cluster-level tuning of a shallow water equation solver on the Intel MIC architecture" (2014, arXiv:1408.1727)
- "File I/O on Intel Xeon Phi Coprocessors: RAM disks, VirtIO, NFS and Lustre" (2014, Colfax Research)
- "Multithreaded Transposition of Square Matrices with Common Code for Intel Xeon Processors and Intel Xeon Phi Coprocessors" (2013, hpgu.org)

[2] "Parallel Programming and Optimization with Intel Xeon Phi Coprocessors" (2nd edition), May 2015, ISBN: 978-0-9885234-0-1

[3] http://colfaxresearch.com/

[4] "High Performance Parallelism Pearls", November 2014, ISBN: 9780128021187

[5] "Intel Xeon Phi Processor High Performance Programming" (2nd edition), June 2016, ISBN: 9780128091951

- "Configuration and Benchmarks of Peer-to-Peer Communication over Gigabit Ethernet and InfiniBand in a Cluster with Intel Xeon Phi Coprocessors" (2014, Colfax Research)
- "Heterogeneous Clustering with Homogeneous Code: Accelerate MPI Applications Without Code Surgery Using Intel Xeon Phi Coprocessors" (2013, hgpu.org)
- "How to Write Your Own Blazingly Fast Library of Special Functions for Intel Xeon Phi Coprocessors" (2013, Colfax Research)
- "Calculation of Stochastic Heating and Emissivity of Cosmic Dust Grains with Optimization for the Intel Many Integrated Core Architecture" (2013, arXiv:1311.4627)
- "Test-driving Intel Xeon Phi coprocessors with a basic N-body simulation" (2013, Colfax Research)
- "Testing the Origin of High-Energy Cosmic Rays" (2012, The Astrophysical Journal)
- "Spectra of magnetic fluctuations and relativistic particles produced by a nonresonant wave instability in supernova remnant shocks" (2012, The Astrophysical Journal Letters)
- "GALPROP WebRun: an internet-based service for calculating galactic cosmic ray propagation and associated photon emissions" (2011, Computer Physics Communications, arXiv:1008.3642)
- "Modeling Magnetic Field Amplification in Nonlinear Diffusive Shock Acceleration" (2009, NCSU, Ph. D. dissertation)
- "Nonlinear Diffusive Shock Acceleration with Magnetic Field Amplification" (2006, The Astrophysical Journal)

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Principal Consultant: Ryo Asai

Ryo Asai is a Researcher at Colfax International holding a B. A. degree in physics from University of California, Berkeley. His expertise includes many-core architecture programming, utilization of high-performance interconnect and storage technologies in computing, data analytics, and machine learning[6].

Ryo is a co-author of a book on parallel programming and optimization[7], lead instructor of a developer training course of the same name, a regular contributor to the online resource Colfax Research[8], and an author of an invited paper in an industry-leading book on MIC architecture programming[9]. Selected publications:

- "MCDRAM as High-Bandwidth Memory (HBM) in Knights Landing Processors" (2016, Colfax Research)
- "Clustering Modes in Knights Landing Processors" (2016, Colfax Research)
- "N-Body Simulation" (2016, chapter in Intel Xeon Phi Processor High Performance Programming, 2nd edition)
- "Introduction to Intel Data Analytics Acceleration Library" (2015-2016, Colfax Research: Part 1, Part 2)
- "Intel Cilk Plus for Complex Parallel Algorithms: 'Enormous Fast Fourier Transforms' (EFFT) Library" (2015, Parallel Computing, arXiv:1409.5757)
- "Software Developer's Introduction to the HGST Ultrastar Archive Ha10 SMR Drives" (2015, Colfax Research)

[6] Ryo Asai is able to enter consulting agreements requiring US citizenship

[7] "Parallel Programming and Optimization with Intel Xeon Phi Coprocessors" (2nd edition), May 2015, ISBN: 978-0-9885234-0-1

[8] http://colfaxresearch.com/

[9] "Intel Xeon Phi Processor High Performance Programming" (2nd edition), June 2016, ISBN: 9780128091951

Principal Consultant: Vishal Kasliwal

Vishal Kasliwal, Ph. D., is a Research Engineer at Colfax International. Before joining Colfax, he worked on computational astrophysics projects at Drexel University. He has broad experience in scientific computing, statistical modeling and performance optimization for modern architectures in the C, C++, and Python languages, and is also proficient with the common toolchain of scientific computing and statistics, including IDL, MATLAB, and R. Vishal's experience includes work on performance optimization of the software stack of the Large Synoptic Survey Telescope (LSST) and contributions to the Thirty Meter Telescope (TMT) time domain science development efforts.

Vishal's selected publications include:

- "Extracting Information from AGN Variability" (2016, subm. to MNRAS)
- "Do the Kepler AGN Light Curves Need Re-processing?" (2015, MNRAS)
- "Are the Variability Properties of the Kepler AGN Light Curves Consistent with a Damped Random Walk?" (2015, MNRAS)
- "The LSST Data Management System" (2015, arXiv:1512.07914)
- "Thirty Meter Telescope Detailed Science Case: 2015" (2015, arXiv:1505.01195)
- "Probing AGN Accretion Physics through AGN Variability" (2015, Drexel University, Ph. D. dissertation)