

Davood Mohajerani

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I am an HPC software developer/researcher experienced in the design, implementation, and optimization of parallel algorithms on CPUs (Cilk/OpenMP) and GPUs (CUDA). I am interested in performance portability, optimizing compilers, parallel algorithms, and computational number theory. As a team member, I focus on iterative development, effective (written and verbal) presentation of ideas, simplifying the workflow, and maximizing the outcome within the constraints.

Open Source Portfolio (2015-Present)

- **Lead developer of [KLARAPTOR](#) (Kernel Launch Rational Program Estimator)**
A tool for improving running time of CUDA kernels by estimating block dimensions built on top of CUPTI and LLVM.
- **A CUDA library for parallel arbitrary-precision integer arithmetic on GPUs (in progress)**
Supporting addition, subtraction, multiplication, and FFT for vectors of arbitrary-length large integers.
- **A new parallel algorithm for arbitrary-precision integer multiplication on GPUs (in progress)**
 - A new algorithm based on quadratic plain multiplication with a low span and a high degree of parallelism.
 - The fine-tuned implementation (via specialized arithmetic and PTX) in CUDA will be released soon.
- **Parallel FFT over big prime fields (for integer coefficients fitting on multiple 64-bit machine-words)**
 - Developed and optimized parallel implementations of six-step FFT over big prime fields.
 - The cache-friendly Cilk implementation aimed at multi-core CPUs (with near linear speedup) is integrated in [BPAS](#).
 - The GPU (CUDA) implementation is fine-tuned for high ILP, high occupancy, and fully-coalesced accesses.
- **Parallel FFT over small prime fields (for integer coefficients that fit on a 64-bit machine-word)**
 - The cache-friendly Cilk implementation aimed at multi-core CPUs (with near linear speedup) is integrated in [BPAS](#).
 - A vectorized reimplementation using AVX2 has speedup of 1.1x to 1.3x on an Intel i7-7700 (4.2 GHz).
- **Developed and optimized a new parallel algorithm for univariate polynomial division on GPUs (CUDA).**

Education

- 2017-2021 **Ph.D. in Computer Science**, University of Western Ontario, Canada
Thesis: "[Parallel Arbitrary-precision Integer Arithmetic](#)"
- 2015-2016 **M.Sc. in Computer Science**, University of Western Ontario, Canada
Thesis: "[FFT over Prime Fields of Large Characteristic and Their Implementation on GPUs](#)"
- 2010-2015 **B.Sc. in Computer (Software) Engineering**, Isfahan University of Technology, Iran

Skills

Programming C, C++, CUDA, PTX, Cilk, OpenMP, x86 Assembly, AVX/AVX2, Python, bash, Make
Libraries/API LLVM (Pass Framework), NVIDIA CUPTI, GNU GMP, POSIX, NTL
Tools/DBMS L^AT_EX, GDB, valgrind, perf, nvprof, SQL (MySQL/SQL Server)
Familiar with MPI, OpenCL, NumPy/SymPy, Verilog, MATLAB, Maple, OpenGL, Web development

Awards

- "[Distinguished Software Demonstration Award](#)" for presenting [CUMODP](#) library in [ACM ISSAC 2017](#) conference.
- University of Western Ontario Graduate Research Scholarship (WGRS) for Ph.D. and M.Sc. in Computer Science.
- Ranked among the top 1% in the Iranian university entrance exam in 2010 (~ 320,000 participants).

Publications

- [1] S. Covanov, [Davood Mohajerani](#), M. M. Maza, and L. Wang, "Big Prime Field FFT on Multi-core Processors," in *ISSAC 2019*.
- [2] A. Brandt, [Davood Mohajerani](#), M. M. Maza, J. Paudel, and L. Wang, "KLARAPTOR: A Tool for Dynamically Finding Optimal Kernel Launch Parameters Targeting CUDA Programs," *CoRR*, vol. abs/1911.02373, 2019.
- [3] S. A. Haque, X. Li, F. Mansouri, M. M. Maza, [Davood Mohajerani](#), and W. Pan, "CUMODP: a CUDA library for modular polynomial computation," *ACM Commun. Comput. Algebra*, vol. 51, no. 3, pp. 89–91, 2017.
- [4] S. A. Haque, A. Hashemi, [Davood Mohajerani](#), and M. M. Maza, "Plain, and Somehow Sparse, Univariate Polynomial Division on Graphics Processing Units," in *PASCO@ISSAC 2017*, ACM, 2017.
- [5] L. Chen, S. Covanov, [Davood Mohajerani](#), and M. M. Maza, "Big Prime Field FFT on the GPU," in *ISSAC 2017*, ACM, 2017. DOI: [10.1145/3087604.3087657](https://doi.org/10.1145/3087604.3087657).