Pedro D. **Bello-Maldonado**

Research Assistant · Graduate Student

(217) 552-4823 | metalcycling@gmail.com | https://belloma2.web.engr.illinois.edu/ | Metalcycling | metalcycling

"There is only one corner of the universe you can be certain of improving, and that's your own self." -Aldous Huxley

Education

PhD in Computer Science — *Urbana, IL*
University of Illinois at Urbana-Champaign — *August 2016 - PRESENT*
Thesis: *Polynomial Reduction with Full Domain Decomposition Preconditioner for Spectral Element Poisson Solvers*

M.S. in Computer Science — *Urbana, IL*
University of Illinois at Urbana-Champaign — *August 2014 - December 2016*
Thesis: *Low-Order Finite Element Preconditioner for Spectral Element Pressure Solver in Navier-Stokes Equations*

M.S. in Electrical Engineering — *Miami, FL*
Florida International University — *May 2013 - August 2014*

B.S. in Electrical Engineering — *Miami, FL*
Florida International University — *August 2010 - April 2013*
Magna Cum Laude Graduate

Skills

Programming Languages	C/C++, FORTRAN, Python, C#, JAVA, MATLAB, Bash
Software Libraries	LaTeX, MPI, OpenMP, CUDA, MFEM, Hypre, Trilinos, NumPy
Web and App Development	HTML, CSS, JavaScript, XML, JSON, jQuery, Android
Hardware	Electric and electronic circuits, microcontrollers, FPGAs
Personal	U.S. Citizen, Spanish (native/fluent), English (native/fluent)

Experience

Research Assistant — *Urbana, IL*
University of Illinois at Urbana-Champaign — *August 2015 - PRESENT*
- Implemented a GPU based Poisson solver capable or running on thousands of GPUs. Achived a total solve time of about 0.5 seconds for a run with 4096 GPUs and 8 billion degrees of freedom using 1 GPU per MPI rank
- Designed and integrated a low-order finite element preconditioner in a high-order spectral element method code used for computational fluid dynamics
- Bounded the number of iterations in the GMRES solver independent of polynomial degree or mesh geometry, specially in the case of high-aspect ratio elements
- Released my findings as part of the open source software for fluid dynamics, Nek5000

Research Intern — *Remote*
IBM Research — *June 2020 - September 2020*
- Worked implementing novel solvers for the inversion problem in video-driven cancer diagnostics achieving 100x speedup on algorithm improvements alone
- Accelerated the computation time using GPUs deployed on IBM clusters with OpenShift
- Awarded the intern of the year award for significant participation and contributions

Summer Intern — *Livermore, CA*
Lawrence Livermore National Laboratory — *May 2017 - August 2018*
- Implemented a high-order finite element hyperviscous term for shock capturing in ALE hydrodynamics simulations
- Reduced running time of implementation by using a partial-assembly finite element formulation for the stiffness and mass operators
- Proved satisfactory convergence properties of the method for Lagrangian simulations with moving geometries

Graduate Research Intern — *Albuquerque, NM*
Sandia National Laboratories — *May 2016 - August 2016*
- Accelerated a Discontinuous Galerkin code for seismic imaging using GPUs and the Kokkos library in Trilinos
- Ported computationally intensive tasks such as matrix-matrix and matrix-vector multiplication to the GPU, and achieved improvements up to 20x faster kernel code and 2x faster kernel+communication code

Summer Intern — *Oak Ridge, TN*
Oak Ridge National Laboratory — *May 2015 - August 2015*
- Worked collecting and analyzing data from high performance computing components
- Applied machine learning techniques to find correlations and predict performance behavior

Software Developer
Urbana, IL

University of Illinois at Urbana-Champaign — *March 2015 - August 2015*

- Wrote a front end user interface for model manipulation and linking
- Implemented a field data contour computation tool on Python and integrated it to a C# project
- Wrote a C# helper class to manage HDF5 tables including writing and querying functions

Summer Researcher
La Jolla, CA

San Diego Supercomputer Center — *May 2014 - August 2014*

- Improved the running time of quantum mechanical and molecular mechanical (QM/MM) simulations by targeting numerical linear algebra routines that could be accelerated using software libraries (e.g. MKL, MAGMA) and hardware accelerators (e.g. GPUs, Xeon Phi)
- Measured performance improvements and scalability on the Stampede and Gordon supercomputers
- Scripted different sets of benchmarks with variable number of parameters using Python

Independent Researcher
Salisbury, MD

Salisbury University — *June 2012 - April 2014*

- Accelerated a Multiple Input Multiple Output Propagation and Backpropagation (MIMO-PBP) ultrasonic tomography algorithm using NVIDIA GPUs and CUDA. Reduced the MATLAB execution time from 6 hours to 43 seconds using faster C code and GPU accelerators
- Accelerated a sparsity aware ultrasonic tomography imaging algorithm using GPUs. Reduced the total execution time of the algorithm by a factor of 10x faster compared to the non-sparsity aware version and 23x faster compared to the sparsity aware version
- Published 4 original papers as part of this work

Junior Associate Technology
Miami Beach, FL

SapientNitro — *August 2013 - March 2014*

- Developed an Android application for Google Glass that did real time facial recognition and augmented reality using OpenCV. The application achieved a very good recognition rate (greater than 80% on average) for subjects in the training data under different ambient conditions
- Rewrote a BBVA Facebook app called "Project: ME" using Node.js. Developed web services to manage user data stored in various MySQL tables as well as AJAX communication between front-end and back-end

Visiting Researcher
Amsterdam, The Netherlands

University of Amsterdam — *May 2013 - July 2013*

- Developed a data aggregation web service for scientific data from different domains, locations, and database paradigms. Supported MySQL and HBase databases but made the framework modular so other types of databases can be added with ease
- Parallelized the aggregation process using data partitioning and thread-per-table approaches. Results showed that parallel aggregation of data by chunks is much more efficient than parallel table aggregation

Research Assistant
Miami, FL

Florida International University — *September 2011 - May 2013*

- Designed and implemented a wifi-controlled robot that mapped real objects to 3D models using the Microsoft Kinect and OpenGL
- Designed, simulated, and implemented a linear regression engine that, adaptively, predicted misses in cache L2 based on misses in cache L1
- Ran simulations of the architecture using VHDL in Xilinix to validate the model and then enabled testing on a physical system using FPGAs

Scholarships & Awards

2020-2021	**Award**, Graduate Student Outstanding Service Award	*Urbana, IL*
2020	**Award**, IBM Research Intern of the Year	*Urbana, IL*
2020	**Scholarship**, Hispanic Scholarship Fund (HSF) Scholar	*Urbana, IL*
2016	**Scholarship**, Sloan Scholar Alfred P. Sloan Foundations Minority Ph.D. (MPHD) Program	*Urbana, IL*
2015	**Scholarship**, Siebel Scholar Class of 2016	*Urbana, IL*
2014	**Award**, Outstanding Graduate Award in Electrical Engineering	*Miami, FL*
2012/14/20	**Scholarship**, Tapia Conference Scholarship Recepient	*Miami, FL*

Selected Publications

- **P. D. Bello-Maldonado**, T. V. Kolev, R. N. Rieben, and V. Z. Tomov, "A Matrix-Free Hyperviscosity Formulation for High-Order ALE Hydrodynamics", *Computers and Fluids*, Volume 205, 2020
- **P. D. Bello-Maldonado** and P. F. Fischer, "Scalable low-order finite element preconditioners for high-order spectral element Poisson solvers", *SIAM Journal on Scientific Computing*, vol. 41, pp. S2-S18, 2019
- **P. D. Bello-Maldonado**, R. López, C. Rogers, Y. Jin, and E. Lu, "Parallel computing for simultaneous iterative tomographic imaging by graphics processing units," *SPIE Proceedings*, vol. 9870, pp. 09–14, May 2016
- **P. D. Bello-Maldonado**, A. Rivera-Longoria, M. Idleman, Y. Jin, and E. Lu, "Graphics processing units accelerated MIMO tomographic image reconstruction using target sparseness," *SPIE Proceedings*, vol. 91090O, pp. 02-14, May 2014

Extracurricular Activities

Zumba Instructor
Urbana, IL

University of Illinois at Urbana-Champaign — *August 2015 - PRESENT*

Taught at least three classes a week ranging from 5 to 60 students. Choreographed music from all over the world including Salsa, Reggaeton, Merengue, Bachata, Flamenco, Korean Pop, Bollywood, and many more