Daniel Abdi

Personal Data

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Education

February 2014 | Doctor of Philosophy in Civil Engineering,
The University of Western Ontario, London, ON, CA
Thesis: "Numerical evaluation of aerodynamic roughness of the built environment and complex terrain" | Advisor: Dr. Girma Bitsuamlak
Specialization: *Computational wind engineering, CFD*

August 2006 | Master of Science in Civil Engineering,
Indian Institute of Technology, Roorkee, IN
Thesis: "Analysis of eccentrically loaded slabs" | Advisor: Prof. K.K. Singh
Specialization: *Structural engineering*

August 2003 | Bachelor of Science in Civil Engineering,
Addis Ababa University, Addis Ababa, ET
Project: "Structural design of a G+5 building" | Advisor: Dr. G. Zereayohannes
Specialization: *Structural engineering*

Work Experience

Present / July 2017 | Senior software engineer at TempoQuest, Inc., Boulder,CO
My responsibility is leading the development of the GPU acceleration of the Weather Research Forecasting (WRF) model. This is the second the second numerical weather prediction model I have worked in the past 5 years, which needs acceleration on recent many-core and multi-core supercomputers. In about 6 months, we were able to accelerate WRF by upto 7 times in a direct socket-to-socket comparison of a 16-core CPU vs a Volta GPU. Due to the shear size o the codebase, we used a mix of OpenACC and CUDA to port the code to the GPU.

July 2017 / May 2014 | Research associate at the Naval Postgraduate School (NPS), California
My research focuses on porting the non-hydrostatic unified model of the atmosphere (NUMA) to many-core machines, such as GPUs and Intel MIC. NUMA uses both Continuous and Discontinuous galerkin methods with explicit and implicit-explcit (IMEX) time integrators. We have obtained accelerations of upto 15 times using a K20x GPU as compared to a 16-core AMD CPU. Excellent scalability is demonstrated using 16384 GPUs of the Titan supercomputer.

Feb 2014 / May 2012 | Research assistant at the University of Western Ontario, Canada
Developed a high performance CFD program for wind flow on complex terrain study.

May 2012 / Jan 2009 | Research assistant at Florida International University, Florida
Started my research in Wind Engineering, while working as a teaching assistant for different civil engineering courses .

Jan 2009 – Sep 2006 | Lecturer at Addis Ababa University, Ethiopia
Thought many civil engineering courses to 3rd year undergraduate students. Supervised final year projects on the design of tall story buildings.

Sep 2004 – Sep 2003 | Part time structural Engineer at Elugi Consulting, Ethiopia
Conducted structural design and detailing of medium rise buildings for several clients.

Sep 2004 – Sep 2003 | Assistant Lecturer at Addis Ababa University, Ethiopia
Served as a tutor for several civil engineering courses.

Codes

Present – 2017 | Ported the Weather Research and Forecast (WRF) model to run entirely on the GPU. The WRF model is the most widely used numerical weather prediction model and thus its acceleration is valuable to the user interms of reducing forecast time as well as improving accuracy of simulations. Under my leadership, our software engineering team was able to demonstrate speedups of upto 7 times for the first time. Before this result, many leaders in the field seem to have given up in accelerating this huge legacy code. This result that our comapny TempoQuest, Inc achieved within a short time have resonated with the WRF community and rasied hopes of getting WRF exa-scale ready. | WRF

2017 – 2014 | Contributed to the numerical weather prediction model NUMA. Responsible for unifying implementations of the continuous / discontinuous Galerkin methods, accelerating NUMA using GPUs and testing scalability using upto 16384 GPUs of Titan, implementing parallel grid generation library p4est in the DG code. | NUMA website

Present – 2013 | Developer of a Computational Fluid dynamics (CFD) program Solver using finite-volume and high order discontinuous Galerkin method. It has different RANS/LES turbulence models for use in wind flow simulations on complex terrain. Parallelized to use a cluster of CPUs and GPUs using the domain decomposition method. It has a unique polyhedral AMR library that allows anisotropic refinement and coarsening. | Solver code

2010 – 2006 | Developer of a Finite Element (FEM) structural analysis and design program StAnD using different national codes and standards. It has the following features: linear static and dynamic analysis, response spectrum plots, non-linear p-delta analysis, buckling analysis of 3D columns, reinforced concrete and steel design, and finally preparation of AutoCAD drawing. | StAnD code

HPC Training

August 2015 | Argonne training program on extreme-scale computing
A 15 day 13 hours/day intensive training St. Charles, IL, Chicago

October 2015 | GPU Hackathon, Oak Ridge Leadership Computing Facility
A one week training on hybrid CPU-GPU programming, Knoxville, TN

Programming languages

Languages	C, C++, Fortran, Java, x86 assembly, python, javascript
Parallel programming	MPI, OpenMP, Cilk, Pthreads
	CUDA, OpenCL, OpenACC and OCCA
Graphics	MFC, QT, Java Swing, Android
Database	SQL, Oracle

Skills

Structural analysis	SAP 2000; ETABS; STAAD. Pro; Ansys FEM
CAD modeling	AutoCAD; SolidWorks ; Design modeler; Arc-GIS; Global - Mapper
CFD solvers	Fluent; Ansys Workbench; OpenFOAM; Star-CCM+
Grid generators	ICEM CFD; OpenFOAM snappyHexMesh; Gambit
Visualization	Tecplot 360; ParaView; Ansys CFD Post Processing
Statistical packages	Matlab, MatchCad, Mathematica, Maple, R
Project Management:	Primavera p4

Wind Labs

2012 2009	The Wall of Wind (**WoW**) facility for full-scale testing of buildings in hurricane conditions
2014 2012	Alan Davenport Boundary Layer Wind Tunnel (**BLWT**) facility for model scale testing of buildings and bridges

Journals

[1] D. Abdi and G. Bitsuamlak, "Numerical evaluation of the effect of multiple roughness changes," *Wind and Structures*, vol. 19, pp. 585 –601, 6 2014. DOI: 10.12989/was.2014.19.6.585.

[2] ——, "Wind flow simulations on idealized and real complex terrain using various turbulence models," *Advances in Engineering Software*, vol. 75, pp. 30 –41, 2014. DOI: 10.1016/j.advengsoft.2014.05.002.

[3] ——, "Asynchronous parallelization of a cfd solver," *Journal of Computational Engineering*, 2015. DOI: 10.1155/2015/295393.

[4] ——, "Wind flow simulations in idealized and real built environments with models of various level of complexity," *Wind and structures*, vol. 22, pp. 503–524, 4 2016. DOI: 10.12989/was.2016.22.4.503.

[5] D. S. Abdi and F. X. Giraldo, "Efficient construction of unified continuous and discontinuous galerkin formulations for the 3d euler equations," *Journal of Computational Physics*, vol. 320, pp. 46 –68, 2016, ISSN: 0021-9991. DOI: http://dx.doi.org/10.1016/j.jcp.2016.05.033.

[6] D. S. Abdi, L. C. Wilcox, T. C. Warburton, and F. X. Giraldo, "A gpu-accelerated continuous and discontinuous galerkin non-hydrostatic atmospheric model," *The International Journal of High Performance Computing Applications*, vol. 0, no. 0, p. 1 094 342 017 694 427, 2017. DOI: 10.1177/1094342017694427.

[7] D. S. Abdi, F. X. Giraldo, E. M. Constantinescu, L. E. Carr, L. C. Wilcox, and T. C. Warburton, "Acceleration of the implicit–explicit nonhydrostatic unified model of the atmosphere on manycore processors," *The International Journal of High Performance Computing Applications*, vol. 0, no. 0, p. 1 094 342 017 732 395, 0. DOI: 10.1177/1094342017732395. [Online]. Available: https://doi.org/10.1177/1094342017732395.

Conferences

[8] D. Abdi, L. Wilcox, T. Warburton, and F. Giraldo, "GPU accelerated spectral element methods: 3d euler equations," in *American Geophysical Union Fall meeting*, San Francisco, US, 2015.

[9] L. Wilcox, T. Warburton, D. Abdi, A. Kloeckner, and F. Giraldo, "Accelerating numa in a performance portable way," in *ICMS, Galerkin methods with applications in weather and climate forecasting*, Edinburgh, United Kingdom, 2015.

[10] A. Mueller, D. Abdi, M. Kopera, L. Wilcox, and F. Giraldo, "Towards operational weather prediction at 3.0km global resolution with the dynamical core numa," in *KIAPS, Workshop on solution of PDEs on the Sphere*, Seoul, South Korea, 2015.

[11] D. Abdi, S. Levin, and G. Bitsuamlak, "Application of an artificial neural network model for boundary layer wind tunnel profile development," in *11th Americas conference on wind Engineering*, 2009.

[12] D. Abdi and G. Bitsuamlak, "Estimation of surface roughness using CFD," in *The Fifth International Symposium on Computational Wind Engineering (CWE-2010)*, 2010.

[13] ——, "Assessing the effect of boundary conditions on simulating atmospheric boundary layer," in *2012 Joint Conference EMI/PMC*, 2012.

[14] ——, "Development of computational tools for large scale wind simulations," in *ATC and SEI Advances in Hurricane Engineering Conference*, 2012, pp. 1006 –1016. DOI: 10.1061/9780784412626.087.

[15] A. Mueller, D. Abdi, S. Marras, M. Kopera, and F. Giraldo, "Cloud simulations with the nonhydrostatic unified model of the atmosphere (NUMA)," in *SIAM Conference on Mathematical and Computational Issues in the Geosciences*, Stanford, CA, USA, 2015.

[16] F. Giraldo, A. Mueller, M. Kopera, and D. Abdi, "Towards exascale computing with numa: An element-based galerkin nonhydrostatic global and atmopsheric modeling," in *American Geophysical Union Fall meeting*, San Francisco, US, 2015.

[17] D. Abdi, A. Mueller, L. Wilcox, T. Warburton, and F. Giraldo, "Scaling element-based galerkin methods on multi-core and many-core computers for geophysical fluid dynamics models," in *SIAM Annual meeting*, Boston, MA, USA, 2016.

[18] D. Abdi, F. Giraldo, E. M. Constantinescu, L. Carr, L. Wilcox, and T. Warburton, "Acceleration of a semi implicit non-hydrostatic atmospheric model on many core architecture," in *American Geophysical Union Fall meeting*, San Francisco, US, 2016.

[19] F. Giraldo, D. Abdi, and M. Kopera, "GNuMe: A galerkin-based numerical modeliing environment for modeling geophysical fluid dynamics applications ranging from the atmosphere to the ocean.," in *19th EGU General Assembly, EGU2017*, Vienna, Austria, 2017.

[20] F. Giraldo, D. Abdi, M. Kopera, and A. Mueller, "The NUMA/NUMO model for nonhydrostatic atmosphere and ocean dynamics.," in *AGU Fall meetings*, San Francisco, US, 2016.

Talks

[21] S. Elliot, I. Gohari, D. Abdi, D. Berchoff, and G. Pache, *Key applications of the weather research and forecasting (wrf) model running on gpus, acecast*. Boulder, CO, 2018.

[22] D. Abdi, S. Elliott, I. Gohari, D. Berchoff, and G. Pache, *Acceleration of wrf on the gpu*, Boulder, CO, 2018.

[23] A. Mueller, M. Kopera, S. Marras, D. Abdi, and F. Giraldo, *Efficiency of high-order continuous and discontinuous galerkin methods*, Offenbach, Germany, 2015.

Editorial/Reviews

Building and Environment, Wind and Structures, Geoscientific Model Development, Journal of Computational Physics, Sustainable Cities and Societies, Vehicle System Dynamics

Honors and Awards

2016	National Research Council (NRC) associateship programs
2014	National Research Council (NRC) associateship programs
2012	Full tuition assistantship, The University of Western Ontario
2010	CHI EPSILON National Honor Society
2009	Full tuition assistantship, Florida International University
2004	Full tuition assistantship, Indian Institute of Technology, Roorkee
1998	Aklilu Lemma Merit Scholarship

Memberships

2015	American Geophysical Union (AGU)
2010	American Society of Civil Engineers (ASCE)
2010	American Association of Wind Engineers (AAWE)