Abiy F. Melaku

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FOCUS AREAS

- Numerical simulation of atmospheric boundary layer flows
- Wind load evaluaton on buildings using CFD
- Scientific computing
- Fluid-structure interaction

EDUCATION

May. 2016 - Present	**PhD Candidate in Civil Engineering and Scientific Computing, Western University (UWO), Canada** Dissertation topic: *A computational framework for unsteady aerodynamic and aeroelastic modeling of tall buildings under wind* Advisor: Professor Girma Bitsuamlak (Western University)
Feb. 2014 - Feb. 2016	**MASc in Computational Structural Engineering, Chungbuk National University, South Korea** Thesis topic: *Fatigue assessment of intermittent fillet weld for vertical web stiffener of steel box girder bridge* Advisor: Professor Jung Kyoung-Sub
Sep. 2008 - Jun. 2013	**BSc in Civil Engineering with Very Great Distinction, Adama Science and Technology University, Ethiopia** Final project topic: *Development of Structural Analysis and Design Software(ESADS) for Ethiopian Building Code of Standards(EBCS)* Advisors: Dr. Beka Hailu and Eng. Ayele Zewdu

RESEARCH EXPERIENCE

May. 2016 - Present	**Graduate Research Assistant, Western University, Canada** Advisor: Professor Girma Bitsuamlak Wind tunnel and CFD projects conducted[1] Research project 1: *Development of a new inflow turbulence generation method for atmospheric boundary layer (ABL) flows and comparison with wind tunnel measurements* Research project 2[2]: *Preparation of aerodynamic database for the CAARC building conducting a wind tunnel test at the Boundary Layer Wind Tunnel Laboratory (BLWTL)* Research project 3: *Predicting the wind-induced response of the CAARC building using large-eddy simulation and dynamic analysis* Research project 4[3]: *Large-eddy simulation of wind loads on a tall building located in a city center* Research project 5: *Development of fluid-structure interaction framework for predicting the aeroelastic response of tall buildings under wind excitation*

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[1] All of the listed research projects are part of my PhD study. In the research projects, I developed numerical modeles for wind load simulation and conducted wind tunnel tests for validating the models.

[2] Existing aerodynamic data sets for tall buildings are often not complete enough for validating CFD models. In this project, I conducted a wind tunnel test on the CAARC building and prepared detailed aerodynamic and wind field data for three exposure conditions. This database is finally used to validate the numerical models I developed.

[3] In collaboration with Thornton Tomasetti, this research project aimed to develope a numerical procedure to asses wind induced response of high-rise buildings with 500m radius proximity model. Experimental test results obtained from BLWTL were used to validate the numerical models.

SCHOLARSHIPS AND AWARDS

May. 2016 - May. 2020	**Ontario Trillium Scholarship**[4] Amount: $40,000/year
Mar. 2012	**ASTU Certificate of Academic Excellence** Adama Science and Technology University, Adama, Ethiopia
Mar. 2010	**AU Annual High Scoring Students' Award,** Adama Science and Technology University, Adama, Ethiopia

WORK EXPERIENCE

Sept. 2017 - Dec. 2017	**Research Intern** Company: FM Global Research, Norwood, Massachusetts, USA Supervisor: Dr. Lakshmana Doddipatla Project title[5]: *Enhancing OpenFOAM's wind engineering modeling capability*
Sept. 2019 - Dec. 2019	**Research Intern** Company: FM Global Research, Norwood, Massachusetts, USA Supervisor: Dr. Lakshmana Doddipatla Project title[6]: *Large-eddy simulation of wind loads on roof-top equipment mounted on low-rise building*
July. 2014 - Feb. 2016	**Construction Engineer** (*Part time*) Project site: *Namyangju-Byeolnae Road Construction Site(555-Gwangjeon-ri, Byeolnae-myeon, Namyangju-si, Gyeonggi-do, South Korea)* Company: Daelim Industrial Co. Ltd, Seoul, South Korea

REFEREED JOURNAL PUBLICATIONS

1. **Melaku, A. F.** & Bitsuamlak, G. T. (2021). A divergence-free inflow turbulence generator using spectral representation method for large-eddy simulation of ABL flows. *Journal of Wind Engineering and Industrial Aerodynamics.*

2. **Melaku, A. F.** & Jung, K. S. (2017). Evaluation of welded joints of vertical stiffener to web under fatigue load by hotspot stress method. *International Journal of Steel Structures.*

3. **Melaku, A. F.**, Geleta, T. N. & Jung, K. S. (2015). Application of object-oriented finite element method in structural mechanics. *Journal of the Institute of Construction Technology.*

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[4] This project involves a C++ implementation of a ground surface and inflow boundary conditions in OpenFOAM that are particularly important for simulating wind loads on low-rise buildings using large-eddy simulation.

[5] I did a parametric study of the variation of wind loads on roof-top equipment depending on its elevation and location on the roof. The final results from the CFD simulations were properly validated against wind tunnel measurements and included in the Company's aerodynamic database.

[6] The Ontario Trillium Scholarships (OTS) program is an important initiative to attract top international students to Ontario,Canada for their PhD studies.

CONFERENCE PUBLICATIONS

1. **Melaku, A. F.**, Doddipatla, L. S., Bitsuamlak & G. T. (2021). Large-eddy wimulation of wind Loads on a roof-mounted cube: contribution to experimental database In *The 6th American Association for Wind Engineering Workshop*, Clemson University, Clemson, SC, USA.

2. Geleta, T. N., Elshaer, A., **Melaku, A. F.** & Bitsuamlak, G. T. (2018). Computational wind load evaluation of low-rise buildings with complex roofs using LES. In *The 7th International Symposium on Computational Wind Engineering 2018.*, Seoul, Republic of Korea.

3. **Melaku, A. F.**, Bitsuamlak, G. T., Elshaer & A., Aboshosha, H. (2017). Synthetic inflow turbulence generation methods for LES study of tall building aerodynamics. In *The 13th Americas Conference on Wind Engineering (13ACWE)*, Gainesville, Florida, USA.

4. Adamek K., **Melaku, A. F.**, Bitsuamlak, G. T. & Sadeghpour, F. (2017). Wind safety assessment during high rise building construction. In *The 13th Americas Conference on Wind Engineering (13ACWE)*, Gainesville, Florida, USA.

TECHNICAL REPORTS

1. **Melaku, A. F.**, Geleta, T. N., Birhane, T. H., & Bitsuamlak, G. T. (2021). Enabling OpenFOAM® for wind load evaluation. Prepared for *FM Globa Research*, Norwood, Massachusetts, USA.

JOURNAL PAPERS UNDER PREPARATION

1. **Melaku, A. F.**, Doddipatla, L. S. & Bitsuamlak, G. T. Large-eddy simulation of wind loads on a rooftop equipment: assessment of the loading mechanism and the effect of equipment location. In preparation for *Journal of Wind Engineering and Industrial Aerodynamics*.

2. **Melaku, A. F.** & Bitsuamlak, G. T. Computationally efficient simulation of multivariate stochastic processes using Nyström approximation. In preparation for *Probabilistic Engineering Mechanics*.

3. **Melaku, A. F.** & Bitsuamlak, G. T. Predicting the wind induced responses of a high-rise building using LES and dynamic anaylysis: Validation with wind tunnel data. In preparation for *Journal of Wind Engineering and Industrial Aerodynamics*.

CODES

2018 - Present	**Divergence-free Spectral Representation (DFSR)** Github link: https://github.com/abiyfantaye/DFSR Discription: *Computationally efficient inflow turbulence generation method developed for large-eddy simulation of the atmospheric boundary layer(ABL) flows. The method is developed targeting LES-based wind load evaluation application on structures.*
2019 - Present	**Pressure Integration Model(PIM)** Github link: https://github.com/abiyfantaye/PIM Discription: *A python script that analyses pressure data for buildings and report estimated wind loads and structural response. Compatable with wind tunnel and CFD data.*
2020 - Present	**Fluid-Structure Interaction(FSI) for tall building eroelastic analysis** Discription: *A C++ library to perform fluid-structure interaction using OpenFOAM's unsteady solver and in-house developed multi-degree of freedom(MDOF) structural solver. The code implements a direct load and displacement transfer mechanism for efficient computation.*
2014 - 2015	**Object-Oriented Finite Element Method(OOFEM)** Github link: https://github.com/abiyfantaye/OOFEM Discription: *An object-oriented finite element framework for 2D linearly elastic structural analysis which is capable of handling both static and transient analysis scenarios.*
2012 - 2013	**Ethiopian Structural Analysis and Design Software(ESADS)** Github link: https://github.com/abiyfantaye/ESADS Discription: *A structural analysis and design software developed based on the Ethiopian Building Code of Standards(EBCS-1995). ESADS can be used to analyze and design reinforced concrete structures such as beam, baxial column, slab and foundation footings.*
2011 - 2012	**Structural Analyis Program(STRAP)** Github link: https://github.com/abiyfantaye/STRAP Discription: *A GUI bases structural analysis application developed mainly to analyze small-scale 2D structures like beam, truss and plane frames. This program was written during the 3rd-year of my undergraduate study.*

HPC TRAINING

July 2016	**Ontario High Performance Computing Summer School** University of Toronto, Ontario, Canada
July 2018	**Compute Ontario Summer School on High Performance and Technical Computing** Western University, Ontario, Canada

PROGRAMING LANGUAGES

Languages	C, C++, C#, Python, MATLAB
Parallel Programming	MPI, OpenMP, CUDA, OpenCL
Shell Programming	bash, tcsh

SOFTWARE SKILLS

CFD	OpenFOAM, Star-CCM+
Grid generation	HEXPRESS, OpenFOAM snappyHexMesh
Structural analysis	SAP 2000, ETABS, Midas Civil, Abaqus FEA
CAD Modeling	AutoCAD, SALOME
Visualization	ParaView

TEACHING EXPERIENCE

Jan. 2018 - Apr. 2018	**Graduate Teaching Assistant, Western University** Course: Computational Methods for Civil Engineering Course Mentor: Dr. Martha Dagnew
Sep. 2018 - Dec. 2018	**Graduate Teaching Assistant, Western University** Course: Computational Wind Engineering Course Mentor: Professor Girma Bitsuamlak
Sep. 2017 - Dec. 2017	**Graduate Teaching Assistant, Western University** Course: Engineering Statics Course Mentor: Dr. Ayman M. El Ansary
Sept. 2013 - Feb. 2014	**Graduate Assistant Lecturer, Debre Berhan University, Ethiopia** Courses: Engineering Mechanics I

PROFESSIONAL MEMBERSHIP

1. Student member of Canadian Society for Civil Engineering (CSCE) Structures Division

2. Student member of American Society of Civil Engineers (ASCE)

3. Member Graduate Engineering Society (GES) at Western University

From Academia

1. Professor Girma Bitsuamlak, Ph.D., P.Eng., F CSCE
   Canada Research Chair in Wind Engineering
   Site-leader for Sharcnet - high performance computing center
   Director (Research) Boundary Layer Wind Tunnel Laboratory
   Director (Research) WindEEE Research Institute
   Civil & Environmental Engineering, Western University
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2. Professor Hassan Peerhossaini, PhD
   Western Research Chair in Urban Resilience and Sustainability
   Cross-appointed at Department of Mechanical & Materials Engineering, and
   Civil & Environmental Engineering, Western University
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From Industry

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