FARZAD TAGHADDOSI

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EDUCATION

Post-doctoral Fellow (Mechanical Engineering), McGill University, Montreal, Canada. **2006 – 2007**

Ph.D. (Mechanical Engineering), McGill University, Montreal, Canada. **2006**

- Dissertation: '*3D Parallel Computations of Turbofan Engine Noise Propagation Using A Spectral Element Method*'
- Advisor: Professor Wagdi G. Habashi

M.Sc. (Aerospace Engineering), Wichita State University, Wichita, Kansas, USA. **1999**

- Thesis: '*ProRAPP: A Computer Program for Propeller/Rotor Acoustic Prediction*'
- Advisor: Professor Ramesh K. Agarwal
- Course work: Airfoil Design, Subsonic, Hypersonic and Rotor Aerodynamics, Panel Methods

M.Sc. (Mechanical Engineering), Concordia University, Montreal, Canada. **1996**

- Thesis: '*An Adaptive Least-Squares Finite Element Method for the Compressible Euler Equations*'
- Advisor: Professors Wagdi G. Habashi and Grant G. Guèvremont
- Course work: Advanced Fluid Dynamics, Computational Aerodynamics, Gas Dynamics, Finite Element/Finite Difference Methods, Applied Mathematics

B.Sc. (Mechanical Engineering), *summa cum laude,* University of Tabriz, Tabriz, Iran. **1991**

- Senior Design Project: '*Thermodynamic Design of a Four-Stage Gas Turbine*'

TEACHING EXPERIENCE

Summary of Teaching Philosophy: Strong emphasize on teaching core fundamental concepts through student engagement/active learning strategies with focus on application-oriented, project-based learning. Proficient in both traditional and online teaching methods.

Accreditation Experience:

- Experience in preparing rubrics to assess student outcomes (SO) and program criteria (PC).
- Completed ABET Evaluator Training, 2017.

University of Kentucky, Dept. of Mechanical Engineering **Fall 2015 – present**

- Lecturer
- Courses taught:
  - *ME 101 – Intro to Mechanical Engineering (Fall 2015, Spring 2016)*
  - *EM 221 – Statics (Fall & Spring semesters: 2015 to 2020)*
  - *ME 220 – Eng. Thermodynamics I (Spring 2019, Spring 2020, Fall 2020, Summer 2016-2020, Both In-person & Online)*
  - *EM 302 – Mechanics of Deformable Solids (Fall 2017, Fall 2018)*
  - *ME 311 – Engineering Experimentation II (Fall 2019)*

  - *ME 321 – Eng. Thermodynamics II (Spring 2016, Fall 2020)*
  - *ME 330 – Fluid Mechanics (Fall 2016, Summer 2016-2020, Both In-person & Online)*
  - *ME 340 – Intro to Mechanical Systems (Spring 2017-2020)*
  - *ME 411 & 412 – Senior Design: Conducted FE Exam Reviews for Fluid Mechanics, Thermo I & II, and Heat Transfer (Fall & Spring Semesters, 2016-2019)*
  - *ME 548 – Aerodynamics of Turbomachinery (Fall 2018)*
- Typical rating on **quality of teaching** in course evaluations: **~85-90%**
- Revised curriculum for ME 101 & ME 311.
- Frequently advised seniors (informally) on their capstone design project.

U. Colorado (Boulder) & Colorado Mesa U. Mech. Eng. Partnership Program Fall 2012 – July 2015

- Assistant Professor
- Courses taught: Statics & Structures, CAD & Fabrication, Fluid Mechanics, Thermodynamics, Heat Transfer, Turbomachinery, Fluid Power Systems
- Average rating of student course evaluations: 80%
- Curriculum Developed:
  - *Heat & Power (ENGR 336)*
  - *Engineering Statistics & Quality Control (STAT 305)*
  - *Fluid Power Systems (ENGR 455)*
  - *Energy Systems (ENGR 460)*
  - *Thermal-Fluid Systems Analysis Using CFD (ENGR 481)*
- Set up, equipped, and managed the ***Pneumatics Lab*** *using Festo equipment*.
- Student projects advised:
  - Design of A Venturi Tube for An Evacuation Slide (First-Year engineering project): A special type of Venturi tube with additional suction holes was designed and built to increase flow rate needed to inflate an evacuation slide of an airplane. Using the new design, students showed that they were able to fill an inflatable chair with air twice as fast.
  - Experimental Equipment for Measuring Major and Minor Losses (Fluid Mechanics course project): Students designed and built an equipment that allowed measurement of losses in both series and parallel piping systems, taking into account the impact of pipe size & material, and the losses associated with different fittings.
  - Rotating Drum Viscometer (Fluid Mechanics course project)
  - Material Handling Station (Fluid Power Systems course project): An automated, two-axis pneumatic system was designed and built by students that would grab a part from one station and move it to a new station.
  - 2 DOF Robotic Arm (Fluid Power Systems course project): A two degree of freedom robotic arm was designed and built to move parts between two stations. It used suction for grabbing the part and an electric motor for rotating the arm. The system was automated using an Arduino connected to several sensors.
  - Design and Optimization of A Heat Sink for A Microchip (Heat Transfer course project): Included both analytical and numerical simulation of both conduction and convection heat

transfer, determining the optimal position of the cooling fan, and optimizing the number/size/shape of the fins on the heat sink.

- Spark Plug Dispenser (Fluid Power Systems course project): An automated pneumatic system was designed and built to simulate a packaging line where packs of 4 spark plugs would be continuously dispensed into the boxes. The equipment used an Arduino connected to several sensors to detect box positions & activate actuators.
- Parts Cleaning Station (Fluid Power Systems course project): An electro-pneumatic system was designed and built to move parts from a loading station into a cleaning bath, allowing them to soak for a while, and then removing and draining them before taking the parts back to the initial location. The pneumatic circuit was initially simulated using the FluidSIM software. The equipment also included a manual operating mode and an emergency shut-down bottom.
- Thermal Analysis of A Heating Machine (Industry-sponsored project): Advised four teams of students who each performed an independent analysis of the efficiency of a mobile heater capable of delivering 1.2 MM Btu/h. The project was sponsored by Certek Heating Solutions (www.certek.ca). Main elements of the project included: theoretical analysis, selecting proper measurement instruments and installing them, project management, technical presentation and report writing. At the end, the company was highly satisfied with the outcome (85%) and expressed willingness to hire some of the students, as well.

Concordia University, Faculty of Engineering **2000 – 2002**

- Adjunct Instructor
- Course taught: *Numerical Methods in Engineering (4 times)*

McGill University, Department of Mechanical Engineering **2000 – 2004**

- Teaching Assistant
- Courses: *Thermodynamics I & II, Fluid Mechanics I, Gas Dynamics.*

Concordia University, Department of Mechanical and Industrial Engineering **Winter 2000**

- Teaching Assistant
- Courses: *Thermodynamics I, Matrices and Advanced Calculus.*

McGill University, Tutoring Services **2000 – 2008**

- Lead Tutor (highly rated by students)
- Courses tutored:
  - **Engineering**: Statics, Mechanics of Solids, Fluid Mechanics, Heat Transfer, Thermodynamics.
  - **Mathematics**: Algebra, Trigonometry, Elementary and Advanced Calculus, Ordinary and Partial Differential Equations, Fourier/Laplace Transforms, Matrices and Linear Algebra, Numerical Methods, Computer Programming.

RESEARCH INTERESTS

- Computational Fluid Dynamics (CFD) and Computational Aeroacoustics (CAA)
- Wind Energy & Renewables

- High-Order Numerical Methods
- Aerodynamic Design and Optimization
- Parallel Algorithms and Solution Methods (iterative, domain-decomposition, etc.) for HPC

RESEARCH & INDUSTRIAL EXPERIENCE

Basque Center for Applied Mathematics (BCAM), Bilbao, Spain **June – July 2013**

➢ *Visiting Fellow*

- Established framework for research collaboration with Prof. L. Remaki on aeroacoustics design and simulation of fans and compressors. The collaboration was within the framework of the project: "Development of an efficient, flexible, and innovative CFD platform for simulation and optimal design of industrial products", funded by the government of the Basque country under grant no. DFB/BFA 6/12/TK/2012/00020
- Advised graduate students

GE Global Research Center, Aerodynamics & Acoustics Lab., Niskayuna, NY, USA **2008 – 2012**

➢ *Research Engineer*

(Note: Due to the proprietary nature of my research at GE, project details could not be disclosed)

- Was the first to identify the mechanism associated with "abnormal" amplitude modulation of wind turbines using numerical simulations, leading to an important patent. This work helped significantly advance GE's understanding of this phenomenon and provided clear directions for future research into noise reduction of wind turbines, especially for wind farms
- Performed detailed acoustic analysis of fan-booster interaction noise for the newly launched GE9X engine program, including analytical study of noise sources, innovative design changes for noise reduction, and validation.
- Designed and analyzed an active flow control system aimed at increasing aerodynamic efficiency of a proprietary GE Wind Turbine. Tasks included analysis and down-selection of the design, providing technical support for wind tunnel tests, analysis of experimental data, and detailed model validation
- Performed numerical simulations (using **PROPID** & in-house codes) to analyze aerodynamic losses in the root section of a GE Wind Turbine. The study determined the entitlement for different loss mechanisms and helped shape future research to improve blade aerodynamic efficiency
- Successfully designed a number of low-noise blade concepts for the **Open Rotor** engine program through detailed aerodynamic design and acoustic analysis. Some of these concepts were down-selected as final designs and were tested at NASA Glen wind tunnel in 2011
- Supported low-speed wind tunnel tests of the **Open Rotor** engine architecture, a joint effort of GE Aviation and NASA Glen Research Center. Conducted a series of pre- and post-test acoustic simulations on the first generation of blade designs, provided comparison with test data and an in-depth analysis of noise characteristics of different design configurations
- Conducted a fundamental study on noise source characterization for the **Open Rotor** engine to quantitatively determine contribution of different noise generating mechanisms. The results from this study were subsequently used for designing a number of blades for low-speed testing at NASA Glen in 2010

McGill University, CFD Laboratory, Montreal, Canada **2000 – 2007**

➢ *Post-doctoral Fellow*

- Developed a very versatile helicopter noise prediction software based on permeable surface FW-H equation for **Bell Helicopter Canada** capable of aeroacoustic simulations of helicopters with

arbitrary configuration (multiple main/tail rotors, non-uniformly spaced blades, user-defined articulation) under hover, forward flight, or arbitrary flight conditions. The program was validated against similar codes developed at NASA

➢ *Research Assistant*

- Developed a 3D software (with 14000+ lines of coding) for **Pratt & Whitney Canada** to simulate forward-propagating tone noise of aircraft engines for 3D nacelle shapes of arbitrary geometry. The code, similar to **ACTRAN™**, was applicable to any kind of ducted acoustic problems, whether 2D or 3D, and could also be applied to nacelle/fuselage scattering
- The formulation was based on the linearized Euler equations solved in the frequency domain using the spectral element method (SEM)
- Solution of the resulting multi-million set of equations was performed in parallel, with the extensive use of PETSc/MPI libraries, on CLUMEQ supercomputer using a non-overlapping domain decomposition technique (Schur complement). The code was capable of running on both distributed- and shared-memory supercomputers or cluster of workstations
- A novel preconditioner (modified Neumann-Neumann) was developed for the Schur matrix. The preconditioner was shown to be robust and lead to signification reduction in solution time
- The 3D code also included a mean flow solver based on the full potential equation to take into account the effects of external flow on the radiated sound field. It used the Conjugate Gradient solver with additive Schwarz as preconditioner
- The code was validated and successfully applied to realistic 3D engine geometries and nacelle/fuselage combinations, with or without mean flow
- It was optimized for memory usage and provided excellent parallel scaling

National Institute for Aviation Research (NIAR), Wichita, Kansas, USA **1996-1999**

➢ *Research Assistant*

- Modified and upgraded **ProRAPP** code to simulate the effect of impulsive noise of supersonic helicopter blades
- Was selected as one of 3 final contestants under **NASA AGATE** program to perform a series of simulations for aircraft propeller noise
- Developed a computer program to analyze the performance of a propeller/helicopter rotor under different flight conditions and shaft orientations in both variable-pitch & constant-speed modes
- Developed a model to study the effect of blade-vortex interaction (BVI) on airfoils

Concordia University, CFD Laboratory, Montreal, Canada **1993-1996**

➢ *Research Assistant*

- Developed a general purpose 2D finite element CFD code using the least-squares method for the solution of Euler equations
- Incorporated a moving-node mesh adaptation technique to significantly enhance accuracy
- Validated and successfully applied the code to transonic and supersonic test cases

PUBLICATIONS

- F. Taghaddosi *et al.*, "Amplitude Modulation of Wind Turbine Noise: Understanding the Root Cause," *Technical Report*, General Electric Global Research Center, Niskayuna, NY, 2012.

- K. Ramakrishnan, F. Taghaddosi and T.H. Wood, "Open Rotor Engine Design Record Book", *Technical Report*, General Electric Global Research Center, Niskayuna, NY, 2010.

- A. Sharma, F. Taghaddosi, A. Gupta, A. Gopinath, M.E. Braaten, and S. Herr, "Diagnosis of Aerodynamic Losses in the Root Region of a Horizontal Axis Wind Turbine," *Technical Report*, General Electric Global Research Center, Niskayuna, NY, 2009.

- F. Taghaddosi and W.G. Habashi, '3D Parallel Spectral Computations of Fan Noise,' European Conference on Computational Fluid Dynamics (ECCOMAS CFD 2006), Netherlands, Sep. 2006.

- F. Taghaddosi, W.G. Habashi and G. Guèvremont, '3D Computations of Noise Propagation from Ducted Fans Using a Spectral Element Method,' *AIAA Paper 2004-0520*, 42nd AIAA Aerospace Sciences Meeting and Exhibit, Reno, Nevada, January 2004.

- F. Taghaddosi and R.K. Agarwal, 'Quadrupole Modeling for Prediction of High-Speed Impulsive Noise of Propellers,' *AIAA Paper 2000-2089*, 6th AIAA/CEAS Aeroacoustics Conference and Exhibit, 2000.

- F. Taghaddosi, W.G. Habashi, G. Guèvremont, and D. Ait-Ali-Yahia, 'An Adaptive Least-Squares Method for the Compressible Euler Equations,' *Int. J. on Numerical Methods in Fluids*, Vol. 31, pp. 1121-1139, 1999.

- F. Taghaddosi, J.M. Gallman, and R.K. Agarwal, 'Development and Validation of a Propeller/Rotor Acoustic Prediction Program (ProRAPP),' *AIAA paper 98-2285*, 4th AIAA/CEAS Aeroacoustics Conference, Toulouse, France, June 1998.

- F. Taghaddosi, W.G. Habashi, G. Guèvremont, and D. Ait-Ali-Yahia, 'An Adaptive Least-Squares Finite Element Method for the Compressible Euler Equations,' *AIAA paper 97-2097*, 13th AIAA computational Fluid Dynamics Conference, Snowmass, Colorado, June 1997.

PROPOSALS

- "Teaching Innovation Institute", University of Kentucky, 2020. Amount Awarded: $6000. Among 24 awardees from across the university. The training involved two semesters of exploration, experiment, and reflection on developing innovative digital and multimodal pedagogies and instructional skills to enhance student learning at the University of Kentucky.

- "eLearning Innovative Initiative", University of Kentucky, 2019. Amount Awarded: $6000. Selected as a participant in an intensive faculty development program to improve student learning outcomes, student success, engagement and retention through creative course design and application of learning technologies.

- "Aeroacoustic Design and Optimization of a Lightweight Supersonic Unmanned Aerial System," F. Taghaddosi, Senior Personnel, NSF REU Site Proposal on *Parallel Computations of Complex Fluids using Open-source Software*, University of Colorado Boulder, submitted August 2014.

- "Fly-over Noise Measurement Using Microphone Arrays," *R&D Proposal to Bombardier Aerospace:* F. Taghaddosi and W.G. Habashi, CFD Laboratory, McGill University, 2006.

- "Prediction and Minimization of Rotor Noise via Computational Aeroacoustics," *R&D Proposal to Bombardier Industrial Chair in Multi-disciplinary CFD:* F. Taghaddosi and W.G. Habashi, CFD Laboratory, McGill University, 2005.

PROJECT REPORTS

- F. Taghaddosi, "A Review of Two-Dimensional Blade-Vortex Interaction," Aerospace Engineering Department, Wichita State University, May 1998.

- F. Taghaddosi, "Transition in Hypersonic Flow," Aerospace Engineering Department, Wichita State University, December 1997.

- F. Taghaddosi, "A Review of Separation Bubble Models for Low Reynolds Number Airfoils," Aerospace Engineering Department, Wichita State University, December 1996.

AWARDS & PATENTS

- ASME Bluegrass Chapter **Outstanding Faculty** in Mechanical Engineering, U. Kentucky. **2020**
- **US Patent 20140219795 A1:** *Method and Apparatus for Wind Turbine Noise Reduction*, General Electric Co. Research Center. **2014**
- **Technology of the Year Award**: Open Rotor Project, GE Research Center. **2011**
- **Award for Aero Design:** Active Flow Control for Wind Turbines, GE Research Center. **2010**
- **Award for Technical Excellence:** Open Rotor Aeroacoustic Design, GE Research Center. **2009**
- **Award for Outstanding Teamwork:** Open Rotor Project, GE Research Center. **2008**

INVITED TALKS & LECTURES

Basque Center for Applied Mathematics (BCAM), Bilbao, Spain **July 2013**

- "Fluid Mechanics and Aeroacoustics of Fans and Compressors": A three-day short course. (http://www.bcamath.org/en/courses/bcamcourse2013-06-02-04-ftaghaddosi)

PROFESSIONAL & COMMUNITY SERVICE

- **Senior Member**: American Institute of Aeronautics and Astronautics (AIAA).
- **Product Advisory Committee Member, John Wiley & Sons**, 2019-present.
- **Editorial Reviewer, McGraw-Hill Publication**: Preformed prepublication review of the textbook: *Thermodynamics*, Cengel et al., 9th Edition, 2019. Checked solutions for end-of-chapter problems for Chapter 5 for accuracy, use of proper units, and ABET outcomes for the Connect companion site.
- **Focus Group Member**, McGraw-Hill Mechanical Engineering Symposium, Austin, TX, 2018. Joined 14 other instructors from across the country to discuss adding and improving pedagogical features to major textbooks on Thermodynamics & Statics. For example, methods to enhance digital content through addition of short videos (on concepts and applications), suggestions to improve Connect interface, adding more in-depth information on student progress and activities to the interface, and introducing the newly launched tool for creating free-body diagrams.
- **Prepublication Editorial Reviewer**, *System Dynamics* by Yang & Abramova, Cambridge U. Press. Reviewed three chapters and two appendices, provided feedback on book outline, presentation of material, accuracy & currency, structure and organization of material, and pedagogical features, 2018.

- **Invited Guest**, Wiley EdTech Summit, Hoboken, NJ, 2018. Discussed best practices to effectively leverage digital resources to improve student engagement.
- Conducted detailed review of pedagogical features of ***Fundamentals of Eng. Thermodynamics***, Moran *et al.,* and its companion WileyPLUS e-text, 2018.
- **Head Judge**, AIAA Region III Student Conference, Purdue University, April 2018.
- **Technical Judge**, Kentucky Science & Engineering Fair, Eastern Kentucky University, 2018-2020.
- **Technical Paper Judge**, AIAA Region III Student Conference, University of Michigan, Mar 2017.
- **Prepublication Reviewer** of WileyPLUS Next Gen site for *Fluid Mechanics,* Munson, 8th Edition, 2016.
- **Guest Speaker**, Women in Engineering Summer Workshop (WEISS), University of Kentucky, 2016.
- **Technical Paper Judge,** AIAA Region III Student Conference, U. Illinois Urbana-Champaign, 2016.
- **Technical Paper Judge**, AIAA Region V Student Conference, Wichita, KS, 2015.
- **Technical Judge**: Western Colorado Science Fair (middle- and HS student projects), 2013 & 2014.
- **Session Chair**: 40th AIAA Fluid Dynamics Conference, Chicago, 2010.
- **Reviewer**: Int. Journal of CFD (2006); AIAA Fluid Dynamics Conference (2010); ASME Turbo Expo Conference, IGTI (2010).

SERVICE TO DEPARTMENT

- Member, **Engineering Technology Task Force**. Active participant; Drafted the four-year curriculum for the Mechanical Engineering Technology program, U. Kentucky College of Engineering, 2019.
- **Undergraduate Studies** committee member, U. Kentucky, ME Department, 2018-2020.
- **Distance Learning** committee member, U. Kentucky, ME Department, 2017-2018.
- **Aerospace Curriculum** committee member, U. Kentucky, ME Department, 2016-2017.
- **Activities & Awards** committee member, U. Kentucky, ME Department, 2015-2016.
- **Faculty Senate** Distinguished Award Committee Member, Colorado Mesa University, 2014.
- **International Education** Committee Member, Colorado Mesa University, 2014.

PROFESSIONAL TRAINING

- *'Six-Sigma Green Belt Certification'*, GE Global Research Center, Niskayuna, NY, USA.
- *'Phased Array Beamforming for Aeroacoustics'*, AIAA Short Course.
- *'Parallel Preconditioned Iterative Solution Methods for Large Linear Systems',* Short Course, CLUMEQ Supercomputer Center, McGill University, Montreal, Canada.
- *'University Teaching Workshop'*, Center for Teaching and Learning Services, Concordia University, Montreal, Canada.
- '*Von Karman Lecture Series in Computational Fluid Dynamics*', Von Karman Institute, held in North America at Concordia University, Montreal, Canada.
- *'Finite Element Method in Computational Fluid Dynamics and Heat Transfer',* Short Course, Purdue University School of Engineering and Technology (IUPUI), Indianapolis, IN, USA.
- *'Workshop on Iterative Solution Methods for Large-scale Equation Systems'*, Centre de Recherche en Calcul Appliqué (CERCA), Montreal, Canada.

TECHNICAL & COMPUTER SKILLS

- 15+ yrs of experience in object-oriented engineering software development.
- Experienced user of commercial CFD/CAD/grid generation software: UG, ICEM CFD, CFX, SolidWorks.
- Proficient in parallel programming using MPI & PETSc.

REFERENCES

Prof. Wagdi G. (Fred) Habashi – C.Q., FRSC,FCAE,FAIAA,FASME
Professor and Director of CFD Lab, Department of Mechanical Engineering, McGill University
NSERC-Lockheed Martin-Bell Helicopter Industrial Research Chair for Multi-physics Analysis and Design of Aerospace Systems
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