

Hang Li

Postdoctoral Researcher

Mechanical, Aerospace, Computational Science & Biomedical

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Education

- December 2019 **Doctor of Philosophy in Mechanical Engineering**
Ph.D. Minor: Computational Science
University of Tennessee, Knoxville - United States
Dissertation title: "*The One-shot Aeroelastic Method: a Highly Efficient Modeling Approach Based on the Harmonic Balance Technique*"
Advisor: Dr. Kivanc Ekici
- August 2018 **Master of Science in Mechanical Engineering**
University of Tennessee, Knoxville - United States
Advisor: Dr. Kivanc Ekici
- January 2014 **Master of Engineering in Aeronautical Engineering**
Beihang University - China
Thesis title: "*Development of a Flight Loads Test Method for Wing Structures*"
Advisor: Dr. Zhiqiang Wan
- July 2011 **Bachelor of Engineering in Aircraft Design and Engineering**
Beihang University - China
Thesis title: "*The Overall Design of a Flying Vehicle Based on the Coanda-Effect*"
Advisor: Dr. Zhiqiang Wan

Professional Experience

- Aug 2021 - July 2024 (expected) **Postdoctoral Scholar**
Computational Aerodynamics and Flow Physics Lab (CAFPLab)
Department of Mechanical and Aerospace Engineering
The Ohio State University
- Develop simulation techniques for vehicle aerodynamics and aeroacoustics, including vibro-acoustic models for greenhouse noise prediction and reduction;
 - Act as the first-level advisor to lab students on their projects.

Oct 2019 - **Postdoctoral Associate**

July 2021 *Computational Modeling Research Lab*

Department of Head and Neck Surgery & Communication Sciences

Duke University & Health System

- NIH-funded project (R01DE028554) "Computational modeling of the mature unilateral cleft lip nasal deformity for objective assessment of patient nasal function and treatment outcomes";
- Modeled and assessed objectively the airflow and air-conditioning (heating and humidification) characteristics of breathing air in human nasal cavities under cleft conditions;
- Developed MPI-paralleled C++ codes and Scheme scripts for new models and boundary conditions in the Ansys Fluent environment;
- Quantified simulation uncertainties due to computational domain discretization;
- Simulated the effectiveness of face masks using a porous-jump boundary condition;
- Studied inhaled particle deposition using discrete phase modeling for particle tracking;
- Designed an in-vitro experimental testbed for studying nasal airflow characteristics using 3D-printed models, flow & pressure sensors and LabVIEW-based data acquisition;
- Mentored two students for conducting lab research of computational flow simulations.

Aug 2014 - **Graduate Research/Teaching Assistant with Chancellor's Fellowship**

Aug 2019 *Computational Fluid Dynamics (CFD) Lab*

Department of Mechanical, Aerospace and Biomedical Engineering

University of Tennessee, Knoxville

- NSF-funded project (CBET-1150332) "A Multidisciplinary Framework for Innovative Design of Wind Turbines";
- Developed and validated multiple novel Fourier-based, highly efficient and robust One-shot pseudo-time code-coupling algorithms for solving various non-linear fluid-structure interaction (FSI) problems (e.g. flutter onset, limit-cycle oscillation and vortex-induced vibrations (VIV));
- Developed and validated the supplemental frequency harmonic balance (SF-HB) method for efficiently solving dynamic systems under multiple excitation of distinct frequency values;
- Developed an efficient Chebyshev-based time-spectral approach for modeling periodic and non-periodic dynamic response;
- Developed and validated multiple fluid dynamics and structural dynamics solvers in Fortran and C++ with MPI and OpenMP parallelization for resolving nonlinear partial and ordinary differential equations;
- Assisted the teaching of undergraduate course. Responsibilities included grading, holding office hours for Q&A and serving as a proctor on behalf of primary instructors.

Sep. 2011 - **Graduate Research/Teaching Assistant**

Jan. 2014 School of Aeronautics, Beihang University

- Developed a method to test flight loads for wing-like structure;
- Analyzed flight loads of an amphibian airplane under longitudinal trim condition based on Finite Element Simulation and wind tunnel experiments;
- Conducted static aeroelastic analysis of a delta wing model associated with a high speed air vehicle design using the ZONA software;
- Assisted the teaching of undergraduate course "Introduction to Aerospace Engineering" for four semesters. Responsibilities included grading, holding office hours for Q&A and serving as a proctor on behalf of primary instructors.

April 2012 - **Instructor of the Aeromodeling Team**

April 2013 Beihang University

- Employed as a graduate instructor after had been an undergraduate member of this team for four years and served as the team leader in 2010

June 2008 - **Undergraduate Research Assistant**

May 2011 School of Aeronautics, Beihang University

- Designed, fabricated and tested two vertical take-off and landing (VTOL) aircraft prototypes based on the Coanda effect;
- Developed a scaled test model of a transport aircraft, which was later used for both undergraduate and graduate experiment courses;
- Field tests of unmanned aerial systems (UAS).

Publications

Journal Papers

- 1- **Hang Li**, Hannah L. Martin, Jeffrey R. Marcus and Dennis O. Frank-Ito, "*Analysis of Nasal Air Conditioning in Subjects with Unilateral Cleft Lip Nasal Deformity*", Respiratory Physiology & Neurobiology, 2021, DOI: <https://doi.org/10.1016/j.resp.2021.103694>
- 2- Yash J. Avashia, Dennis O. Frank-Ito, Hannah L. Martin, **Hang Li**, Carolyn Lowery, Charles Woodard and Jeffrey R. Marcus "*Computational Analyses of Physiologic Effects after Midvault Repair Techniques in Rhinoplasty*", Plastic and Reconstructive Surgery, Under Review
- 3- **Hang Li** and Kivanc Ekici, "*Supplemental-Frequency Harmonic Balance: A New Approach for Modeling Aperiodic Aerodynamic Response*", Journal of Computational Physics, Vol. 436, July 2021, DOI: <https://doi.org/10.1016/j.jcp.2021.110278>
- 4- Kivanc Ekici, Reza Djeddi, **Hang Li** and Jay I. Frankel, "*Modeling Periodic and Non-periodic Response of Dynamical Systems Using an Efficient Chebyshev-Based Time-Spectral Approach*", Journal of Computational Physics, Vol. 417, September 2020, DOI: <https://doi.org/10.1016/j.jcp.2020.109560>

- 5- **Hang Li** and Kivanc Ekici, "*Aeroelastic Modeling of the AGARD 445.6 Wing Using the Harmonic-Balance-Based One-Shot Method*", AIAA Journal, Vol. 57, No. 11, 2019, pp. 4885-4902. DOI: <https://doi.org/10.2514/1.J058363>
- 6- **Hang Li** and Kivanc Ekici, "*A Novel Approach for Flutter Prediction of Pitch-Plunge Airfoils Using an Efficient One-Shot Method*", Journal of Fluids and Structures, Vol. 82, October 2018, pp. 651-671. DOI: <https://doi.org/10.1016/j.jfluidstructs.2018.08.012>
- 7- **Hang Li** and Kivanc Ekici, "*Improved One-Shot Approach for Modeling Viscous Transonic Limit Cycle Oscillations*", AIAA Journal, Vol. 56, No. 8, 2018, pp. 3138-3152. DOI: <https://doi.org/10.2514/1.J056969>
- 8- **Hang Li** and Kivanc Ekici, "*Revisiting the One-Shot Method for Modeling Limit Cycle Oscillations: Extension to Two-Degree-of-Freedom Systems*", Aerospace Science and Technology, Vol. 69, October 2017, pp. 686-699. DOI: <https://doi.org/10.1016/j.ast.2017.07.037>

Conference Papers

- 1- **Hang Li** and Kivanc Ekici, "*Aeroelastic Modeling of a Three-Dimensional Wing Using the Harmonic-Balance-Based One-Shot Method*", presented as Paper No. 0607 at the AIAA SciTech 2019 Forum (Jan. 7-11, 2019, San Diego, CA), DOI: <https://doi.org/10.2514/6.2019-0607>
- 2- **Hang Li** and Kivanc Ekici, "*Modeling Limit Cycle Oscillations Using a Second-Order Pseudo-Spectral Harmonic Balance Approach*", presented as Paper No. 3644 at the 2018 Applied Aerodynamics Conference (June 25-29, 2018, Atlanta, GA). DOI: <https://doi.org/10.2514/6.2018-3644>
- 3- **Hang Li** and Kivanc Ekici, "*An Improved One-Shot Approach for Modeling Viscous Transonic Limit Cycle Oscillations*", presented as Paper No. 0460 at the 2018 AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference (Jan. 8-12, 2018, Kissimmee, FL), DOI: <https://doi.org/10.2514/6.2018-0460>

Poster

- 1- **Hang Li**, Jeffrey Marcus and Dennis Frank-Ito, "*Computational Modeling of Nasal Air-Conditioning in Cleft and Normal Subjects*", presented at Duke Research Computing Symposium 2020 (Feb. 5, 2020, Durham, NC)

Awards & Honors

- 2017-2019 **Chancellor's Fellowship**
University of Tennessee, Knoxville
- 2018 **Chancellor's Citation for Extraordinary Professional Promise**
University of Tennessee, Knoxville
- 2019 **Outstanding Graduate Student Award**
Department of Mechanical, Aerospace and Biomedical Engineering
University of Tennessee, Knoxville

- 2018 **Outstanding Contribution in Reviewing**
Aerospace Science and Technology (Journal)
Elsevier
- 2011-2013 **University Graduate Fellowship**
Beihang University
- 2012 **Outstanding Graduate Student Award**
Beihang University
- 2011 **The Seventh National Science and Technology Innovation Award for Youth**
Biannually, the highest honor of innovative activities for youth in China
- 2010 **Special Award in Beijing and Second Class Award in the National Final**
The Challenge Cup of Scientific Achievement Competition
Ministry of Education of China, Association of Science and Technology of China
- 2009-2011 **Undergraduate Scholarships for Outstanding Innovation Activities**
Beihang University
- 2008-2010 **One championship and three second places**
National Aeromodeling Competition of China for College Students

Membership

- 2019-present **Sigma Xi: The Scientific Research Honor Society**
- 2017-present **American Institute of Aeronautics and Astronautics (AIAA)**

Research Skills

Mechanical & Aerospace Engineering

- *Statics and Dynamics, Solid Mechanics, Structural Dynamics, Fluid Mechanics, Compressible Flow, Turbulence, Fluid-Structure Interaction, Aeroacoustics, Thermodynamics, Turbomachinery, Aircraft Design, Flight Mechanics*
- *Engineering Graphics, Machine Design, 2D/3D Modeling using AutoCAD, Inventor, SolidWorks and CATIA*
- *Operation of Traditional and CNC Processing Tools, Casting, Laser Cutting and 3D Printing*
- *Design, Fabrication and Operation of Unmanned Aerial Vehicles (UAV)*

Mathematical Modeling & Numerical Analysis

- *Dense/Sparse Linear Algebra, Eigenproblems, Nonlinear Equations, Fourier and Chebyshev-based Methods, Polynomial Approximation and Interpolation, Differentiation and Integration, ODE, PDE, Optimization, Stability Analysis, Uncertainty Quantification*
- *Unsteady Computational Fluid Dynamics (CFD) Simulation and Code Development in both Time and Frequency Domains*

- *Static and Dynamic Fluid-Structure Interaction (FSI) Analysis and Code Development using Traditional Methods and Modern Fourier-Based Techniques*
- *Fluid Dynamics and Heat Transfer Modeling using COMSOL Multiphysics and Ansys Fluent*
- *Finite Element Analysis (FEA) and Flight Load Analysis using Patran/Nastran*
- *Sensitivity Analysis using Automatic Differentiation (AD) and Gradient-Based Optimization*
- *Particle Tracking using Discrete Phase Modeling*
- *Porous Media Modeling using Porous Zone Conditions and Porous-Jump Boundary Conditions*

Programming, Simulation Tools & Documentation

- *Fortran, C/C++, MPI, OpenMP, Python, MATLAB, Data Structures and Algorithms, Git, Intel oneAPI, GDB Debugger*
- *LAPACK and BLAS, SuperLU, Intel MKL, MUMPS, Y12M, NumPy*
- *Linux, Mac OS and Windows OS, HPC, bash shell scripting, Lustre file system, PBS and Slurm workload managers)*
- *STAR-CCM+, Simcenter 3D, COMSOL Multiphysics, Ansys Fluent, ICEM-CFD, CFD-Post, Pointwise, Patran/Nastran, Tecplot, ParaView, VisIt, Aviso, LabVIEW*
- *L^AT_EX, Microsoft Office, Xmgrace, Notion*

Experiments

- *Wind Tunnel and Flight Tests of UAV*
- *In-Vitro Experiments of Nasal Airflow*
- *LabVIEW Programming for Serial Communication, Data Acquisition (DAQ)*

Rhinology

- *Interpret and Analyze the Anatomy and Physiology of Sinonasal Airway*
- *Using the Aviso Software to Reconstruct 3D Anatomically Realistic Upper Respiratory Airway Models from CT Scans*
- *Respiratory Airflow and Air-Conditioning (Heating and Humidification) Simulations*

Web Profiles

Google Scholar <https://scholar.google.com/citations?hl=en&user=OG2U1AgAAAAJ>

ResearchGate <https://researchgate.net/profile/Hang-Li-2>