ADITYA SAINI

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EDUCATION

- **Ph.D., Aerospace Engineering** **2017** **GPA: 3.89/4**
  North Carolina State University (Raleigh, NC)

- **Master of Science, Aerospace Engineering** **2014** **GPA: 3.87/4**
  North Carolina State University (Raleigh, NC)

- **Bachelor of Technology, Mechanical Engineering** **2012** **GPA: 7.94/10**
  Indian Institute of Technology (Ropar, India)

Relevant coursework: Applied Aerodynamics, Airfoil and Wing Theory, Computational Fluid Dynamics, Experimental Fluid mechanics, Advanced Dynamics, Flight Vehicle Aerodynamics (MIT-edx), Engineering Design Optimization, Advanced Convective Heat Transfer, Fluid Dynamics of Combustion, Propulsion Systems, Energy Science and Technology, Power Plant Engineering.

SKILLS

- Deep understanding of flight vehicle aerodynamics (fixed wing/rotorcraft) and aero-thermal dynamics.
- Expertise in numerical tools for aerodynamic design and analysis of airfoils/wings (XFOIL, PROFOIL, AVL, XFLR5) and aircraft conceptual design (OpenVSP).
- Experienced in commercial CFD software packages like STAR-CCM+ and ANSYS (CFX, FLUENT).
- Experienced in developing low-order Panel Methods and high-order incompressible Navier-Stokes flow solver.
- Expertise in experimental testing and data acquisition (LabVIEW programming, NI DAQs).
- Programming Languages/Tools: Python, MATLAB, Fortran, and MATHEMATICA.
- CAD Tools (6+Yrs. Experience): SolidWorks, AutoCAD, and CATIA.
- Proficient in signal processing, data analysis/visualization, feature extraction, and scripting & automation.
- Experienced in statistical modeling and machine learning techniques for intelligent asset management.

WORK EXPERIENCE

DEI Group, MD **Reliability Engineer** ***April 2018 – Present***

- Develop and analyze algorithms for anomaly detection and predictive risk modeling of equipment for intelligent asset management.
- Develop Bayesian belief networks using sensor data and physics-based calculations for the determination of failure probability index (health/degradation) associated with different failure mechanisms.
- Responsible for complete diagnostics and prognostics analysis of Gas Turbine Engines (GE's LM2500 & Mitsubishi's M501GAC).
- Identify and extract features from high speed waveform data, using Order Analysis and FFT, for monitoring of Hydropower generator failure modes.
- Conduct Failure Mode and Effects Analysis for condition-based monitoring of multiple critical equipment.

North Carolina State University **Research & Teaching Assistant** ***March 2013 – April 2018***

- Developed novel technique for aerodynamic parameter estimation and stall detection.
- Simulated & analyzed CFD data (steady and unsteady) and automated CFD post-processing and data analysis using Tecplot & MATLAB.
- Conducted wind-tunnel tests for validating low-order methods. Designed & fabricated experimental models and setups for investigating the flow in different scenarios, such as flow past airfoil models, airfoil in the wake of a cylinder, flat plate with bluff bodies etc.
- Developed a digital PID controller using LabVIEW for tuning a single degree-of-freedom electromechanical plant for teaching PID tuning as part of the control's lab.
- Simulated and animated robotic manipulator motions (forward and inverse kinematics) by developing a GUI in MATLAB as a teaching aid in the graduate level robotics course.

RESEARCH EXPERIENCE

Leading-Edge Flow Sensing Algorithm **North Carolina State University**

- Developed a novel algorithm for real-time estimation of aerodynamic parameters using discrete surface pressures measured at a few ports near the leading edge of a wing or blade section.
- The algorithm directly computes the inflow velocity, the stagnation-point location, section angle of attack and lift coefficient (without any calibration for airfoils with thickness less than 15% of chord).
- Demonstrated the functioning of the LEFS algorithm on computational data (steady & unsteady simulations) and wind-tunnel data (steady flow & rotating blade).
- Successfully applied the LEFS algorithm for detecting surface pressure signatures associated with leading-edge vortex formation, shedding, and detachment from airfoils undergoing unsteady motions.

Stall Detection and Post-Stall Aerodynamics **North Carolina State University**

- Investigated surface-mounted pressure probes for detecting flow-separation and identifying stall onset.
- Designed & conducted wind-tunnel experiments to assess the effectiveness of the LEFS method in deducing the loss of dynamic pressure due to wake impingement on tail surfaces.
- Augmented the LEFS algorithm with Kirchhoff equations for identifying aerodynamic parameters in post-stall conditions.

Aerodynamic Flow Sensing with Elastic Microfence Structures **North Carolina State University**

- Designed wind-tunnel setups and evaluated the performance of microfence structures quantifying shear-stress and identifying critical aerodynamic flow features, in collaboration with NASA Langley Research Center.
- Designed experiments to characterize the directional sensitivity of the micro-structures by creating flow reversal at the sensor location during wind-tunnel runs.
- Successfully minimized the effects of flow-induced vibration in the recorded videos using image processing algorithms in MATLAB and Python during post processing.
- Explored bimorph piezo-system for flow sensing using energy formulation and Euler-Bernoulli beam theory.

PROJECTS

Aerodynamic Design & Analysis **North Carolina State University**

- Conducted preliminary aircraft sizing study and performance analysis for conceptual VTOL aircraft (modeled using OpenVSP).
- Evaluated propeller performance using blade element momentum theory (BEMT) for comparison with experimental data obtained using the propeller test rig in the NCSU subsonic wind tunnel.
- Performed a parametric study to analyze the effect of varying thickness, laminar extent, and flap deflection on the drag bucket of a cambered natural-laminar-flow airfoil using PROFOIL, MFOIL & XFOIL.
- Created codes based on the Lifting-Line theory and Vortex Lattice method for the analysis of different subsonic wing configurations.

Computational Fluid Dynamics **North Carolina State University**

- Conducted CFD analysis of unsteady airfoil pitching motion at different oscillating frequencies in ANSYS Fluent to understand leading-edge vortex formation.
- Created meshes using ICEM CFD and developed User-Defined Function (UDF) for sliding zone motion.
- Developed CFD codes for solution of Incompressible Navier-Stokes Equations using Finite Volume Methods for a driven cavity and for flow in a divergent channel (with and without an immersed body) using FORTRAN.

Advanced Dynamics Simulations **North Carolina State University**

- Developed mathematical models for tilt-rotor aircraft dynamics and conceptual lighter-than-air airborne wind turbine system.
- Modeled and simulated the multi-body motion of a gyroscopic system using Newton-Euler approach.
- Animated the system for comparison with the real experimental setup to analyze the phenomenon of precession and nutation.
- Analyzed and compared different methods (Newton-Euler, Lagrangian, and Kane's method) for modeling and simulating the chaotic behavior of a double pendulum.

SELECTED PUBLICATIONS

Journal

- **Saini, A.** and Gopalarathnam, A."Leading-Edge Flow Sensing for Aerodynamic Parameter Estimation", AIAA Journal, Vol. 56, No. 12 (2018), pp. 4706-4718.
- Kim, T., **Saini, A.,** Kim, J., Gopalarathnam, A., Zhu, Y., Palmieri, F.L., Wohl, C.J. and Jiang, X., "Piezoelectric Floating Element Shear Stress Sensor for the Wind Tunnel Flow Measurement," in IEEE Transactions on Industrial Electronics, vol. 64, no. 9, pp. 7304-7312, Sept. 2017.

Conference

- **Saini, A.,** Kim, T., Cui, Z., Schuessler, B., Palmieri, F., Lin, Y., Connell, J., Jiang, X., Zhu, Y., Gopalarathnam, A. and Wohl, C.,"Aerodynamic Flow Sensing with Elastic Microfence Structures," AIAA Paper2017-0479, 2017.
- **Saini, A.,**& Gopalarathnam, A., "Determination of Section Aerodynamic Operating Condition on Wings and Rotor Blades from Leading-Edge Pressure Measurements,". AIAA Paper 2015-3290, 2015.
- Aleman, M. A., **Saini, A.,**& Gopalarathnam, A., "Airfoil Flow-Separation and Stall Detection Using Surface-Mounted Pitot Tubes," AIAA Paper 2017-3749, 2017.
- Kim, T., **Saini, A**., Kim, J., Gopalarathnam, A., Zhu, Y., Palmieri, F. L., ... & Jiang, X., "A piezoelectric shear stress sensor," Proc. SPIE 9803, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2016, 98032S (20 April 2016)

Invited Talk

- Gopalarathnam, A., **Saini, A**., Narsipur, S., Babu, A.V.S., Ramesh, K.K., "Surface Signatures for Leading Edge Vortex Shedding and Detachment from Unsteady Airfoils". In 55th AIAA Applied Aerodynamics Conference, Grapevine TX, January 2017.