SARASIJA SUDHARSAN

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Education

Iowa State University (ISU), Ames, IA
Ph.D., Aerospace Engineering (2024)
Dissertation title: A vorticity-based criterion for dynamic stall onset

Indian Institute of Science (IISc), Bangalore, India
M.S., Aerospace Engineering (2015)

Anna University, Chennai, India
B.E., Aeronautical Engineering (2012)

Employment

Aerospace/Mechanical Engineering, ISU, Ames, IA
Postdoctoral Research Associate & Instructor (Jul 2024 - Present)

Aerospace Engineering, ISU, Ames, IA
Graduate Research/Teaching Assistant (2017 - 2024)

Pacific Northwest National Laboratory (PNNL), Richland, WA
Regional Energy Innovator Intern (Oct 2022 - June 2023)

GE Aviation, Bangalore, India
Engineer, Turbine Aerodynamics (2014 - 2016)
Aero design ownership of the turbine rear frame on the GE9X engine (designed for the Boeing 777X)
Engineer, Analytics (2016 - 2017)
Calibrated a Kalman filter to predict component failures using measured engine data

Selected Research

Computational efficiency of data-based versus conventional Riemann solvers, present
With NSF funding and in collaboration with ISU Translational AI Center. Numerical schemes for compressible flows solve a Riemann problem at cell interfaces to compute fluxes. The present work evaluates the computational efficiency of conventional approaches such as Roe's scheme and data-based, neural-network approaches integrated into numerical schemes. These comparisons will include complexities such as modeling real gases.

Characterizing the onset of dynamic stall using a vorticity-based criterion, 2017 - 2024

With NSF funding and ALCF computational grants. Advisor: Dr. Anupam Sharma, ISU. The objective is to characterize the onset of stall over airfoils undergoing unsteady maneuvers using computational fluid dynamics. Based on the analysis of large-eddy simulation results, a fundamental, vorticity-based parameter providing insight into vortex formation during stall was identified. Nonlinear dynamical systems/modal decomposition techniques such as dynamic mode decomposition, wavelet transforms, and finite-time Lyapunov exponent fields to find coherent structures in the flow field were also explored.

Characterizing precipitation over onshore and offshore sites in the US, Oct 2022 - Jun 2023

With Department of Energy funding through PNNL. The goal of the project was to improve estimates of precipitation-induced leading edge erosion of wind turbine blades. Precipitation patterns over onshore and offshore sites in the US were characterized using disdrometer data for use in leading-edge erosion prediction models.

Experimental evaluation of turbine rear frame designs, 2015 - 2016

Collaboration between GE Aviation and Indian Institute of Technology, Madras. The objective was to evaluate the aerodynamic performance of various turbine rear frame designs. The test matrix was designed, the blade models were dynamically scaled and test data was processed for comparing different designs.

Criterion for vortex breakdown in swirling flows, 2012 - 2014

Research supported by IISc, Bangalore. Advisor: Dr. O. N. Ramesh, IISc. Numerical modeling of vortex breakdown in swirling flows was carried out in a closed cylinder configuration with one rotating lid. An in-house direct numerical simulation (DNS) code was modified for use with cylindrical coordinates. A helicity-based criterion representing vortex line linkages was proposed to characterize vortex breakdown.

Publications

Journal Articles:

- **Sudharsan, S.** and Sharma, A. (2024). Criteria for dynamic stall onset and vortex shedding in low-Reynolds-number flows. *Journal of Fluid Mechanics*, 996, A11. https://doi.org/10.1017/jfm.2024.753
- **Sudharsan, S.**, Narsipur, S., and Sharma, A. (2023). Evaluating Dynamic Stall Onset Criteria for Mixed and Trailing-Edge Stall. *AIAA Journal*, 1-16. https://doi.org/10.2514/1.J062011.
- **Sudharsan, S.**, Ganapathysubramanian, B., and Sharma, A. (2022). A vorticity-based criterion to characterise leading edge dynamic stall onset. *Journal of Fluid Mechanics*, 935, A10. https://doi.org/10.1017/jfm.2021.1149.

Submitted/ in preparation:

- A numerical demonstration of dynamic stall control.
- Applying dynamic stall criteria in the compressible regime.
- Comparison of precipitation characteristics at onshore and offshore US wind farm sites.

Conference Proceedings/Presentations:

- **Sudharsan, S.** (2024). A numerical demonstration of real-time dynamic stall control. In: *Bulletin of the American Physical Society*.
- **Sudharsan, S.**, Narsipur, S., and Sharma. A. (2023). Effects of Compressibility on Leading-Edge Dynamic Stall Criteria. In: *AIAA AVIATION 2023 Forum.* https://doi.org/10.2514/6.2023-3371.
- **Sudharsan, S.**, Narsipur, S., and Sharma, A. (2022). Evaluating Dynamic Stall Onset Criteria for Mixed and Trailing-Edge Stall. In: *AIAA SCITECH 2022 Forum.* https://doi.org/10.2514/6.2022-1983.
- **Sudharsan, S.**, and Sharma, A. (2021). Exploring Various Techniques to Characterize Leading-Edge Dynamic Stall Onset. AIAA 2021-2520. In *AIAA AVIATION 2021 Forum.* https://doi.org/10.2514/6.2021-2520.

Dissertations/Theses:

- **Sudharsan, S.** (2024). *A vorticity-based criterion for dynamic stall onset.* [Doctoral dissertation, Iowa State University, Ames, IA]. ProQuest Dissertations Publishing.
- **Sudharsan, S.** (2014). *Studies on vortex breakdown in a closed cylinder with a rotating endwall* [Master's thesis, Indian Institute of Science, Bangalore, India]. Electronic Theses and Dissertations of Indian Institute of Science https://etd.iisc.ac.in/handle/2005/2985.

Patents

Khan, M. H., **Sudharsan, S.**, Seshadri, G., Avancha, R., Dailey, L. D. (2017). Turbine rear frame for a turbine engine. *U.S. Patent 20170211399A1.* https://patents.google.com/patent/US20170211399A1/en

Grants

- Director's Discretionary Allocation Award of 30,000 node hours on high-performance computing systems in the Argonne Leadership Computing Facility (Aug 2022 - Dec 2023)
- Contributed to two successful federal grant proposals (NSF & DoE)

Honors/Awards

- Research Excellence Award, Graduate College, ISU (Summer 2023)
- Winner of 'Most Pedagogical' and 'Most Comprehensive' flow visualization awards at the AIAA Aviation Forum, San Diego, CA, June 2023 [(link to entry)](#)
- Alexander Lippisch Memorial Scholarship awardee for research productivity, ISU (2023)
- Graduate Teaching Excellence Award, Aerospace Engineering, ISU (Fall 2022)
- Scholarship to participate in the 'Fluid Dynamics of Sustainability and the Environment' 2022 summer school at L'École Polytechnique, France (declined)

Leadership & Service

Leadership

· Organized and moderated panel on 'Offshore wind in the US West Coast: Status, Challenges and Outlook' at the Regional Energy Innovator internship seminar, PNNL (April 2023)

- Selected to participate in the 'Rising Stars in Aerospace' Symposium at the University of Colorado Boulder (May 2022)
- Worked collaboratively in a fast-paced, short-term project team to identify solutions for accelerating career growth across GE businesses, Bangalore, India (2016)

Service
- Peer reviewer for Journal of Fluid Mechanics and American Institute of Aeronautics & Astronautics (AIAA) journal (2022 - Present)
- Contributed talk titled 'Precipitation-induced wind turbine blade erosion' at the Young Researchers Conference conducted by the Earth & Biological Sciences Directorate, PNNL (Feb 2023)
- Contributed research talk on the onset of dynamic stall over wind turbine blades at the Graduate and Professional Student Senate conference, ISU (Apr 2022)

Teaching Experience

Instructor of Record Mechanical Engineering, ISU

Designed/presented course lectures, assignments, and exams for an undergraduate class (class size ~ 70).

- ME 2310: Engineering Thermodynamics I (Fall 2024)

Teaching Assistant/Co-teacher Aerospace Engineering, ISU

Engaged with students in undergraduate classes (class sizes $\sim$ 40 - 60) through in-class sessions, office hours, grading, and feedback in the following courses.

- AER E 411: Aerospace Vehicle Propulsion (Fall 2022, Fall 2017)
  - conducted problem-solving sessions in engineering thermodynamics
- AER E 161: Numerical Techniques for Aerospace Engineering (Fall 2020)
  - led weekly lab sessions on coding in Matlab
- AER E 362: Aerospace Systems Integration (Spring 2019, 2020)
  - evaluated student work and provided feedback
- AER E 448: Fluid Dynamics of Turbomachinery (Spring 2018)
  - presented an introductory lecture on turbomachinery applications

Other GE Aviation

Conducted instructional sessions on Unix command line use for the Turbine Aerodynamics team

Memberships

American Physical Society
American Institute of Aeronautics & Astronautics

Skills

Programming Python, Matlab, Fortran, shell scripting, git, LaTeX