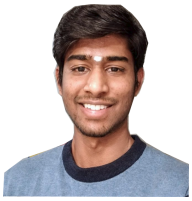
Komahan Boopathy — Curriculum Vitae



Senior R&D Engineer
Fluent High Performance Computing
ANSYS Inc.
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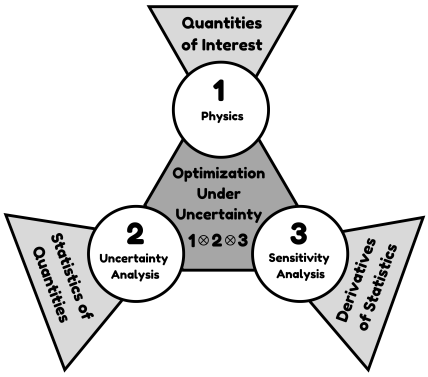
Research Objectives

My objective is to develop a foundational and scalable computational aerosciences framework for **multidisciplinary optimization under uncertainty**, unifying core mathematical principles with exascale-ready algorithms for aerospace system design.

Computational Aerosciences

- **Mathematical Science:** stochastic partial differential equations; discretization principles for spatial-, temporal-, and probabilistic coordinates; linear and nonlinear system solvers and preconditioners; semi-analytical sensitivity analysis; uncertainty quantification; surrogate models and neural networks; multi-dimensional numbers and algebra; synthesis of numerical and analytical methods; unified probabilistic-space-time algebra
- **Computational Science:** software architecture, standards and interfaces for UQ, OUU, MDOUU; orthogonalization of hardware, geometry, physics, and algebra implementations; scalable data structures and algorithms; heterogeneous high performance computing; parallel-partitioners and assemblers; graph schedulers; contextual reflection of abstract interfaces
- **Physical Science:** flexible multibody dynamics and fluid mechanics (standalone and coupled); generalized governing frameworks for mechanics; stochastic and deterministic physics



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Education

Doctor of Philosophy in Aerospace Engineering — Fall 2015–Summer 2020

⋆ **Georgia Institute of Technology** — Atlanta, Georgia, United States

- Thesis: Adjoint Based Design Optimization of Systems with Time Dependent Physics and Probabilistically Modeled Uncertainties
- Advisor: Dr. Graeme J. Kennedy

Master of Science in Aerospace Engineering — Fall 2012–Spring 2014

⋆ **University of Dayton** — Dayton, Ohio, United States

- Thesis: Uncertainty Quantification and Optimization Under Uncertainty Using Surrogate Models
- Advisor: Dr. Markus P. Rumpfkeil

Bachelor of Technology in Aerospace Engineering — 2008–2012

⋆ **SRM University** — Chennai, Tamilnadu, India

- Gold medalist for Rank I and final year at the University of Dayton under dual-degree Program
- Project: Estimation of Aerodynamic Forces on Wright Flyer II Pedestal
- Advisor: Dr. Nikolai V. Khartchenko

Professional Service and Membership

AIAA Technical Committees Non-Deterministic Approaches (full member); Multidisciplinary Design Optimization (friend member).

Peer Review Structural and Multidisciplinary Optimization; AIAA Journal.

Publications & Conference Proceedings

11. 2026 — **K. Boopathy**, "Structural Optimization of Rotorcraft Blades for Probabilistic Control Inputs using Stochastic Galerkin Method", 28th AIAA Non-Deterministic Approaches Conference at SciTech 2026, Orlando, Florida, Jan 2026. AIAA Paper 2026-xxxx.

10. 2024 — **K. Boopathy** and G.J. Kennedy, "Semi-Intrusive Stochastic Galerkin Finite Element Method for Adjoint-Based Optimization Under Uncertainty", Journal of Aerospace Information Systems. Vol. 21, No. 9, pp. 684–697, 2024, DOI: 10.2514/1.I011254

9. 2020 — **K. Boopathy** and G. J. Kennedy, "Semi-Intrusive Uncertainty Propagation and Adjoint Sensitivity Analysis Using the Stochastic Galerkin Method", 22nd AIAA Non-Deterministic Approaches Conference at SciTech 2020, Orlando, Florida, Jan 2020. AIAA Paper 2020-1146.

8. 2019 — **K. Boopathy** and G.J. Kennedy, "Parallel Finite Element Framework for Rotorcraft Multibody Dynamics and Adjoint Sensitivities", AIAA Journal, Vol. 57, No. 8, pp. 3159–3172, 2019, DOI: 10.2514/1.J056585.

7. 2017 — **K. Boopathy** and G. J. Kennedy, "Adjoint-based derivative evaluation methods for flexible multibody systems with rotorcraft applications", 55th AIAA Aerospace Sciences Meeting, Grapevine, Texas, Jan 2017. AIAA Paper 2017-1671.

6. 2016 — G. J. Kennedy and **K. Boopathy**, "A Scalable Adjoint Method for Coupled Flexible Multibody Dynamics", 57th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, San Diego, California, Jan 2016. AIAA Paper 2016-1907.

5. 2015 — **K. Boopathy** and M.P. Rumpfkeil, "Unified Framework for Training Point Selection and Error Estimation for Surrogate Models", AIAA Journal, Vol. 53, No. 1, pp. 215–234, 2015, DOI: 10.2514/1.J053064.

4. 2015 — **K. Boopathy**, M.P. Rumpfkeil and R. M. Kolonay, "Robust Optimization of a Wing Under Structural and Material Uncertainties", 17th AIAA Non-Deterministic Approaches Conference, Kissimmee, Florida, Jan 2015. AIAA Paper 2015-0920.

3. 2014 — **K. Boopathy** and M.P. Rumpfkeil, "Robust Optimizations of Structural and Aerodynamic Designs", 15th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, Atlanta, Georgia, June 2014. AIAA Paper 2014-2595.

2. 2013 — **K. Boopathy** and M.P. Rumpfkeil, "A Multivariate Interpolation and Regression Enhanced Kriging Surrogate Model", 21st AIAA Computational Fluid Dynamics Conference, San Diego, California, June 2013. AIAA Paper 2013-2964.

1. 2013 — **K. Boopathy** and M.P. Rumpfkeil, "Building Aerodynamic Databases Using Enhanced Kriging Surrogate Models", AIAA Region III Student Conference, Chicago, Illinois, April 2013.

Non-Refereed Publications & Presentations

8. 2016 — **K. Boopathy**, "Adjoint-Based Derivative Evaluation Methods for Flexible Multibody Systems", AE Seminar Series, Georgia Institute of Technology, Atlanta, Georgia, Nov 2016.

7. 2014 — **K. Boopathy** and M.P. Rumpfkeil, "Design Optimization Under Uncertainty Using Surrogate Models", Brother Joseph W. Stander Symposium, University of Dayton, Dayton, Ohio, April 2014.

6. 2014 — **K. Boopathy**, "Uncertainty Quantification and Optimization Under Uncertainty Using Surrogate Models", Master's Thesis, University of Dayton, Dayton, Ohio, March 2014.

5. 2014 — **K. Boopathy** and M.P. Rumpfkeil, "Practices for Deterministic and Stochastic Design Optimization", Oral Presentation, 39^{th} AIAA Dayton – Cincinnati Aerospace Sciences Symposium, Dayton, Ohio, March 2014.

4. 2013 — **K. Boopathy** and M.P. Rumpfkeil, "Surrogate models and their applications in aerospace engineering", Oral Presentation, Brother Joseph W. Stander Symposium, University of Dayton, Dayton, Ohio, April 2013.

3. 2013 — **K. Boopathy** and M.P. Rumpfkeil, "A Multivariate Interpolation and Regression Enhanced Kriging Surrogate Model", Oral Presentation, 38^{th} AIAA Dayton – Cincinnati Aerospace Sciences Symposium, Dayton, Ohio, March 2013.

2. 2012 — **K. Boopathy**, K. Doyle, E. Getter and V.M. Kotha, "Estimation of Aerodynamic Forces on Wright Flyer II Pedestal – Wright Image Group", Innovation Center Capstone Design Symposium, University of Dayton, Dayton, Ohio, April 2012.

1. 2011 — **K. Boopathy**, B. Shepherd, D. Garcher, J. Andras, K. Connolly, L. Jespersen and S. Dobbertin, "A Humanitarian Response Unmanned Aircraft System (HR-UAS)", University of Dayton, Dayton, Ohio, Nov 2011.

Technical Skills

Programming Languages	Fortran, Python, C/C++, LLVM, Java, Matlab, shell tools.
High-Performance Computing	Parallel applications with MPI, OpenMP, Coarray Fortran, CUDA.
Simulation & Optimization	Ansys Fluent, ASTROS, Abaqus, Ipopt, in-house adjoint solvers.
Data & Visualization	Matplotlib/PyPlot, gnuplot, Tecplot, ParaView.
Platforms	Linux only!
Documentation	LaTeX, BibTeX, beamer.
Version Control	git, Subversion, Mercurial.

Research Experience

■ **Georgia Institute of Technology** Atlanta, Georgia, United States

⋆ **Research Assistant (Graduate)** Aug 2015 – July 2020

- Project Title: Development of Discrete Adjoint Capability for Rotorcraft Comprehensive Code
- Funding: National Institute of Aerospace, NASA Langley Research Center
- Brief: The implementation of time-dependent discrete adjoint capabilities in TACS and DYMORE flexible multibody dynamics frameworks for the purpose of rotorcraft optimization

- Creation of Structural Solver Abstraction Layer (SSAL) to act as an interface for flexible multibody dynamics implementations. The evaluation of residuals of governing Euler–Lagrange equations, their machine-accurate state-variable derivatives (Jacobians), their design-variable derivatives; and corresponding implementations from functions of interest used in rotorcraft structural optimization. The SSAL interfaces with CFD solvers for coupled-aeroelastic simulations or standalone dynamics of helicopter blade hub assembly
  - Source: https://github.com/smdogroup/tacs

- Modular implementation of implicit time-marching schemes for solving differential-algebraic equations from multibody dynamics, and time-dependent adjoint sensitivity analysis equations for evaluating gradients of functions with respect to the design variables to drive the optimization of rotorcraft designs. The implementation contains multistep schemes: Backward Differences, Adams–Bashforth–Moulton, Newmark; and multistage Diagonally-Implicit Runge–Kutta time-integrators, and their discrete adjoint formulations for time-dependent sensitivity analysis.
  - Source: https://github.com/komahanb/time-marching-adjoint
- A general-purpose algebra library with classical and Krylov iterative solvers for linear systems, eigenvalue problem solvers, and nonlinear system solvers.
  - Source: https://github.com/komahanb/linear-nonlinear-algebra
- A Probabilistic-Space library to provide quadrature sampling nodes and basis functions corresponding to normal, uniform, and exponential probability distributions; and tensorization schemes for higher-dimensional calculations, intended for usage in the context of uncertainty quantification.
  - Source: https://github.com/komahanb/pspace
- The creation of Stochastic-TACS finite element and adjoint derivative framework tailored for optimization under uncertainty (OUU) applications. The OUU framework supports different options for uncertainty propagation such as non-intrusive stochastic sampling, projection, and intrusive Galerkin projection, through a surgical application of the principle of sampling at different hierarchical levels to naturally extend deterministic finite-element framework as stochastic finite-element frameworks. The conceptual demonstrations are carried out on static and time-dependent differential equations in the context of flexible multibody dynamics and an aerospace application motivated by the Canadarm-II.
  - Source: https://github.com/komahanb/stacs

■ **University of Dayton** Dayton, Ohio, United States

⋆ **Research Assistant (Graduate)** May 2012 – May 2015

- Devised an adaptive training and validation framework for surrogate models that utilizes data from local surrogate models constructed within sub-domains of a primary surrogate model – a synthesis of concepts like multigrid and domain decomposition in the context of surrogate modeling. The incorporation of low and high-fidelity training data in model construction, along with first- and second-order derivatives if available in the training matrix to mitigate the curse of dimensionality.
- Implemented adaptively trained kriging and polynomial chaos surrogate models to supply function outputs and their derivatives for mixed aleatory and epistemic optimization under uncertainty applications such as aerodynamic shape optimization and structural sizing of wing-box.
  - Kriging model: https://github.com/komahanb/kriging
  - Polynomial chaos model: https://github.com/komahanb/pchaos

■ **Alagappa University** Karaikkudi, Tamilnadu, India

⋆ **Student Researcher** May 2006

- Topic: Anti-bacterial Activity of Traditional Herbs Against Enteric Pathogens
- Funded by the Department of Biotechnology, Govt. of India
- Advisor: Dr. S. Karutha Pandian

- Screening of herbal extracts for anti-bacterial activity against enteric pathogens using Kirby-Bauer antibiotic susceptibility test, and authored a technical report of the findings.

Teaching Experience

■ **Georgia Institute of Technology** Atlanta, Georgia, United States

⋆ **Teaching Assistant** Aug 2015 – Dec 2015, Aug 2018 – May 2019

- Classes : AE 3145 Structures Laboratory, AE2610 Experimental Methods
- Conducted lab sessions, graded reports

■ **University of Dayton** Dayton, Ohio, United States

⋆ Conducted two lectures in graduate CFD class Jan 2014

⋆ **Teaching Assistant** Aug 2013 – Dec 2013

- Class : MEE 308 Fluid Mechanics, EGR 202 Thermodynamics
- Instructor : Dr. Andrew Henrick
- Substituted lectures, conducted help sessions, graded assignments and exams, prepared test questions

Work Experience

■ **ANSYS Inc.** Lebanon, New Hampshire, United States

⋆ **Senior R&D Engineer** Aug 2020 – Current

- Implementation of mathematical models of physics, discretization methods, and CFD algorithms for execution on heterogeneous CPU & GPU hardware platforms:
  - Abstracted mechanism for data exchange between CPU and GPU
  - Implementation of the physics of moving reference frames for simulating mixing tanks and turbo-machinery
  - Customization infrastructure to support spatio-temporal and expressions-based user input data for physical fields

■ **Indus Valley Consultants Inc.** Dayton, Ohio, United States

⋆ **Systems Analyst** July 2014 – May 2015

- Participated in the development of Java-based web environment authentication and authorization framework applying object-oriented programming principles

■ **Hindustan Aeronautics Limited** Koraput, Orissa, India

⋆ **Intern** Jun 2010

- Observation and documentation of processes involved in the functioning of jet engines, including the fitting of compressor and turbine blades onto discs, testing their weight balance, and identifying flaws in blades. Authored a summary report titled "Components and Functions of Jet Engine".

■ **University of Dayton** Dayton, Ohio, United States

⋆ **Admissions Assistant** May 2012 – Aug 2013

- Assistance in application processing and responding to prospective students

Awards & Achievements

■ **University of Dayton** 2011–2013

- Graduate Student Summer Fellowship Awardee May – Aug 2013
- II place for Technical paper, Master's category, AIAA Region III student Conference, Illinois Institute of Technology, Chicago Apr 2013
- Academic Scholarship holder Aug 2011 – May 2014

■ **SRM University** 2008–2011

- Gold medalist for University Rank I in Aerospace Engineering
- Consecutive recipient of merit scholarship offered to top 3 students in the department
- Winner of 'Aerocypher' during Chakravyuha – a Technical Festival of the School of Mechanical Engineering

■ **Miscellaneous**

- Candidate for government sponsored research programme, "Vacation Training Programme on Bio-Resources" at Alagappa University May 2006
- "Award of Academic Excellence" from the Academic Council of Principals of Matric. Schools, Coimbatore & Nilgiris, India Jun 2006
- Winner in several state & district level chess tournaments 2001-2006

Extra-Curricular Certifications

■ **Diploma in Information Technology** 2003

- Tamilnadu Computer Development Education Centre Palani, Tamilnadu, India

■ **Diploma in Computer Applications** 2003

- Tamilnadu Computer Development Education Centre Palani, Tamilnadu, India

Leadership

■ **SRM Aerospace Engineers' Association** SRM University, Chennai, India

⋆ **Joint Secretary** Dec 2009 – Jul 2011

- Assisted in organizing expert seminars from Indian Space Research Organisation, DRDO and IIT Madras
- Organization of technical events and workshops
- Maintenance of member database, administrative duties, and technical support during events