Komahan Boopathy | Curriculum vitae

R&D Engineer II
Fluent High Performace Computing
ANSYS Inc.
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📧 scholar.google.com/citations?user=YLg4R3sAAAAJ
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Research Span

My research subspace is spanned by the broad mathematical divisions of abstract and applied mathematics. I take a special interest in scientific computing, probabilistic mechanics, and aerospace design optimization.

Technical Methods

- **Mathematics:** numerical methods for differential and algebraic systems, discretization methods (finite-element, finite-volume, spectral), analytical methods for sensitivity analysis (adjoint and direct), uncertainty quantification (aleatory and epistemic), predictive models (surrogates)

- **Physics:** structural mechanics, fluid mechanics, multibody dynamics (deterministic and probabilistic forms)

- **Computing:** numerical software architecture, data structures and algorithms, high performance computing

- **Engineering:** design optimization of fixed- and rotary-wing aerospace systems

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 University of Dayton under dual-degree Program
- Project: Estimation of Aerodynamic Forces on Wright Flyer II Pedestal
- Advisor: Dr. Nikolai V. Khartchenko

Publications & Conference Proceedings

10. K. Boopathy and G.J. Kennedy, "Semi-Intrusive Stochastic Galerkin Methods derived from a Deterministic Finite-Element Framework, Journal of Aerospace Information Systems. (Under Review)

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

Computer Skills

- **Computer Programming:** Fortran, Python, Java, C/C++, Matlab, shell tools

- **High Performance Computing:** Parallel codes using MPI/OpenMP, Coarray Fortran, CUDA

- **Platform:** Linux only! (productivity)

- **Document Preparation:** 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
    - Sponsor: National Institute of Aerospace, NASA Langley Research Center
    - Source: https://github.com/gjkennedy/tacs.git.

- Creation of a structural solver abstraction layer for interfacing with CFD solvers, tailored for coupled-aeroelastic simulations. Under this abstraction, is the development of implicit time marching methods for differential-algebraic equations from multibody dynamics, and the implementation of adjoint-based sensitivity analysis for optimizing rotorcraft configurations

- Hierarchical extension of deterministic finite-element and adjoint capabilities to include probabilistically-modelled uncertainties resulting in a stochastic finite-element framework

■ University of Dayton   Dayton, Ohio, United States

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

- **Surrogate Modeling:** Designed an iterative training and error-estimation framework for surrogate models, utilizing data from local surrogate models constructed within sub-domains of the primary surrogate model. Additionally, created a Fortran library capable of Hessian-based polynomial regression.

- **Optimization Under Uncertainty:** Customized the gradient-enhanced surrogate models for analyzing uncertainties and optimizing under both aleatory and epistemic uncertainties. Applied these models to solve structural sizing and aerodynamic shape optimization challenges.

■ 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

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

- Implementation of mathematical models of physics, discretization methods and CFD algorithms for execution on heterogeneous CPU & GPU hardware platforms

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

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

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

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

  ⋆ **Intern**   Jun 2010

- Observed and documented the 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   [link]   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

Non-Refereed Publications & Presentations

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

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

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

4. 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. K. Boopathy and M.P. Rumpfkeil, "A Multivariate Interpolation and Regression Enhanced Kriging Surrogate Model", Oral Presentation, 38th AIAA Dayton − Cincinnati Aerospace Sciences Symposium, Dayton, Ohio, March 2013.

2. 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. 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.

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

List of References

Dr. Graeme J. Kennedy
- Assistant Professor, School of Aerospace Engineering, Georgia Institute of Technology
- E-mail: graeme.kennedy@aerospace.gatech.edu
- Relationship: Ph.D advisor

Dr. Marilyn J. Smith
- Professor, School of Aerospace Engineering, Georgia Institute of Technology
- E-mail: marilyn.smith@ae.gatech.edu
- Relationship: Ph.D committee member

Dr. Markus P. Rumpfkeil
- Associate Professor, Dept. of Mechanical and Aerospace Eng., University of Dayton
- E-mail: Markus.Rumpfkeil@udayton.edu
- Relationship: Master's advisor

Dr. Raymond M. Kolonay
- Multidisciplinary Science and Technology Center, Air Force Research Laboratory, Wright–Patterson AFB, Ohio
- E-mail: Raymond.Kolonay@us.af.mil
- Relationship: Master's thesis committee

Dr. Brian J. German
- Associate Professor, School of Aerospace Engineering, Georgia Institute of Technology
- E-mail: brian.german@aerospace.gatech.edu
- Relationship: Ph.D committee member