

Mandar D. Kulkarni

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EDUCATION

PhD in Aerospace Engineering (Aug. 2011- Jul. 2016)

Virginia Polytechnic Institute and State University, Blacksburg, USA; GPA: 3.85/4.00

Dissertation: Continuum Sensitivity Analysis using Boundary Velocity Formulation for Shape Derivatives

Advisers: Dr. Robert A. Canfield and Dr. Mayuresh J. Patil

Bachelor of Technology and Master of Technology in Aerospace Engineering (Jul. 2004 – Jun. 2009)

Indian Institute of Technology (IIT) Bombay, Mumbai, India; GPA: 9.42 / 10.0

Thesis: Active Vibration Control of Aircraft Structure using Piezo-ceramic Stack Actuators

Advisers: Dr. Prasanna M. Mujumdar and Dr. Ashok Joshi

TEACHING EXPERIENCE

- **At Embry-Riddle Aeronautical University (2016-2017):**
 - Instructor for the junior course Aerospace Structures 1 – AE318
 - Instructor for the freshman course Introduction to Aerospace Engineering – EGR101
- **At the Aerospace and Ocean Engineering Department, Virginia Tech (2011-2016):**
 - Instructor for the lab associated with the sophomore course Computational Methods
 - Teaching Assistant for the following courses:
 - Aerospace Propulsion, Structural Dynamics and Vibrations, Vehicle Structures, Thin Walled Structures, Applied Aerodynamics, Engineering Design and Optimization.
- **At the Aerospace Engineering Department, Indian Institute of Technology Bombay (2008-2009):**
 - Lead Teaching Assistant for the Structures Laboratory
- **Software used for interactive class participation:** Canvas, Polleverywhere, Socrative, Respondus

AWARDS AND ACHIEVEMENTS

- **Virginia Tech Pratt Fellowship (2014-2015)** for outstanding graduate student.
- Awarded '**Dr. Shankar Dayal Sharma Gold Medal**' for being the most outstanding student in general proficiency, excellence in academic performance, extra-curricular activities and social services among all 1600 degree recipients of IIT Bombay in the year 2009.
- Awarded **Institute Silver Medal** and **Boeing Scholar Award** for standing 1st among Dual Degree (B.Tech, M.Tech) students of Aerospace Engineering Department, IIT Bombay in the year 2009.
- Won 6th place in 2nd **International Cold Formed Steel Student Design Competition** in 2012.
- **Finalist in AIAA 2015 Student Competition:** Qualified for the final round of student competition at AIAA Multidisciplinary Analysis and Optimization Conference, Jun. 2015.
- **Best paper:** Won the first prize for the project on 'Composites Structures' in national level students' paper presentation competition at 'Zephyr 2006', Aerospace Engg. Association, IIT Bombay.
- **Winter Academy 2007:** One of the seven students to represent IIT Bombay at the annual Indo-German students meeting at Guwahati, India; Presented a talk on 'Finite Element Analysis of Dynamic Systems'.

INDUSTRIAL EXPERIENCE

Airbus Engineering Centre, Bangalore, India

(Apr. 2010 – May 2011)

Associate Engineer in Loads and Aeroelasticity Team

- Estimated loads on aircraft during various manoeuvres for aircraft design certification.

- Accelerated completion of projects related to flight mechanics, aeroelasticity and structural analysis with shell scripting.

MSC Software (Symphony Technology Group), Pune, India

(Jul. 2009 – Mar. 2010)

Senior Application Engineer in Verification and Validation (V&V) Team

- Involved in V&V of new developments in the finite element solver NASTRAN® related to statics, frequency response, non-linear analysis, aeroelasticity.

Department of Statistics, University of Klagenfurt, Klagenfurt, Austria

(May 2007 – Jul. 2007)

Intern for the project ‘Spatial prediction using Bayesian Trans-gaussian Kriging’

- Optimized a MATLAB® program used for spatial prediction of an event using Kriging techniques.

RESEARCH EXPERIENCE

Non-intrusive Continuum Sensitivity Analysis for Aeroelastic Shape Optimization (Ph.D. Dissertation)

Advisers: Dr. Robert A. Canfield and Dr. Mayuresh J. Patil, Virginia Tech

(Nov. 2012 – Jul. 2016)

- Investigating methods of implementing (**analytic**) **Continuum Sensitivity Analysis**.
- Formulating a non-intrusive (or black-box) method of sensitivity analysis for shape optimization, which is **more accurate and less computationally expensive** than the current methods.
- Extending the non-intrusive method for nonlinear aeroelasticity applications.
- Developed an adjoint formulation of CSA to account for large number of design variables.

Aerodynamic Modeling of Flapping Wing Micro-Air-Vehicles (MAVs)

Adviser: Dr. Mayuresh J. Patil, Virginia Tech

(Aug. 2011 – Oct. 2012)

- Developed a **reduced order aerodynamic model** for unsteady aerodynamics of flapping flight based on Unsteady Vortex Lattice Method (UVLM) and Momentum Disc Theory.
- Demonstrated that this model is more accurate than quasi-steady models and could be used for **conceptual MAV design**.

Active Vibration Control of Aircraft Structure using Piezo-ceramic Stack Actuators (Masters Thesis)

Advisers: Dr. Prasanna M. Mujumdar and Dr. Ashok Joshi, IIT Bombay

(May 2008 – Jun. 2009)

- Experimentally demonstrated **active vibration control** of wing box of a typical fighter aircraft by designing optimal control law and implementing it using state-of-the-art data acquisition system.
- Performed simulations and experiments to establish use of **Piezo-ceramic stacks** for vibration control.
- Acquired expertise in data acquisition, signal processing, and frequency response experimentation techniques.

Stress Wave Attenuation during Ballistic Impact on a Ceramic Target

(Jul. 2006 – Mar. 2008)

Advisor: Prof. Niranjan K. Naik, Aerospace Engineering, IIT Bombay

- Numerically and experimentally demonstrated **attenuation of stress waves** due to ballistic impact on ceramic tiles for possible applications in design of armors and military vehicles.
- Proposed the **novel concept of stress wave attenuation coefficient** for ceramics tiles.

Effect of Back Pressure on Impact Characteristics of Composites

(May 2006 – Aug. 2006)

Advisor: Prof. Niranjan K. Naik, Aerospace Engineering, IIT Bombay

- Designed and fabricated equipment for pressurizing glass-fiber composite specimens.
- Experimentally investigated the effect of **low-velocity-impact** on pressurized composite vessels.

PUBLICATIONS

Journals:

- [1] M. D. Kulkarni, D. M. Cross, and R. A. Canfield, “Discrete Adjoint Formulation using Local Continuum Sensitivity Equations,” *AIAA Journal*, Vol. 54, No. 2, pp. 758-766, [doi: 10.2514/1.J053827](https://doi.org/10.2514/1.J053827), **Feb. 2016**.
- [2] M. D. Kulkarni, R. A. Canfield, and M. J. Patil, “Nonintrusive Continuum Sensitivity Analysis for Fluid Applications,” *Journal of Fluids and Structures* (in preparation)
- [3] M. D. Kulkarni, R. A. Canfield, and M. J. Patil, “Nonintrusive Continuum Sensitivity Analysis for Aeroelasticity Applications,” *Structures and Multidisciplinary Optimization* (in preparation)
- [4] M. D. Kulkarni, R. A. Canfield, and M. J. Patil, “Nonintrusive Continuum Sensitivity Analysis for Three Dimensional Structures: Direct and Adjoint Formulations,” *AIAA Journal* (in preparation)
- [5] K. S. Pandya, M. D. Kulkarni, A. Warman, and N. K. Naik, “Simulation of stress wave attenuation in plain weave fabric composites during in-plane ballistic impact,” *Composite Structures*, Vol. 150, pp. 747-757, [doi: 10.1016/j.compstruct.2016.10.115](https://doi.org/10.1016/j.compstruct.2016.10.115), **Jan. 2017**.
- [6] R. Goel, M. D. Kulkarni, K. S. Pandya, and N. K. Naik, “Stress Wave Micro–Macro Attenuation in Ceramic Plates Made of Tiles during Ballistic Impact,” *International Journal of Mechanical Sciences*, Vol. 83, Issue 2, pp. 30-37, [doi: 10.1016/j.ijmecsci.2014.03.020](https://doi.org/10.1016/j.ijmecsci.2014.03.020), **Mar. 2014**.
- [7] M. D. Kulkarni, R. Goel, and N. K. Naik, “Effect of Back Pressure on Impact and Compression-after-Impact Characteristics of Composites,” *Composite Structures*, Vol. 93, Issue 2, pp. 944-951, [doi: 10.1016/j.compstruct.2010.06.027](https://doi.org/10.1016/j.compstruct.2010.06.027), **Jan. 2011**.
- [8] N. K. Naik, R. Goel, and M. D. Kulkarni, “Stress Wave Attenuation in Ceramic Plates,” *Journal of Applied Physics*, Vol. 103, Issue 10, Article No. 103504, [doi: 10.1063/1.2921971](https://doi.org/10.1063/1.2921971), **May 2008**.

Conferences:

- [1] M. D. Kulkarni, R. A. Canfield, and M. J. Patil, “Continuum Sensitivity Analysis for Aeroelastic Shape Optimization,” *57th AIAA Structures, Structural Dynamics and Materials Conference, AIAA SciTech*, Paper No. AIAA-2016-1177, San Diego, CA, USA, [doi: 10.2514/6.2016-1177](https://doi.org/10.2514/6.2016-1177), **Jan. 2016**.
- [2] M. D. Kulkarni, R. A. Canfield, and M. J. Patil, “Non-intrusive Continuum Sensitivity Analysis for Aerodynamic Shape Optimization,” *16th Multidisciplinary Analysis and Optimization Conference, AIAA Aviation*, Paper No. AIAA-2015-3237, Dallas, TX, USA, [doi: 10.2514/6.2015-3237](https://doi.org/10.2514/6.2015-3237), **Jun. 2015**.
- [3] M. D. Kulkarni, R. A. Canfield, and M. J. Patil, “Discrete Adjoint Formulation using Local Continuum Sensitivity Equations,” *56th AIAA Structures, Structural Dynamics and Materials Conference, AIAA SciTech*, Paper No. AIAA-2015-0138, Kissimmee, FL, USA, [doi: 10.2514/6.2015-0138](https://doi.org/10.2514/6.2015-0138), **Jan. 2015**.
- [4] M. D. Kulkarni and R. A. Canfield, “Reliability Based Structural Design using Continuum Sensitivity Analysis,” *56th AIAA Structures, Structural Dynamics and Materials Conference, AIAA SciTech*, Paper No. AIAA-2015-0458, Kissimmee, FL, USA, [doi: 10.2514/6.2015-0458](https://doi.org/10.2514/6.2015-0458), **Jan. 2015**.
- [5] M. D. Kulkarni, R. A. Canfield, and M. J. Patil, “Non-intrusive Continuum Sensitivity Analysis for Aerodynamic Shape Optimization,” *15th Multidisciplinary Analysis and Optimization Conference, AIAA Aviation*, Paper No. AIAA-2014-2043, Atlanta, GA, USA, [doi: 10.2514/6.2014-2043](https://doi.org/10.2514/6.2014-2043), **Jun. 2014**.
- [6] M. D. Kulkarni, R. A. Canfield, M. J. Patil, E. J. Alyanak, “Integration of Geometric Sensitivity and Spatial Gradient Reconstruction for Aeroelastic Shape Optimization,” *10th Multidisciplinary Design Optimization Conference, AIAA SciTech*, Paper No. AIAA-2014-0470, National Harbor, MD, USA, [doi: 10.2514/6.2014-0470](https://doi.org/10.2514/6.2014-0470), **Jan. 2014**.
- [7] M. D. Kulkarni, M. J. Patil, R. D. Snyder, “Reduced Order Model for Unsteady Aerodynamics of Flapping Wing Micro Air Vehicle in Hover,” *54th AIAA Structures, Structural Dynamics and Materials Conference, AIAA SciTech*, Paper No. AIAA-2013-1645, Boston, MA, USA, [doi: 10.2514/6.2013-1645](https://doi.org/10.2514/6.2013-1645), **Apr. 2013**.
- [8] M. D. Kulkarni, G. Kumar, P. M. Mujumdar, and A. Joshi, “Active Control of Vibration Modes of Wing Box by Piezoelectric Stack Actuators,” *51st AIAA Structures, Structural Dynamics and Materials Conference*, Paper No. AIAA-2010-2949, Orlando, FL, USA, [doi: 10.2514/6.2010-2949](https://doi.org/10.2514/6.2010-2949), **Apr. 2010**.

- [9] M. D. Kulkarni, R. Goel, and N. K. Naik, "Effect of Back Pressure on Impact Behavior of Composites," 4th *International Conference on Theoretical, Applied, Computational and Experimental Mechanics*, IIT Kharagpur, India, **Dec. 2007**.
- [10] R. Goel, M. D. Kulkarni, and N. K. Naik, "Stress Wave Attenuation during Ballistic Impact on a Ceramic Target," 16th *International Conference on Composite Materials*, Kyoto, Japan, [available online](#), **Jul. 2007**.

TECHNICAL SKILLS

- **Technical specialties:** Mathematical modeling, Optimization, Computation methods for structural and fluid analysis, Solid mechanics, Fluid mechanics, Experimental testing of ceramics and composite materials.
- **Software:**
Structural Analysis: NASTRAN, PATRAN, ABAQUS, ANSYS
Fluid Analysis: FLUENT, ZEUS, ZAERO, OpenFOAM, SU2
Other: MATLAB, SIMULINK, LabVIEW, SOLIDWORKS, AUTOCAD, MATHEMATICA
- **Programing Languages:** C, C++, Fortran, Python, MATLAB, Shell scripting

HOBBIES

- Amateur radio (Call sign - KK4SXZ), amateur astronomy, aero-modeling, hiking and biking.

REFERNCES

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