

Rajeev KUMAR

Curriculum Vitae

Contact Mechanical Engineering, Texas A&M University-Corpus Christi, TX
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Summary

- Ph. D. in Aerospace Engineering, specialization in CFD (Finite Element Methods).
- Currently a Visiting Assistant Professor in the Mechanical Engineering Department at the Texas A&M University-Corpus Christi, TX.
- Strong fluids background with research experience in Lagrangian coherent structures analysis of a bio-inspired marine propulsor wake at **Syracuse University**, bio-inspired aerodynamics at the **University of Arizona**, and R&D industry experience in experimental aerodynamics from India.
- Currently teaching **undergraduate Thermo-Fluids** courses in online as well as traditional formats at the **Texas A&M University-Corpus Christi** and earlier taught graduate courses Finite Element Methods-structures and Gas Dynamics as an adjunct faculty in 2014-15 at the **University of Texas Arlington**. Taught undergraduate Aeronautics: Science and People as an instructor in 2010 at the University of Arizona.
- Effective oral, written and interpersonal communication skills.
- Published journal and conf. papers in experimental/computational fluid dynamics.

Experience

Project Proposals **Syracuse University, New York**

- Experimental Analysis of the Three-Dimensional Wakes Generated by Bio-Inspired Body-Caudal-Fin Flow Field Interactions, **Office of Naval Research**, Aug 2017 - 2020. (**Co-Principal Investigator**)

University of Texas Arlington

- Impact Mitigation with Fluid-filled, Interconnected Bubble Arrays, **University of Texas Arlington Research Institute**, March 2015. (**Major Contributor**)

University of Arizona Tucson

- Flight Maneuvers in Foraging Bumble Bees: Implications for Optimal Foraging & Plant-Pollinator Coevolution, **National Science Foundation**, Jan 2013. (**Major Contributor**)

Research **Syracuse University, Syracuse, New York**

- Used the state of the art **finite-time Lyapunov exponent (FTLE)** technique to detect the Lagrangian coherent structures in the wake of a bio-inspired pitching panel (**an ONR-funded project**). Ran 3D FTLE Fortran code on University's distributed computing system called 'OrangeGrid'.

University of Arizona Tucson

- Completed an **NSF-funded project on kinematics and aerodynamics of flapping flight** in desert locusts during collision avoidance maneuvers.
- Developed an innovative micro-balance for measuring aerodynamic forces generated by the insects and man-made flapping-wing vehicles.
- Studied aerodynamics and wing kinematics of the locusts in side-slip and straight flight leading to a **bio-inspired design of flapping wing Micro Air Vehicle**.

University of Texas Arlington

- Completed an FSI project on Impact Mitigation using an Array of Interconnected Fluid-filled Bubbles. Impact mitigation through redistribution of impact energy in the lateral fluid movement has civil, military, and biomedical applications.
- Developed a novel finite element method called least-squares/Galerkin split finite element method to solve Navier-Stokes equations. This method treats the first-order terms with the **least-squares method** and the second-order terms with **Galerkin method**; thereby keeps the advantages and avoids the drawbacks of the two.
- Wrote finite element code to solve the Navier-Stokes equations on benchmark problems in **C++ utilizing object-oriented programming concepts**.
- Developed a bubble-enriched least-squares finite element method for advective transport equations. Bubble functions introduced into the finite element space drastically improve the accuracy of results with least additional computational cost.
- Wrote parallel code using **C, MPI & block-Jacobi** iterative scheme for Poisson eqn.

National Aerospace Laboratories Bangalore, India

As an experimental aerodynamicist at **National Aerospace Laboratories**, I successfully completed many research and funded projects. Few of them are:

- *Drag Reduction using Riblets*
Carried out experimental studies on **turbulent drag reduction** using **riblets** on a NACA 0012 and a cambered GA(W)-2 airfoils. Achieved a **total drag reduction** up to 13% in the incidence range of $0^\circ < \alpha < 15^\circ$.
- *Studies on Gurney Flaps*
Studied the effect of three-dimensionality on the aerodynamic performance of **Gurney flaps** that have applications on **race cars, helicopter, and wind-turbine blades** etc.

Teaching

Texas A&M University-Corpus Christi

- Taught undergraduate courses **Heat Transfer** and **Material Science** in the fall of 2018. Currently, I am teaching **Fluid Mechanics** and **Thermodynamics** in an online format and **Material Science** in traditional face-to-face format. I am also designing a course on **Energy Conversion**.
- Created lecture videos in 'screen capture' and 'narrated powerpoint slides' formats using TechSmith Camtasia.

University of Texas Arlington

- Taught graduate **Finite Element Method** in the fall of 2014 and graduate **Gas Dynamics** in the spring of 2015 as an Adjunct Faculty in the Mechanical and Aerospace Engineering Department, earned positive reviews from the students.
- Taught undergraduate courses like **Fluid Mechanics, Incompressible Aerodynamics, Numerical Methods & Computer Programming**, and **Low Speed Wind Tunnel Lab** as Graduate Teaching Assistant to **Dr. Dennis, Dr. Dale Anderson** and **Dr. Seath**. Prepared, evaluated homework assignments, exams and frequently took classes.

University of Arizona Tucson

- Taught undergraduate course **Aeronautics: Science and People** as an instructor and on occasions taught graduate level course **Advanced Dynamics** as a fill-in.

Employment

- 08/2018–Current** **Visiting Assistant Professor**
Mechanical Engineering, Texas A&M University-Corpus Christi, TX
- 07/2015–06/2018 Research Assistant Professor/ Research Associate
Mechanical and Aerospace Engineering, Syracuse University, Syracuse, NY
- 06/2014–06/2015 Research Assistant/ Adjunct Faculty
Mechanical and Aerospace Engineering, University of Texas at Arlington, TX
- 02/2010–08/2013 Research Associate/ Research Assistant Professor
Aerospace and Mechanical Engineering, University of Arizona Tucson, AZ
- 10/2008–02/2010 Post-Doctoral Research Associate
Mechanical and Aerospace Engineering, University of Texas at Arlington, TX
- 08/2004–08/2008 Graduate Research Assistant/Graduate Teaching Assistant
Mechanical and Aerospace Engineering, University of Texas at Arlington, TX

Education

- Ph.D., Aerospace Engineering*, August 2008
University of Texas at Arlington, Arlington, TX
Dissertation: *A least-squares/Galerkin split finite element method for incompressible and compressible Navier-Stokes equations.*
Adviser: Dr. Brian H. Dennis
- M.E., Aerospace Engineering*, January 2000
Indian Institute of Science Bangalore, INDIA
Thesis: *Study of Wortmann FX 63-137 airfoil at low Reynolds numbers*
Adviser: Dr. Kartik Venkatraman
- B.E., Aeronautical Engineering*, June 1992
Panjab University, Chandigarh, INDIA

Computer Skills

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| Languages | Fortran, C/C++ , Python |
| Engineering Platforms | ANSYS FLUENT, TECPLOT, SOLIDWORKS, MATLAB, LabVIEW, FieldView
WINDOWS, LINUX, UNIX |

Publications

- Book/ Book Chapter**
1. Rajeev Kumar, and Brian H Dennis. *Least-squares/ Galerkin split finite element method for incompressible and compressible Navier-Stokes equations: A novel approach.* LAP Lambert Academic Publishing, 2015.
 2. Rajeev Kumar, Ryan Randall, Dima Silin and Sergey Shkarayev. *Insect-inspired micro air vehicles.* Chapter in **Handbook of Biomimetics and Bioinspiration: 2 Electromechanical Systems.**, pp. 613-639, 2014.
- Journal**
1. Rajeev Kumar, Justin T. King, and Melissa A. Green. *Three-dimensional pitching panel wake: Lagrangian analysis and momentum distribution from experiments.* **AIAA Journal**, 2018, DOI: 10.2514/1.J056621.
 2. Justin T. King, Rajeev Kumar and Melissa A. Green. *Experimental observations of the*

*three-dimensional wake structures and dynamics generated by a rigid, bio-inspired pitching panel. **Physical Review Fluids**, Vol 3 (3), pp 034701, 2018. DOI10.1103/PhysRevFluids.3.034701*

3. Rajeev Kumar, Justin T. King, and Melissa A. Green. *Momentum distribution in the wake of a trapezoidal pitching panel. **Marine Technol Soc Journal**, Vol. 50(5), pp 9-23, Sep/Oct 2016.*
4. Sergey Shkarayev and Rajeev Kumar. *Kinematics and inertial effects in locust flapping wings. **Experimental Mechanics**, Vol. 56(2), pp. 245 - 258, Springer US, 2016.*
5. Rajeev Kumar and Sergey Shkarayev. *Kinematic and aerodynamic response of locusts in sideslip. **International Journal of Micro Air Vehicles**, Vol. 7(2), pp. 159 - 180, 2015.*
6. Shkarayev, Sergey and Kumar, Rajeev. *Simultaneous measurement of aerodynamic forces and kinematics in flapping wings of tethered locust. **Bioinspiration & Biomimetics**, Vol. 10, No. 6, 066003, 2015.*
7. Rajeev Kumar, Raymond Chan, Sergey Shkarayev and Fabrizio Gabbiani. *Force measurements on locusts during visually-evoked collision avoidance maneuvers. **International Journal of Micro Air Vehicles**, Vol. 4, No. 3, pp. 227-249, 2012.*
8. Rajeev Kumar and Brian Dennis. *Bubble-enriched least-squares finite element method for transient advective transport. **International Journal of Differential Equations**, 2008.*
9. N Subaschander, Rajeev Kumar and S Sundaram. *Drag reduction due to riblets on a GAW(2) airfoil. **Journal of Aircraft**, Vol. 36, No. 5, p. 890, 1999.*

Conference

1. Ayodeji T. Bode-Oke, Haibo Dong, Justin T. King, Rajeev Kumar, Melissa A. Green. *Computational study of the three-dimensional wake and performance of a trapezoidal pitching panel. AIAA Aerospace Sciences Meeting, p. 0814, Kissimmee, FL, 8-12 Jan 2018.*
2. Rajeev Kumar, Justin T. King, Melissa A. Green. *Lagrangian coherent structure analysis in the three-dimensional wake of a bio-inspired trapezoidal pitching panel. **American Physical Society, DFD Conference 2017**, Denver, CO, 18-21 Nov 2017.*
3. Rajeev Kumar, Ayodeji Bode-Oke, Justin T. King, Geng Liu, Haibo Dong, and Melissa A. Green. *Three-Dimensional Finite-Time Lyapunov Exponent Field in the Wake of an Oscillating Trapezoidal Pitching Panel. **47th AIAA Fluid Dynamics Conference**, Denver, CO, 5-9 June 2017.*
4. Justin T. King, Rajeev Kumar, and Melissa A. Green. *Experimental study on the effects of trailing edge geometry on the wake structure of a trapezoidal pitching panel. **47th AIAA Fluid Dynamics Conference**, Denver, CO, 5-9 June 2017.*
5. Rajeev Kumar, Justin T. King, Melissa A. Green. *Momentum distribution in the wake of a bio-inspired trapezoidal pitching panel. **American Physical Society, DFD Conference 2016**, Portland, OR, 20-22 Nov 2016.*
6. Justin T. King, Rajeev Kumar, Melissa A. Green. *Experimental study of surface pattern effects on the propulsive performance and wake of a bio-inspired Pitching Panel. **American Physical Society, DFD Conference 2016**, Portland, OR, 20-22 Nov 2016.*
7. Justin T. King, Rajeev Kumar, Melissa A. Green. *Experimental study of the three-dimensional wake of a trapezoidal pitching panel. **54th AIAA Aerospace Sciences Meeting**, San Diego, CA, 4-8 Jan 2016.*
8. Sandeep Patil, Siddarth Chintamani, Rajeev Kumar, Ratan Kumar, and Brian Dennis. *Numerical analysis of transient temperature distribution in a partially cooled nuclear fuel*

rod. **ASME IMECE 2015**, Houston, TX, USA, 13-19, Nov 2015.

9. Rajeev Kumar, Brian H. Dennis, Bo Yang, Wei Carrigan, and Muthu B J Wijesundara. *ANSYS simulation of impact reduction with fluid-filled interconnected bubble arrays*. **ASME IDETC/CIE 2015**, Boston, MA, USA, 2-5, August 2015.
10. Rajeev Kumar and Sergey Shkarayev. *Instantaneous forces in locust flapping wings*. **AIAA Aviation and Aeronautics Forum and Exp.**, Atlanta, GA, June 16-20, 2014.
11. Sergey Shkarayev and Rajeev Kumar. *Kinematic and inertial effects in locust flapping wings*. **AIAA Aviation and Aeronautics Forum and Exp.**, Atlanta, GA, June 16-20, 2014.
12. Rajeev Kumar and Sergey Shkarayev. *Kinematics and aerodynamic responses of locusts in sideslip*. **51st AIAA Aerospace Sciences Meeting and Exhibit**, Grapevine TX, January 7-10, 2013.
13. Ryan Randall, Rajeev Kumar, and Sergey Shkarayev. *Bio-inspired design of micro-ornithopters with emphasis on locust hindwings*. **IMAV 2012, Int. Micro Air Vehicle Conf. and Competition**, Braunschweig, Germany, July 03-06, 2012.
14. Rajeev Kumar and Sergey Shkarayev. *Effects of yaw angle on aerodynamic response in locusts*. **AIAA-2012-417, 50th AIAA Aerospace Sciences Meeting and Exhibit**, Nashville TN, January 9-14, 2012.
15. Rajeev Kumar, Dmytro Silin, and Sergey Shkarayev. *Experimental study of aerodynamic performance of locust and model wings*. **AIAA-2011-871, 49th AIAA Aerospace Sciences Meeting and Exhibit**, Orlando FL, January 2-7, 2011.
16. Rajeev Kumar and Brian H. Dennis. *The least-squares/ Galerkin split finite element method for buoyancy driven flow*. **Proceedings of the ASME IDETC/CIE 2010**, No. DETC2010-29157, Montreal, Quebec, Canada, Aug. 15 - 18, 2010.
17. Brian H. Dennis and Rajeev Kumar. *A least-squares/ Galerkin split finite element method for compressible Navier-Stokes equations*. **ASME IDETC/CIE 2009**, San Diego, CA, USA, Aug. 30 - Sep. 2, 2009.
18. Rajeev Kumar and Brian H. Dennis. *Unsteady incompressible flow computations with least-squares/ Galerkin split finite element method*. **ASME Early Career Technical Conference hosted by ASME District E**, Arlington, TX, USA, April 17 - 18, 2009.
19. Rajeev Kumar and Brian H. Dennis. *A least-squares/ Galerkin split finite element method for incompressible Navier-Stokes problems*. **ASME IDETC/CIE 2008**, Brooklyn, NY, USA, 3-6, August 2008.
20. Brian H. Dennis and Rajeev Kumar. *A least-squares/ Galerkin finite element method for incompressible and compressible viscous flows*. **14th Int. Conference on Finite Elements in Flow Problems**, Santa Fe, NM, USA, 26-28, March 2007.
21. Brian H. Dennis and Rajeev Kumar. *Simulation of electromagnetic control of high-speed flows*. **7th World Cong. Comput. Mech.**, Los Angeles, CA, 16-22, July 2006.
22. N B Mathur and Rajeev Kumar. *A novel technique for the direct measurements of afterbody drag in the presence of multi-jet nozzle exhausts*. **XVI International Symposium on Air Breathing Engines**, Cleveland, OH, September 2003.

Review Meeting 1. Justin King, Rajeev Kumar, Melissa A. Green. *Three-dimensional Vortex Wake Structure of Fish-like Propulsion*. **ONR MURI Program Review Meeting**, Harvard University,

Cambridge, MA, 19-20, Sep 2017.

2. Justin King, Rajeev Kumar, Melissa A. Green. *Three-dimensional Vortex Wake Structure of Fish-like Propulsion*. **ONR MURI Program Review Meeting**, Princeton University, NJ, 28-29, Sep 2016.
3. Melissa A. Green, Justin King, Rajeev Kumar. *Three-dimensional Vortex Wake Structure of Fish-like Propulsion*. **ONR MURI Program Review Meeting**, Lehigh University, PA, 21-22, Sep 2015.

Patents

1. Brian H. DENNIS, Frederick M. MACDONNELL, Richard E. BILLO, John W. PRIEST, **Rajeev KUMAR**, Mahir D. ALRASHDAN, Shreeyukta SINGH, METHOD, APPARATUS AND COMPOSITIONS FOR CONVERTING COAL INTO OIL BY HYDROGENATION, U.S. Provisional Patent Application No. 61/317,601, 2010.

Internal: NAL

1. P R Viswanath, Rajeev Kumar. *Preliminary study of 3D Gurney flaps on a GAW-2 airfoil*. **PD EA 0409**, NAL Bangalore, 2004.
2. K Srikanth, Rajeev Kumar. *Improved flow visualization studies in water and low speed wind tunnels*. **PD EA 0302**, NAL Bangalore, 2003.
3. Rajeev Kumar. *MAVs: A brief review*. **PD EA 0011**, NAL Bangalore, 2000.
4. N Subaschander, Rajeev Kumar and S Sundaram. *Studies on turbulent drag reduction due to riblets on a GAW(2) airfoil*. **PD EA 9601**, NAL Bangalore, 1996.
5. N Subaschander, Rajeev Kumar and S Sundaram. *Drag reduction due to riblets on NACA 0012 airfoil at higher angles of attack*. **PD EA 9504**, NAL Bangalore, 1995.

Honors and Memberships

- **Kalpana Chawla Memorial Scholarship** by University of Texas Arlington, 2007.
- **Hermann Doctoral Fellowship** by University of Texas Arlington, 2004-2007.
- Council for Scientific and Industrial Research (**CSIR**) sponsorship for higher studies and research at Indian Institute of Science Bangalore, India (1998).
- Member of **Tau Beta Pi** Engineering Honor Society.
- Member of **American Institute of Aeronautics and Astronautics (AIAA)**
- Member of **American Society of Mechanical Engineers (ASME)**

Outreach

- TV Channel **KVOA Tucson** telecast a brief interview of me and our group working on Micro Air Vehicles at University of Arizona on Feb 23, 2010. The program was titled: *Micro machines to help secure border*.
- TV News clip was telecast featuring our invention to convert lignite coal into crude oil on **WFAA (ABC) Dallas** on February 19, 2010.
- **The Dallas Morning News** published an article titled: *UTA scientists refine method for turning coal to oil* about our energy project funded by Texas Ignition Fund and US Department of Energy on June 28, 2009.

Reviewer

- **Review Coordinator** for ASME International Design Engineering Technical Conferences

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- (IDETC) and Computers and Information in Engineering Conference (CIE) since 2011.
 - **Expert Reviewer** for American Institute of Aeronautics and Astronautics (AIAA) Journal since 2011.
 - **Expert Reviewer** for the Journal of Fluids and Structures since 2015
 - **Expert Reviewer** for the Journal of Fluid Mechanics since 2016.
 - **Expert Reviewer** for Experiments in Fluids since 2016.

Courses Taken

Doctorate Computational Aerodynamics, Fluid Dynamics, Gas Dynamics, High Temperature Gas Dynamics, Engineering Analysis, Structural Dynamics, Finite Element Methods-Heat Transfer, Advanced Flight Mechanics, Parallel Computation, Continuum Mechanics.

Masters Dynamic Systems Simulation, Advanced Finite Element Methods, Grid Adaptation, Numerical Methods, Aerodynamics, Boundary Layer Theory.

March 21, 2019