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## Education

- PhD, 2011, Department of Aerospace Engineering, University of Michigan, Ann Arbor, USA
  - Dissertation: Aerodynamics, Scaling, and Performance of a Flexible Flapping Wing
  - Advisors: Dr. W. Shyy and Dr. C. E. S. Cesnik
- MSc, 2005, Department of Aerospace Engineering, Delft University of Technology, The Netherlands
  - Thesis: Topological Analysis of Fourth Order Juncture Flow
  - Advisor: Dr. P. G. Bakker
- BSc, 2002, Department of Aerospace Engineering, Delft University of Technology, The Netherlands, Cum laude

## Research Experience

- 2013 – present, Assistant Professor, Department of Mechanical and Aerospace Engineering, University of Alabama in Huntsville, USA
  - Development of time-accurate, analytic model for lift on a flexible flapping wing (Kang & Shyy, AIAA-2014-1114)
  - Analysis of effects of flexible wings on the aeroelasticity at insect scale flapping wings (Sridhar & Kang, AIAA-2014-2311)
- 2011 – 2013, Postdoctoral Research Fellow, Department of Aerospace Engineering, University of Michigan, Ann Arbor, USA
  - Advisor: Dr. W. Shyy
  - Scaling laws and novel aeroelastic lift enhancement mechanisms of flexible flapping wings of insect-size (Kang & Shyy, J R Soc Interface, 2013)
  - Review of rigid and flexible flapping wing aerodynamics (Shyy et al, Introduction to Flapping Wing Aerodynamics, 2013)
  - Detailed comparisons of Navier-Stokes computations against experiments and vortex methods in flapping wing systems (Vandenheede et al. AIAA J, In press)
- 2007 – 2011, Graduate Student Research Assistant, Department of Aerospace Engineering, University of Michigan, Ann Arbor, USA
  - Advisor: Dr. W. Shyy
  - Scaling laws for the aerodynamic performance of flexible flapping wings (Kang et al. J Fluid Mech, 2011, Shyy et al. Prog Aerosp Sci, 2009)
  - Detailed comparison of numerical computation of rigid flapping wings at low Reynolds numbers with experiments (Kang et al. AIAA J, 2013)
  - Analysis of fluid physics of rigid flapping wings (Kang et al. AIAA J, 2013; Trizila et al. AIAA J, 2011; Ol et

- al., Exp Fluids, 2009; Shyy et al. AIAA J, 2009)
- Reduced order models and surrogate models in flapping wings (Su et al. IFASD, 2011; Trizila Et al., AIAA-2009-5914)
  - Numerical modeling and development of high-fidelity aeroelastic framework by coupling parallelized finite-volume incompressible Navier-Stokes equation solver and (non)linear beam, nonlinear mem-brane/shell finite-element structural dynamics solvers (Kang et al. AIAA-2011-1313; Aono et al. AIAA-2010-5082)
  - Development of mesh-deformation/remeshing algorithms for 3-D Navier-Stokes computations using Radial Basis Function Interpolation and finite-element methods (Aono et al. AIAA-2010-5082)
  - Development of 2-D multi-block finite-volume code for solving Euler equations for compressible inviscid fluid flow with HLLC and Roe solvers (course: Computational Fluid Dynamics II, 2007)
  - 2002 – 2005, Graduate Student, Delft University of Technology, the Netherlands
    - Advisor: Dr. P. G. Bakker
    - Topological analysis using theorems from nonlinear differential equations of juncture flow
  - 2001 (Jun) – 2001 (Nov), Visiting Scholar, Arizona State University, Tempe, USA
    - Advisor: Dr. W. Saric
    - Experimental investigation on using infrared thermography to detect laminar-to-turbulence transition on swept wings at Mach 2.4 (Saric et al. APS 2001)

### Research Interests

Applied fluid dynamics with focus on modeling and analysis of multi-disciplinary complex systems

- Unsteady aerodynamics, fluid-structure interaction, locomotion in biology, Micro-air vehicles
- Modeling and analysis of complex systems: Systematic investigation using analytic, reduced order models, and scaling methods to predict the behavior and performance of complex systems, such as aerodynamic performance of flexible flapping wing systems, hemodynamics in cardio-vascular systems, wind turbines, and locomotion in biology or bio-inspired systems
- Development of high-fidelity numerical framework: Development of high-fidelity and robust fluid-structure interaction framework coupled to flight dynamics and control
- Reduced order models: Development of nonlinear robust reduced order models for analysis and optimization of complex multidisciplinary systems
- Energy harvesting from vortex-induced vibrations

### Honors and Awards

- UAH Distinguished Individual Investigator Award, 2014
- UAH New Faculty Research Program Award, 2013
- NATO RTO Scientific Achievement Award (AVT-149, Chair: Dr. Michael Ol), 2011

**Book**

1. Shyy, W., Aono, H., Kang, C. and Liu, H. *An Introduction To Flapping Wing Aerodynamics*, Cambridge University Press, 2013

**Journal Publications**

1. Vandenheede, R., Bernal, L. P. B., Morrison, C., Gogulapati, A., Friedmann, P. P., Kang, C., and Shyy, W., "Experimental and Computational Study on Flapping Wings with Bio-Inspired Hover Kinematics," *AIAA Journal*, Vol. 52, Nr. 5, pp. 1047 - 1058, 2014
2. Kang, C. and Shyy, W., "Scaling and Lift Generation of Hovering Flexible Wing of Insect Size," *Journal of Royal Society Interface*, Vol. 10, Nr. 85, 2013
3. Kang, C., Aono, H., Baik, Y.S., Bernal, L.P., and Shyy, W., "Fluid Dynamics of Pitching and Plunging Flat Plate at Reynolds Number of  $O(10^4)$ ," *AIAA Journal*, Vol. 51, No. 2, pp. 315-329, 2013
4. Kang, C., Aono, H., Cesnik, C.E.S., and Shyy, W., "Effects of Flexibility on the Aerodynamic Performance of Flapping Wings," *Journal of Fluid Mechanics*, Vol. 689, pp. 32 - 74, 2011; also AIAA-2011-3121
5. Trizila, P., Kang, C., Aono, H., Visbal, M., and Shyy, W., "Low-Reynolds-Number Aerodynamics of a Flapping Rigid Flat Plate," *AIAA Journal*, Vol. 49, No. 4, pp. 806 - 823, 2011
6. Shyy, W., Aono, H., Chimakurthi, S., Trizila, P., Kang, C., Cesnik, C., and Liu, H., "Recent Progress in Flapping Wing Aerodynamics and Aeroelasticity", *Progress in Aerospace Sciences*, Vol. 48, Nr. 7, pp. 284-327, 2010
7. Ol, M., Bernal, L., Kang, C., and Shyy, W., "Shallow and Deep Dynamic Stall for Flapping Low Reynolds Number Airfoils", *Experiments in Fluids*, Vol. 46, Nr. 5, pp. 883-901, 2009
8. Shyy, W., Trizila, P., Kang, C., Aono, H., "Can Tip Vortices Enhance Lift of a Flapping Wing?", *AIAA Journal*, Vol. 47, pp. 289-293, 2009

**Conference Proceedings and Presentations**

1. Shyy, W. and Kang, C., "Time-Accurate Estimate of Flexible Flapping Wing Aerodynamics," Invited Presentation, 7th World Congress of Biomechanics, Boston, Massachusetts, July 6 - 11, 2014
2. Sridhar, M. K. and Kang, C., "Effects of Flexible Wings in Hover Flight at Fruit Fly Scale," AIAA 2014-2311, 44th AIAA Fluid Dynamics Conference, Atlanta, Georgia, June 16 - 20, 2014
3. Kang, C., and Shyy, W., "A Quasi-Steady Model for the Lift on a Hovering Flexible Wing," AIAA 2014-1114, 52<sup>nd</sup> Aerospace Science Meeting, National Harbor, Maryland, January 3 - 17, 2014
4. Kang, C., and Shyy, W., "Modeling of Instantaneous Passive Pitch of Flexible Flapping Wings," AIAA 2013-2469, 43<sup>rd</sup> AIAA Fluid Dynamics Conference, San Diego, California, June 24 - 27, 2013

5. Vandenheede, R.B.R, Bernal, L.P., Morrison, C., Gogulapati, A., Friedmann, P.P., Kang, C., and Shyy, W., "Comparison of Experiments on Bio-Inspired Hover Kinematics with The Unsteady Vortex Model and CFD, " AIAA 2013-0066, 51th AIAA Aerospace Science Meeting Including the New Horizons Forum and Aerospace Exposition, Grapevine, Texas, January 7 – 10, 2013
6. Shyy, W., Kang, C., and Cho, Y., "Adaptive and Passive Flow Control via Actuation and Flexible Structures at Low Reynolds Number," 5<sup>th</sup> International Symposium on Fluid Machinery and Fluids Engineering, Jeju, Korea, October 24 – 27, 2012
7. Kang, C., and Shyy, W., " Passive Wing Rotation in Flexible Flapping Wing Aerodynamics," AIAA-2012-2763, 30th AIAA Applied Aerodynamics Conference, New Orleans, Louisiana, June 25 - 28, 2012
8. Kang, C., and Shyy, W., "Effects of Flexibility on the Aerodynamics of a Hovering Flexible Airfoil at Reynolds Number of 100 to 1000," AIAA-2012-1206, 50th AIAA Aerospace Science Meeting, Nashville, Tennessee, January 9 - 12, 2012
9. Kang, C., Aono, H., and Shyy, W., "Scaling in Flexible Flapping Wings," American Physical Society, 64th Annual Meeting of the Division of Fluid Dynamics, Baltimore, Maryland, November 19 - 22, 2011
10. Kang, C., Aono, H., Cesnik, C.E.S., and Shyy, W., "Effects of Flexibility on the Aerodynamic Performance of Flapping Wings," AIAA-2011-3121, 6th AIAA Theoretical Fluid Mechanics Conference, Honolulu, Hawaii, June 27-30, 2011
11. Su, W., Kang, C., and Cesnik, C.E.S., "Nonlinear Aeroelastic Analysis of Flapping Wing Micro Air Vehicles with a Surrogate Aerodynamic Model," International Forum on Aeroelasticity and Structural Dynamics 2011, Paris, France, Jun. 26–30, 2011
12. Kang, C., Aono, H., Cesnik, C.E.S., and Shyy, W., "A Scaling Parameter for Thrust Generation of Flapping Flexible Wings," AIAA-2011-1313, 49th AIAA Aerospace Sciences Meeting, Orlando, Florida, 4 - 7 January 2011
13. Aono, H., Kang, C., Cesnik, C.E.S., and Shyy, W., "A Numerical Framework for Isotropic and Anisotropic Flexible Flapping Wing Aerodynamics and Aeroelasticity," AIAA-2010-5082, 28th AIAA Applied Aerodynamics Conference, Chicago, Illinois, June 28-1, 2010
14. Trizila, P., Kang, C., Aono, H., Visbal, M., and Shyy, W., "Fluid Physics and Surrogate Modeling of a Low Reynolds Number Flapping Rigid Flat Plate," AIAA 2010-5081, 28th AIAA Applied Aerodynamics Conference, 28 June - 1 July 2010, Chicago, Illinois
15. Kang, C., Aono, H., Trizila, P., Baik, Y., Rausch, J.M., Bernal, L., Ol, M.V., and Shyy, W., "Modeling of Pitching and Plunging Airfoils of Reynolds Number between  $1 \times 10^4$  and  $6 \times 10^4$ ," AIAA-2009-4100, 27th AIAA Applied Aerodynamics Conference, San Antonio, Texas, June 22-25, 2009
16. Kang, C., Baik, Y., Bernal, L., Ol, M.V., and Shyy, W., "Fluid Dynamics of Pitching and Plunging Airfoils of Reynolds Number between  $1 \times 10^4$  and  $6 \times 10^4$ ," AIAA-2009-536, 47th AIAA Aerospace Sciences Meeting including the New Horizons Forum and Aerospace Exposition, Orlando, Florida,

Jan. 5-8, 2009

17. Trizila, P., Kang, C., Visbal, M., and Shyy, W., "A Surrogate Model Approach in 2-D Versus 3-D Flapping Wing Aerodynamic Analysis", AIAA-2008-5914, 12th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, Victoria, British Columbia, September, 2008
18. Trizila, P., Kang, C., Visbal, M., and Shyy, W., "Unsteady Fluid Physics and Surrogate Modeling of Low Reynolds Number, Flapping Airfoils", AIAA-2008-3821, 38th Fluid Dynamics Conference and Exhibit, Seattle, Washington, June 2008
19. Saric, W., Reed, H., Kang, C., Gladden, R., Gabet, P., and Clevenger, D., "Supersonic Laminar Flow Control on Swept Wings Using Distributed Roughness Experiments," American Physical Society, 54th Annual Meeting of the Division of Fluid Dynamics, San Diego, California, November 18 - 20, 2001

### **Professional Presentations**

- CFDRC, Huntsville, AL, Aug 30, 2013
- University of Alabama in Huntsville, Huntsville, AL, Apr 1, 2013
- Siemens Corporate Research, Princeton, NJ, Feb 21, 2013
- Korea Advanced Institute of Science and Technology, Daejeon, Korea, Dec 22, 2011

### **Teaching Experience**

- Department of Mechanical and Aerospace Engineering, University of Alabama in Huntsville
  - Fundamentals of Aerodynamics (MAE430/530, 2013F, 2014F, undergrad/grad)
  - Graduate Engineering Analysis II (MAE693, 2014S, grad)
  - Advanced Aerodynamics (MAE755, 2014S, grad)
- Department of Aerospace Engineering, University of Michigan
  - Aerodynamics I (ae325, 2010W, undergrad), graduate student instructor

### **Professional Service and Membership**

- Reviewer: Journal of Fluid Mechanics, AIAA Journal, Journal of Theoretical Biology, Bioinspiration & Biomimetics, Journal of Fluids and Structures, Journal of Aerospace Engineering
- Membership: The Royal Institution of Engineers in the Netherlands, AIAA member