

Jeffrey P. Thomas

Department of Mechanical Engineering and Materials Science
Duke University, Box 90300, Durham, North Carolina, 27708-0300
Phone: (919) 660-5173, email: jthomas@duke.edu

INTERESTS

Computational Fluid Dynamics, Aerodynamics, Aeroelasticity, Fluid Structure Interaction, and Adjoint Methods for Design Optimization.

EDUCATION

University of Michigan PhD Aerospace Engineering/Scientific Computing, June 1996.

University of Kansas MS Aerospace Engineering with Honors, August 1991.

University of Kansas BS Aerospace Engineering, December 1989.

RESEARCH AND TEACHING EXPERIENCE

Research Assistant Professor

Duke University

Department of Mechanical Engineering

August 1996 - Present

A research position with efforts directed towards the design of efficient numerical methods for unsteady compressible fluid flows aeroelasticity. Primary work has involved the development of reduced-order modeling techniques within the framework of computational fluid dynamic methods.

Research Assistant / Graduate Student

University of Michigan

Department of Aerospace Engineering

August 1991 - July 1996

Main research efforts concentrated in the development of numerical algorithms for computational acoustics and aeroacoustics. Developed new high-order non-dissipative numerical methods for the solution of long range wave propagation problems. Course work concentrated in gas dynamics, mathematics, numerical methods, and computer science.

Thesis: "An Investigation of the Upwind Leapfrog Scheme for Computational Acoustics and Aeroacoustics" chaired by Professor Philip L. Roe.

Teaching Assistant / Graduate Student

University of Michigan

Department of Aerospace Engineering

September 1994 - May 1996

Teaching assistant over a two year period for a senior-level aerodynamics course. Involved weekly discussion section lectures, grading, assignment solution preparation, and office hours.

Research Assistant / Graduate Student

University of Kansas

Department of Aerospace Engineering

August 1989 - July 1991

Research efforts focused towards the computational simulation of wind-tunnel interference. Developed methods for predicting the wind-tunnel wall interference effects on the lift of high angle-of-attack delta-wings. During first year of program, worked on a project for Boeing Aircraft Company which enabled the modeling of external stores in an existing aircraft potential flow code.

Thesis: "The Simulation of Wind-Tunnel Wall Interference on Delta Wing Lift Using Euler and Navier-Stokes Solutions" chaired by Professor Chuan-Tau Edward Lan.

HONORS AND ACTIVITIES

Member of Sigma Gamma Tau Honor Society (Aerospace Engineering)

Member of Tau Beta Pi Honor Society (Engineering)

1991 Department of Education Fellowship Recipient - University of Michigan

N.T. Veetch Scholarship Recipient - Undergraduate Junior and Senior Years

Chairman - American Institute of Aeronautics and Astronautics Student Branch - Senior Year

Vice-Chairman - AIAA Student Branch - University of Kansas - Junior Year

SCHOLARLY ARTICLES

Thomas, J. P., Custer, C. C., Dowell, E. H., and Hall, K. C., "F-16 Fighter Aeroelastic Computations Using a Harmonic Balance Implementation of the OVERFLOW 2 Flow Solver," AIAA Paper 2010-2632, 51st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Orlando, FL.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Using Automatic Differentiation to Create Order Model Aerodynamic Solver," *AIAA Journal*, Vol. 48, No. 1, January 2010, pp. 19–24.

Schwarz, J. B., Dowell, E. H., Thomas, J. P., Hall, K. C., Rausch, R. D., and Bartels, R. E., "Improved Flutter Boundary Prediction for an Isolated Two-Degree-of-Freedom Airfoil," *Journal of Aircraft*, Vol. 46, No. 6, November–December 2009, pp. 2069–2076.

Dowell, E. H., Thomas, J. P., Hall, K. C., and Denegri, C. M., "Theoretical Predictions of F-16 Fighter Limit Cycle Oscillations for Flight Flutter Testing," *Journal of Aircraft*, Vol. 46, No. 5, September–October 2009, pp. 1667–1672.

Thomas, J. P., Custer, C. H., Dowell, E. H., and Hall, K. C., "Unsteady Flow Computation Using a Harmonic Balance Approach Implemented about the OVERFLOW 2 Flow Solver," AIAA Paper 2009-4270, 19th AIAA Computational Fluid Dynamics Conference, San Antonio, TX.

Custer, C. H., Thomas, J. P., Dowell, E. H., and Hall, K. C., "A Nonlinear Harmonic Balance Method for the CFD Code OVERFLOW 2," International Forum on Aeroelasticity and Structural Dynamics (IFASD) Paper 2009-050, Seattle, WA.

Spiker, M. A., Kielb, R. E., Hall, K. C., and Thomas, J. P., "Efficient Design Method for Non-Synchronous Vibrations Using Enforced Motion," ASME Paper GT-2008-50599, Proceedings of the ASME Turbo Expo 2008: Power for Land, Sea, and Air, Berlin, Germany.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Using Automatic Differentiation to Create a Nonlinear Reduced Order Model Aeroelastic Solver," AIAA Paper 2008-2322, 49th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Schaumburg, IL.

Schwarz, J. B., Dowell, E. H., Thomas, J. P., and Hall, K. C., "Computational Flutter Prediction for Isolated Airfoils," AIAA Paper 2008-1819, 49th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Schaumburg, IL.

Dowell, E. H., Hall, K. C., Thomas, J. P., Kielb, R. E., Spiker, M. A., and Denegri, C. M., "A New Solution Method for Unsteady Flows Around Oscillating Bluff Bodies," IUTAM Symposium on Fluid-Structure Interaction in Ocean Engineering Hamburg University of Technology Hamburg, Germany.

Thomas, J. P., Dowell, E. H., Hall, K. C., and Denegri, C. M., "Virtual Aeroelastic Flight Testing for the F-16 Fighter with Stores," AIAA Paper 2007-1640, U.S. Air Force T&E Days, Destin, FL.

Attar, P. J., Dowell, E. H., White, J. R., and Thomas, J. P., "Reduced Order Nonlinear System Identification Methodology," *AIAA Journal*, Vol. 44, No. 8, August 2006, pp. 1895–1904.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Static/Dynamic Correction Approach for Reduced-Order Modeling of Unsteady Aerodynamics," *Journal of Aircraft*, Vol. 43, No. 4, July–August 2006, pp. 865–878.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Using Automatic Differentiation to Create a Nonlinear Reduced Order Model of a Computational Fluid Dynamic Solver," AIAA Paper 2006-7115,

Liu, L., Thomas, J. P., Dowell, E. H., Attar, P. J., and Hall, K. C., "A Comparison of Classical and High Dimensional Harmonic Balance Approaches for a Duffing Oscillator," *Journal of Computational Physics*, Vol. 215, No. 1, June 2006, pp. 298–320.

Spiker, M. A., Thomas, J. P., Hall, K. C., Kielb, R. E., and Dowell, E. H., "Modeling Cylinder Flow Vortex Shedding with Enforced Motion Using a Harmonic Balance Approach," AIAA Paper 2006-1965, 47th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Newport, RI.

Thomas, J. P., Dowell, E. H., Hall, K. C., and Denegri, C. M., "An Investigation of the Sensitivity of F-16 Fighter Limit Cycle Oscillations to Uncertainties," AIAA Paper 2006-1847, 47th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Newport, RI.

Hall, K. C., Kielb, R. E., and Thomas, J. P., editors, *Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity of Turbomachines*. Springer, April 2006, ISBN: 1402042671.

Thomas, J. P., Hall, K. C., and Dowell, E. H., "Discrete Adjoint Approach for Modeling Unsteady Aerodynamic Sensitivities," *AIAA Journal*, Vol. 43, No. 9, September 2005, pp. 1931–1936.

Dowell, E. H., Hall, K. C., Thomas, J. P., Kielb, R. E., and Spiker, M. A., "Reduced Order Unsteady Aerodynamic Models and Aeroelasticity," *Flow Induced Unsteady Loads and the Impact on Military Applications*, No. 29 in RTO-MP-AVT-123, RTO-NATO, Neuilly-sur-Seine, France, 2005, pp. 29–1–29–26, Meeting Proceedings RTO-MP-AVT-123.

Thomas, J. P., Dowell, E. H., Hall, K. C., and Denegri, C. M., "Further Investigation of Modeling Limit Cycle Oscillation Behavior of the F-16 Fighter Using a Harmonic Balance Approach," AIAA Paper 2005-1917, Presented at the 46th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Austin, TX.

Liu, L., Dowell, E. H., and Thomas, J. P., "Higher Order Harmonic Balance Analysis for Limit Cycle Oscillations in an Airfoil with Cubic Restoring Forces," AIAA Paper 2005-1918, Presented at the 46th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Austin, TX.

Carlson, H. A., Feng, J. Q., Thomas, J. P., Kielb, R. E., Hall, K. C., and Dowell, E. H., "Computational Models for Nonlinear Aeroelasticity," AIAA Paper 2005-1085, Presented at the 43th Aerospace Sciences Meeting Exhibit, Reno, NV.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Modeling Viscous Transonic Limit Cycle Oscillation Behavior Using a Harmonic Balance Approach," *Journal of Aircraft*, Vol. 41, No. 6, November–December 2004, pp. 1266–1274.

Kholodar, D. B., Dowell, E. H., Thomas, J. P., and Hall, K. C., "Limit Cycle Oscillation of a Typical Airfoil in Transonic Flow," *Journal of Aircraft*, Vol. 41, No. 5, September–October 2004, pp. 1067–1072.

Kholodar, D. B., Dowell, E. H., Thomas, J. P., and Hall, K. C., "Improved Understanding of Transonic Flutter: A Three-Parameter Flutter Surface," *Journal of Aircraft*, Vol. 41, No. 4, July–August 2004, pp. 911–917.

Thomas, J. P., Dowell, E. H., Hall, K. C., and Denegri, C. M., "Modeling Limit Cycle Oscillation

Behavior of the F-16 Fighter Using a Harmonic Balance Approach,” AIAA Paper 2004-1696, Presented at the 45th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Palm Springs, CA.

Hall, K. C., Thomas, J. P., Spiker, M. A., and Kielb, R. E., “Prediction of Non-Synchronous Vibration Using a Harmonic Balance Technique,” 9th National Turbine Engine High Cycle Fatigue (HCF) Conference, Village of Pinehurst, NC.

Dowell, E. H., Thomas, J. P., and Hall, K. C., “Transonic Limit Cycle Oscillation Analysis Using Reduced Order Aerodynamic Models,” *Journal of Fluids and Structures*, Vol. 19, No. 1, January 2004, pp. 17–27.

Hall, K. C., Thomas, J. P., Ekici, K., and Voytovich, D. M., “Frequency Domain Techniques for Complex and Nonlinear Flows in Turbomachinery,” AIAA Paper 2003-3998, Presented at the 33rd AIAA Fluid Dynamics Conference and Exhibit, Orlando, FL.

Kielb, R. E., Barter, J. W., Thomas, J. P., and Hall, K. C., “Blade Excitation by Aerodynamic Instabilities - A Compressor Blade Study,” ASME Paper GT-2003-38634, Presented at the ASME Turbo-Machinery Exposition, Atlanta, GA.

Thomas, J. P., Dowell, E. H., and Hall, K. C., “Three-Dimensional Transonic Aeroelasticity Using Proper Orthogonal Decomposition-Based Reduced-Order Models,” *Journal of Aircraft*, Vol. 40, No. 3, May–June 2003, pp. 544–551.

Thomas, J. P., Hall, K. C., and Dowell, E. H., “A Harmonic Balance Approach for Modeling Nonlinear Aeroelastic Behavior of Wings in Transonic Viscous Flow,” AIAA Paper 2003-1924, Presented at the 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Norfolk, VA.

Thomas, J. P., Dowell, E. H., and Hall, K. C., “Modeling Limit Cycle Oscillations for an NLR 7301 Airfoil Aeroelastic Configuration Including Correlation with Experiment,” AIAA Paper 2003-1429, Presented at the 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Norfolk, VA.

Kholodar, D. B., Thomas, J. P., Dowell, E. H., and Hall, K. C., “Parametric Study of Flutter for an Airfoil in Inviscid Transonic Flow,” *Journal of Aircraft*, Vol. 40, No. 2, March–April 2003, pp. 303–313.

Thomas, J. P., Hall, K. C., and Dowell, E. H., “A Discrete Adjoint Approach for Modeling Unsteady Aerodynamic Design Sensitivities,” AIAA Paper 2003-0041, Presented at the 41st AIAA Aerospace Sciences Meeting, Reno, NV.

Thomas, J. P., Dowell, E. H., and Hall, K. C., “A Harmonic Balance Approach for Modeling Three-Dimensional Nonlinear Unsteady Aerodynamics and Aeroelasticity,” ASME Paper IMECE-2002-32532, Presented at the ASME International Mechanical Engineering Conference and Exposition, New Orleans, LA.

Hall, K. C., Thomas, J. P., and Clark, W. S., “Computation of Unsteady Nonlinear Flows in Cascades Using a Harmonic Balance Technique,” *AIAA Journal*, Vol. 40, No. 5, May 2002, pp. 879–886.

Thomas, J. P., Dowell, E. H., and Hall, K. C., “Nonlinear Inviscid Aerodynamic Effects on Transonic Divergence, Flutter and Limit Cycle Oscillations,” *AIAA Journal*, Vol. 40, No. 4, April 2002, pp. 638–646.

Hall, K. C. and Thomas, J. P., "Sensitivity Analysis of Coupled Aerodynamic/Structural Dynamic Behavior of Blade Rows," 7th National Turbine Engine High Cycle Fatigue (HCF) Conference, Palm Beach Gardens, FL.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Modeling Viscous Transonic Limit Cycle Oscillation Behavior Using a Harmonic Balance Approach," AIAA Paper 2002-1414, Presented at the 43th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Denver, CO.

Kholodar, D. B., Thomas, J. P., Dowell, E. H., and Hall, K. C., "A Parametric Study of Transonic Airfoil Flutter and Limit Cycle Oscillation Behavior," AIAA Paper 2001-1211, Presented at the 43th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Denver, CO.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Three-Dimensional Aeroelasticity Using Proper Orthogonal Decomposition Based Reduced Order Models," AIAA Paper 2001-1526, Presented at the 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Seattle, WA.

Dowell, E. H., Thomas, J. P., and Hall, K. C., "Transonic Limit Cycle Oscillation Analysis Using Reduced Order Aerodynamic Models," AIAA Paper 2001-1212, 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Seattle, WA.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Nonlinear Inviscid Aerodynamic Effects on Transonic Divergence, Flutter and Limit Cycle Oscillations," AIAA Paper 2001-1209, Presented at the 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, Seattle, WA.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "A Static/Dynamic Correction Approach for Reduced-Order Modeling of Unsteady Aerodynamics," AIAA Paper 2001-0855, Presented at the 39th Aerospace Sciences Meeting Exhibit, Reno, NV.

Hall, K. C., Thomas, J. P., and Dowell, E. H., "Proper Orthogonal Decomposition Technique for Transonic Unsteady Aerodynamic Flows," *AIAA Journal*, Vol. 38, No. 10, 2000, pp. 1853–1862.

Hall, K. C., Thomas, J. P., and Clark, W. S., "Computation of Unsteady Nonlinear Flows in Cascades Using a Harmonic Balance Technique," *Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity*, edited by P. Ferrand and S. Aubert, Presses Universitaires de Grenoble, Ecole Centrale de Lyon, Lyon, France, September 4-8 2000, pp. 409–426, The 9th International Symposium on Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity (ISUAAT) and Legendre Lectures Series, ISBN 2-7061-1052-X, www.pub.fr, BP 47, 38040 Grenoble Cedex 9.

Thomas, J. P., Dowell, E. H., and Hall, K. C., "Reduced-Order Aeroelastic Modeling Using Proper-Orthogonal Decompositions," CEAS/AIAA/ICASE/NASA Langley International Forum on Aeroelasticity and Structural Dynamics, Williamsburg, VA.

Dowell, E. H., Hall, K. C., Thomas, J. P., Epureanu, B. I., and Heeg, J., "Reduced Order Models in Unsteady Aerodynamics," *Engineering Mechanics*, Vol. 6, No. 4/5, 1999, pp. 229–252, International Journal for Theoretical and Applied Mechanics.

Dowell, E. H., Hall, K. C., Thomas, J. P., Florea, R., Epureanu, B. I., and Heeg, J., "Reduced Order Models in Unsteady Aerodynamics," AIAA Paper 99-1261, 40th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials (SDM) Conference, St. Louis, MO.

Hall, K. C., Thomas, J. P., and Dowell, E. H., "Reduced-Order Modelling of Unsteady Small-Disturbance Flows Using a Frequency-Domain Proper Orthogonal Decomposition Technique," AIAA Paper 99-0655, Presented at the 37th Aerospace Sciences Meeting Exhibit, Reno, NV.

Kim, C., Roe, P. L., and Thomas, J. P., "Accurate Schemes for Advection and Aeroacoustics," AIAA Paper 97-2091, Presented at the 13th AIAA Computational Fluid Dynamics Conference, Snowmass Village, CO, June, 1997. Collection of Technical Papers. Pt. 1.

Thomas, J. P., Kim, C., and Roe, P. L., "Progress Towards a New Computational Scheme for Aeroacoustics," AIAA Paper 95-1758, Presented at the 12th AIAA Computational Fluid Dynamics Conference, San Diego, CA.

Thomas, J. P. and Roe, P. L., "Development of Non-Dissipative Numerical Schemes for Computational Aeroacoustics," AIAA Paper 93-3382, Presented at the 11th AIAA Computational Fluid Dynamics Conference, Orlando, FL.

Thomas, J. P. and Lan, C.-T. E., "The Simulation and Correction of Wind Tunnel Wall Interference of Delta Wing Lift Using Navier-Stokes and Euler Solution," AIAA Paper 91-3300, Presented at the 9th AIAA Applied Aerodynamics Conference, Baltimore, MD.

REFERENCES

Professor and Dean Emertis Earl H. Dowell
Mechanical Engineering - Duke University
Box 90300, Durham, NC 27708-0300
(919) 660-5302, dowell@ee.duke.edu

Professor Kenneth C. Hall
Mechanical Engineering - Duke University
Box 90300, Durham, NC 27708-0300
(919) 660-5328, kenneth.c.hall@duke.edu

Professor Philip L. Roe
Aerospace Engineering - University of Michigan
3021 FXB, Ann Arbor, MI 48109-2118
(734) 764-3394, philroe@umich.edu

Professor Chuan-Tau Edward Lan
Aerospace Engineering - University of Kansas
Lawrence, KS 66044
(785) 864-4276, vortex@ku.edu