

Edward C. Smith

*The Pennsylvania State University
Department of Aerospace Engineering
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Professional Experience

Professor of Aerospace Engineering, 2004-present
Director, Penn State Vertical Lift Research Center of Excellence

Associate Professor of Aerospace Engineering, 1998-2004
Director, Penn State Rotorcraft Center of Excellence

Assistant Professor of Aerospace Engineering, 1992-1998
Co-Director, Director, Penn State Rotorcraft Center of Excellence (1996-2000)

Areas of research include rotorcraft dynamics and aeromechanics, composite structures, elastomeric materials, adaptive structures, and active vibration control.

Graduate Research Fellow, University of Maryland, 1988-1992.

Undergraduate Research Assistant, Penn State Applied Research Laboratory, Fabrication and damping characterization testing of metal matrix composite materials 1986-1988.

Education

Ph.D., Aerospace Engineering
University of Maryland, Center for Rotorcraft Education and Research, August 1992
Dissertation: *Aeroelastic Response and Aeromechanical Stability of Helicopters with Elastically Coupled Composite Rotor Blades*

M.S., Aerospace Engineering,
University of Maryland, Center for Rotorcraft Education and Research, May 1990.

B.S. with High Distinction, Aerospace Engineering, Minor in Mathematics,
The Pennsylvania State University, May 1988.

Honors and Awards

2013 2nd Asian Rotorcraft Forum Best Paper Award, for, "Influence of Aeroelastically Tailored Wing Extensions and Winglets on Whirl Flutter Stability" (with J. Zhang)
2013 Penn State University President's Award for Engagement with Students
2013 AHS Student Design Competition, co-advised students on 1st Place Design
2012 American Helicopter Society National Membership Sponsor Award
2009 DSCD Rudolf Kalman Best Paper Award for, "Multi-Harmonic Adaptive Vibration Control of Misaligned Driveline via Active Magnetic Bearings" Paper No. FMANU-DS-06-1012 (with H. DeSmidt and K.W. Wang)

2008 American Helicopter Society Technical Fellow
 2008 AHS Student Design Competition, co-advised students on 1st Place Design
 2007 Group Achievement Award to the Heavy Lift Rotorcraft Systems Integration Team
 2007 Penn State Engineering Society Outstanding Advising Award
 2007 AHS Student Design Competition, co-advised students on 1st Place Design
 2006 AHS Student Design Competition, co-advised students on 1st Place Design
 2002 Penn State Engineering Society Outstanding Research Award which recognizes
 outstanding engineering researchers for accomplishments in advancing the
 frontiers of knowledge
 2002 Lawrence Sperry Award for extraordinary leadership as founder of a National
 Rotorcraft Technology Center; for pioneering research in aeroelasticity of
 composite rotors; and for dedication to Aerospace Engineering Education.
 2001 American Helicopter Society National Membership Sponsor Award
 2000 Member of team which won the National Partnership for Reinventing
 Government Vice President Al Gore for establishing the National Rotorcraft
 Technology Center
 1998 Fall Penn State Senior Engineering Project Advisor, 2nd Place for Product
 1998 Fall Penn State Senior Engineering Project Advisor, 2nd Place for Presentation
 1997 Mid-Atlantic AHS Regional Lichten Award for Best New Student Paper, co-
 authored paper and advised graduate student winner, (J. Keller)
 1996 American Helicopter Society National Membership Sponsor Award
 1996 AHS Student Design Competition, co-advised students on 1st Place Design
 1996 Mid-Atlantic AHS Regional Lichten Award for Best New Student Paper, co-
 authored paper and co-advised graduate student winner (C. Brackbill)
 1995 American Helicopter Society National Membership Sponsor Award
 1994 American Helicopter Society Director's Award
 1994 Army Research Office Young Investigator Award
 1990 Vertical Flight Foundation - Boeing Helicopters Scholarship
 1989 Vertical Flight Foundation - Kaman Corporation Scholarship
 1988 Vertical Flight Foundation - American Helicopter Society Scholarship
 Minta Martin Fellowship - University of Maryland College of Engineering
 Rotorcraft Fellowship - University of Maryland Aerospace Engineering Department
 George F. Wislicenus Undergraduate Honors Program - Penn State University/ARL
 Sigma Gamma Tau, National Aerospace Engineering Honor Society
 Tau Beta Pi, National Engineering Honor Society

Academic and Professional Service Highlights

Committee member: College of Engineering Strategic Planning Committee: Educational and Research Facilities Sub-Committee

Faculty Advisor: American Helicopter Society, growth from 12 members to 60+ members (largest university/student chapter within AHS), Co-Advisor, August 1992 – 1996, Advisor, 1996–present

Advisor: College of Engineering Freshman-Sophomore Engineering Advising Center, 1992-1996, 2004, 2009, 2012-13

Committee Chairman: AHS Dynamics Committee, May 2000-2002

Committee Chairman: AHS Education Committee, 1997-2012

Committee Member: AHS Education Committee, May 1995-present

Committee Member: PSU Department Head Search Committee, 2004

Committee Member: University Faculty Senate Planning Committee, 2002-2004

Committee Member: AHS Dynamics Technical Committee, 1995-2000, 2013-present.

Committee Member: AIAA Structural Dynamics Technical Committee, 1995-1999

Senior Member: American Institute of Aeronautics and Astronautics, 1986-present

Member: American Helicopter Society, 1986-present

Board Member: American Helicopter Museum and Education Center, West Chester, PA, 2009-2012

Technical Group Leader: Penn State Center for Acoustics and Vibration (CAV), Rotorcraft Acoustics and Dynamics Group, January 1994-present

Co-Director: Penn State Ben Franklin Center for Structural Health Monitoring (SHM), 2006-2012.

Member: Eighth Editorial Board, Nanjing University of Aeronautics and Astronautics, 2007-present

Member: Research Steering Committee, Augusta Westland Corporation, January 2006

University Representative: Technical Advisory Committee, NRTC CRI, Represents ten Universities and participates in technical evaluation of \$8M in federal/industry annual research activities, 2005-present

Co-Chairman: 3rd AHS International Basic Research Conference on Rotorcraft Technology, Nanjing, China, October 14-16, 2009

General/Technical Chairman, 8th Army Research Office Workshop on dynamics and Aeroelasticity of Rotorcraft Systems, University Park, PA, October 1999

Feature Editor: AHS *Vertiflite Magazine*, "Profiles of Young AHS Members Series," 1993-1999

Manuscript Reviewer: *AIAA Journal, AHS Journal, AIAA Journal of Aircraft, AIAA Journal, Journal of Smart Materials & Structures, etc.*

Book Reviewer: Provided technical review for Irwin Publishing Inc. of proposed textbook entitled *A First Course in Aircraft Structures*, November 1993, November 1995

Academic Instruction

Aerospace Structures I - Junior level aerospace structures class.

Aerospace Structures II - Aerospace structures class.

Structures and Dynamics Laboratory - Senior level laboratory class including experiments and term design projects.

Helicopter Design - Senior level undergraduate team design class. Focused on AHS Design Competition and multidisciplinary design project on remote control helicopters.

Aerospace Vehicle Design and Fabrication - Vertically integrated undergraduate design course involving hands-on laboratory work, supervised design sessions, and complementary lectures.

Behavior of Advanced Composite Structures - Graduate/undergraduate elective focused on analysis of composite structures.

Rotorcraft Dynamics - Graduate elective focused on rotary-wing vibration, response, aeroelastic stability, and aeromechanical stability.

VSTOL/Rotorcraft Aerodynamics – Graduate/undergraduate elective course covering topics in rotorcraft aerodynamics and performance.

Aeroelasticity - Graduate course on classical and modern topics in aeroelasticity including dynamic response, divergence, flutter, control reversal, material tailoring.

Hands-On Helicopter – First year seminar course to introduce engineering concepts via lab demos, tours, and discussions.

Senior Project Advising – 1994-present: Supervised industry sponsored teams of Aerospace, Mechanical, and Electrical Engineering students involved with design, build and test of helicopter hardware.

Research Associates & Post Doctoral Scholars

Name	Research Area
Dr. SARIBAY, Zihni	Design Analysis of Pericyclic Transmission Systems (January 2010–present)
Dr. SEMPERLOTTI, Fabio	Structural Health Monitoring (September 2009–April 2010)
Dr. PALACIOS, Jose	De-Icing Systems, Active rotor systems, rotor and airfoil icing (June 2008–present)
Dr. HAN, Dong	Rotor Blade Loads Control and rotor dynamics (April 2008- April 2010)
Dr. KIM, Jun-Sik	Rotor Dynamics and Smart Structures Programs (January 2006–June 2008)
Dr. SZEFI, Joseph	Experimental and Analytical Research Tasks in Support of NRTC Rotorcraft Center Noise and Vibration Control Projects (Sept 2003–November 2005)
Dr. ZHANG, Jianhua	Rotorcraft dynamics simulations, and rotor blade design analysis (2001-present)

Graduate Advisees

Student Name	Type of Degree	Title of Thesis	Degree Date
SCARBOROUGH, Lloyd	PhD	Vibration Control Via Fluidlastic Devices	In Progress
Kentaro Miura	PhD	Tailboom Damping via Flexible Fluidic Tubes	In Progress
Sean Treacy	PhD	Flutter Stability of Rotors with Fluidic Pitch Links	In Progress
Matt Krott	PhD	Structural Damping, Vibration Control, and Energy Harvesting via Flexible Fluidic Tubes	In Progress
Willie Costa	PhD	Small Scale Whirl Flutter Experiments for Tiltrotors with Aeroelastically Tailored Wings	In Progress
Sandilya Kambabampi	PhD	Optimal Design of Aeroelastically Tailored Tiltrotor Wings	In Progress
Gowtham Haribabu	MS	High Fatigue Shape Memory Alloy Devices for Rotorcraft Applications	In Progress
NAMPY, Sreenivas	PhD	Advanced Grid-Stiffened Composite	Aug

Narayanan		Shells for Applications in Heavy Lift Helicopter Rotor Blade Spars	12
TIWARI, Chandrashekhar	PhD	Energy Absorbing Load Limiters for Crashworthy Payload Restraint	Aug 12
MARR, Conor	PhD	Multi State Helicopter Lag Dampers	May 12
ZHU, Yun	PhD	Structural Tailoring and Actuation Studies for Low Power Ultrasonic De-icing of Aluminum and Composite Plates	Dec 10
SARIBAY, Zihni	PhD	Analytical Investigation of the Pericyclic Variable-Speed Transmission System for Helicopter Main Gearbox	Dec 09
SEMPERLOTTI, Fabio	PhD	Structural Damage Detection Via Nonlinear System Identification and Structural Intensity Methods	Aug 09
PALACIOS, Jose	PhD	Design, Fabrication, And Testing Of An Ultrasonic De-Icing System For Helicopter Rotor Blades	May 08
KIM, Jun-Sik	PhD	Design and Analysis of Rotor Systems with Multiple Trailing Edge Flaps and Resonant Actuators	Dec 05
DESMIDT, Hans	PhD	Robust-Adaptive Active Vibration Control of Alloy and Flexible Matrix Composite Rotorcraft Drivelines via Magnetic Bearings: Theory and Experiment	May 05
SZEFI, Joseph	PhD	Helicopter Gearbox Isolation Using Periodically Layered Fluid Isolators	Aug 03
HEVERLY, David	PhD	Optimal Actuator Placement and Active Structure Design for Control of Helicopter Airframe Vibrations	Aug 02
CENTOLANZA, Louis	PhD	Induced Shear Piezoelectric Actuators for Smart Rotor Blades	Aug 01
HOWARD, Anna	PhD	The Aero Mechanical Stability of Soft-Inplane Tiltrotors	Aug 01
KANG, Hao	PhD	Rotor Blade Lag Damping Using Embedded Chordwise Absorbers	Aug 01
KELLER, Jonathan	PhD	Analysis and Control of the Transient Aeroelastic Response of Rotors During Shipboard Engagement and	May 01

		Disengagement Operations	
STEVENS, Patricia	PhD	Active Interrogation of Helicopter Main Rotor Faults Using Trailing Edge Flap Actuation	May 01
ZHANG, Jianhua	PhD	Active-Passive Hybrid Optimization of Rotor Blades With Trailing Edge Flaps	May 01
BRACKBILL, Christian	PhD	Helicopter Rotor Aeroelastic Analysis Using a Refined Elastomeric Damper Model	Dec 00
FLOROS, Matthew	PhD	Elastically Tailored Composite Rotor Blades for Stall Alleviation and Vibration Reduction	Dec 00
GOVINDSWAMY, Kiran	PhD	Modeling of Strain, Temperature, and Frequency-Dependent Properties of Elastomeric Damper and Bearing Materials	Dec 95
MAHMOOD, Raheel	MS	High Efficiency Vibrational Energy Harvesters	In Progress
JOHNSON, Sam	MS	Whirl Flutter Testing of Small Scale Tiltrotor Systems	In Progress
MIURA, Kentaro	MS	Tailboom Damping via Integrated Flexible Matrix Composite Fluidic Circuits	In Progress
WOZNIAK, Michael	MS	Characterization of Single Crystal Piezoelectric Energy Harvesters	In Progress
KURCZEWSKI, Nicolas	MS	Coupled Fluidic Vibration Isolators for Rotorcraft Pitch Link Loads Reduction	May 12
HENRY, Todd	MS	Static and Dynamic Characterization of Composite Materials for Future Driveshaft Systems	May 12
OVERMEYER, Austin	MS	Actuator Bonding, Optimization and System Control of a Rotor Blade Ultrasonic Deicing System	May 12
WINSLOW, Anna	MS	Calibration of a Four Degree of Freedom Stewart Platform Sensor Subject to Translational Constraints	Dec 12
HAN, Yigiang	MS	Theoretical and Experimental Study Of Scaling Method In The Rotor Blade Ice Accretion Test	Aug 11
QUINTANGELI, Michael	MS	An Energy Harvesting Device For Powering Rotor Loads Monitoring	Aug 11

		Sensors	
ROMANO, Peter	MS	Investigation of Contact Acoustic Nonlinearities in Metal and Composite Airframe Structures via Intensity Based Health Monitoring	Aug 11
CHOEPHEL, Tenzin	MS	Experimental Investigation of Dynamic Roughness as an Aerodynamic Flow Control Method	Dec 10
KONG, William	MS	A Method of Selecting and Configuring Optimal energy Absorbing Cargo Restraint Systems to Improve Crashworthiness	Dec 10
SLABY, Jason	MS	Influence of Pylon Airloads and Composite Tailoring On Aeroelastic Stability of a Forward Swept Wing	Dec 10
SOLLENBERGER, Stanton	MS	Characterization And Modeling Of A Flexible Matrix Composite Material For Advanced Rotorcraft Drivelines	Aug 10
BROUWERS, Edward	MS	The Experimental Investigation of a Rotor Icing Model with Shedding	May 10
SANTARELLI, David	MS	An Energy Harvesting Device For Powering Rotor Load Monitoring Sensors	May 10
WANG, Joseph	MS	Embedded Inertial Dampers For Control Of Transient Rotor Loads During Resonance Crossing	May 10
SCHMIDT, Walter	MS	Open-Crack Damage Assessments Of Aluminum Panels Using Structural Intensity-Based Techniques	Dec 09
CORL, Jonas	MS	A Comparison of Helicopter Active Rotor Gust Rejection and Vibration, Alleviation Methods	Aug 09
TIWARI, Chandrashekhar	MS	Innovative Energy Absorbing And Load Limiting Devices Based On Composite Tubes	Aug 09
BOSSENBROEK, Kirsten	MS	Damage Tolerance Of Layer-Wise Hybrid Laminates Consisting Of Glass Reinforced Flexible And Rigid	Aug 08
MONTANYE, Pam	MS	Shipboard Helicopter Gust Response Alleviation Using Active Trailing Edge Flaps	Aug 08
MARR, Conor	MS	The Domain Modeling of Fluidlastic Lead-Lag Dampers	Dec 07

WALCHKO, Joe	MS	Hybrid Feedforward-Feedback Control For Active Helicopter Vibration Suppression	May 07
MAYRIDES, Bryan	MS	Analysis and Synthesis of Highly Flexible Helicopter Drivelines with Flexible Matrix Composite Shafting	Dec 05
NARAYANAN, Sreeni	MS	Structural Behavior and Design of Flexible Matrix Composite Box Beams with Extension Twist Coupling	Aug 05
LEHEN, Francois	MS	Actively Enhanced Periodically Layered Isolator For Helicopter Gearbox Isolation	Dec 04
PALACIOS, Jose	MS	Dynamic Analysis & Experimental Testing of Thin-Walled Structures Driven by Shear Tube Actuators	Dec 04
PETRIE, Jason	MS	Helicopter Rotor Blade Lag Damping Using Fluid Elastic Embedded Chordwise Inertial Dampers	Aug 04
DAVIS, Ronald	MS	The Development of Experimental Teaching Facilities for Rotorcraft Aerodynamics and Dynamics	May 03
OCALAN, Murat	MS	High Flexibility Rotorcraft Driveshafts Using Flexible Matrix Composites & Active Bearing Control	May 02
RAMRAKHYANI, Deepak	MS	Nonlinear Modeling of Elastomeric Materials Using Fractional Derivatives and a Continuously Yielding Plastic Element	May 02
SARKAR, Sumit	MS	Two-Dimensional Finite Element Modeling of Elastomeric Components in the Low Dynamic Shear Strain Amplitude Regime	Dec 98
CENTOLANZA, Louis	MS	Refined Structural Modeling of Thick-Walled, Closed Section Composite Rotor Blades	Dec 97
KELLER, Jonathan	MS	An Experimental and Theoretical Correlation of an Analysis for Helicopter Rotor Blade and Droop Stop Impacts	Dec 97
BYERS, Lynn	MS	Experimental and Analytical Investigation of the Thermomechanical	May 97

			Behavior of Elastomeric Materials	
BRACKBILL, Christian	MS	Thermomechanical Modeling of Elastomeric Materials Using The Method Of Anelastic Displacement Fields	Dec 96	
FLOROS, Matthew	MS	Finite Element Modeling of Open Section Composite Beams with Warping Restraint Effects	Aug 96	
BEALE, Michael	MS	Material Characterization and Aeroelastic Analysis for Helicopters with Elastomeric Dampers	Aug 95	
GEYER, William	MS	Aeroelastic Analysis of Transient Blade Dynamics During Shipboard Engage/Disengage Operations	Aug 95	
VASCSINEC, Michael	MS	Dynamics of Helicopter Rotor Systems With Elastomeric Dampers	Dec 94	
WALLIS, Emily	BS	Aerospace Engineering, A Vibration-Based Liquid Water Concentration Sensor for a Rotating Blade Icing Chamber	May 10	
SANTO, Angela	BS	Performance Of Industrial Fluidlastic™ Mounts- Feasibility For Helicopter Seat Application	Dec 09	
CAMPBELL, Alan	BS	A Study Of The Aerodynamic Feasibility Of Dynamic Roughness For Airfoil Separation Control	May 09	
JOSTES, Michael	BS	Ice Detector Liquid Water Concentration Sensing And New Adverse Environment Rotor Test Stand Calibration	May 09	
OSTRICH, Adam	BS	The Use Of Conductive Carbon Films As Electromechanical Pressure Sensors On Helicopter Blades	May 09	
SOLLENBERGER, Stanton	BS	Evaluation Of Stress Concentrations In Misaligned Flexible Matrix Composite Driveshafts	May 08	
YANG, Tim	BS	Active Flow Control Using Piezoelectrically Actuated Dynamic Roughness	May 08	
CLAUSER, Robert	BS	Development of a Table Top Tiltrotor Model	May 03	
PALACIOS, Jose	BS	Helicopter Blade Anti-Icing System	May 03	

Journal Publications

Han, D., Rahn, C.D., and Smith, E.C., Higher Harmonic Pitch Link Loads Reduction Using Fluidlastic Isolators," *Journal of Aerospace Engineering*, Accepted for publication, December 2012.

Han, D., Wang, J., Smith, E.C., and Lesieutre, G., Transient Loads Control of a Variable Speed Rotor During Lagwise Resonance Crossing," *AIAA Journal*, Vol. 51, (1), January 2013.

Romano, P.Q., Conlon, S.C., and Smith, E.C., "Investigation of Contact Acoustic Nonlinearities on Metal and Composite Airframe Structures via Intensity Based Health Monitoring," *J. Acoust. Soc. Am.* 133 (1), January 2013.

Chen, Y., Qiu, J., Palacios, J, and Smith, E.C., "Tracking Control of Piezoelectric Stack Actuator Using Modified Prandtl–Ishlinskii Model," *Journal of Intelligent Material Systems and Structures*, (0), (0) published online), August 2012.

Palacios, J., Han, Y., Brouwers, E., Smith, E., "Icing Environment Rotor Test Stand Liquid Water Content Measurement Procedures and Ice Shape Correlation," *American Helicopter Society Journal*, Volume 57, Number 2, April 2012.

Palacios, J., Smith, E., Rose, J., and Royer, R., "Instantaneous De-Icing of Freezer Ice via Ultrasonic Actuation," *AIAA Journal*, Vol. 49 No. 6, June 2011, pp. 1158-1167.

Palacios, J., Smith, E., Rose, J., and Royer, R., "Ultrasonic De-Icing of Wind-Tunnel Impact Icing," *Journal of Aircraft*, Vol. 48 No. 3, May-June 2011, pp. 1020-1027.

Scarborough, L., Rahn, C., and Smith, E.C., "Fluidic Composite Tunable Vibration Isolators," *Journal of Vibration and Acoustics*, 2011.

Semperlotti, F., Wang, K.W., and Smith, E.C., "Localization of a Breathing Crack Using Nonlinear Subharmonic Response Signals," *Applied Physics Letters*, Vol. 95 No. 25, December 2009.

Han, D. and Smith E.C., "Lagwise Loads Analysis of a Rotor Blade with an Embedded Chordwise Absorber," *Journal of Aircraft*, Volume 46, No. 4, July-August 2009, pp. 1280-1290.

Semperlotti, F., Wang, K.W., and Smith, E.C., "Identification of the Location of a Breathing Crack using Super-Harmonics Response Signals due to System Nonlinearity", *AIAA Journal*, Vol. 47 No. 9, 2009.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., "Multiharmonic Adaptive Vibration Control of Misaligned Driveline via Active Magnetic Bearings," *Journal of Dynamic Systems, Measurement and Control, Transactions of the ASME*, Vol. 130, No. 4, July

2008, pp. 041006.1 – 041006.13.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., "Robust-Adaptive Magnetic Bearing Control of Flexible Matrix Composite Rotorcraft Driveline," *Journal of the American Helicopter Society*, Vol. 53, No. 2, April 2008, pp. 115-124.

Howard, A.K.T. and Smith, E.C., "Prediction of Air and Ground Resonance Stability of Soft-Inplane Tiltrotors Using a Semispan Analytical Model," *Journal of the American Helicopter Society*, Vol. 53, No. 2, April 2008, pp. 164-178.

Kim, J.S., Cho, M., and Smith, E.C., "An Asymptotic Analysis of Composite Beams with Kinematically Corrected End Effects," *International Journal of Solids and Structures*, Vol. 45, April 2008, pp. 1954-1977.

Kim, J.S., Wang, K.W., and Smith, E.C., "Synthesis and Control of Piezoelectric Resonant Actuation Systems with Buckling Beam Motion Amplifier," *AIAA Journal*, Vol. 46, No. 3, March 2008, pp. 787-791.

Kim, J.S., Wang, K.W., and Smith, E.C., "Development of a Resonant Trailing-Edge Flap Actuation System for Helicopter Rotor Vibration Control," *Journal of Smart Materials and Structures*, Vol. 16, October 2007, pp. 2275-2285.

Kang, H., Smith, E.C., and Lesieutre, G.A., "Experimental and Analytical Study of Blade Lag Damping Augmentation Using Chordwise Absorbers," *Journal of Aircraft*, Vol. 43, No. 1, January-February 2006.

DeSmidt, H.A., Wang, K.W., Smith, E.C., and Provenza, A., "On the Robust Stability of Segmented Driveshafts with Active Magnetic Bearing Control," *Journal of Vibration and Control*, Vol. 11, No. 3, March 2005, pp. 317-329.

Kim, J.S., Wang, K.W., and Smith, E.C., "High-authority Piezoelectric Actuation System Synthesis through Mechanical Resonance and Electrical Tailoring" *Journal of Intelligent Material Systems and Structures*, Vol. 16, January 2005, pp. 21-31.

Heverly II, D.E., Wang, K.W., and Smith, E.C., "Dual Stack Piezoelectric Device with Bidirectional Actuation and Improved Performance," *Journal of Intelligent Material Systems and Structures*, Vol. 15, July 2004, pp. 565-574.

Ramrakhiani, D.S., Lesieutre, G.A., and Smith, E.C., "Modeling of Elasticmeric Materials Using Nonlinear Fractional Derivative and Continuously Yielding Fraction Elements," *International Journal of Solids and Structures*, Vol. 41, No. 14, July, 2004, pp. 3929-3948.

Zhang, J., Smith, E.C., and Wang, K.W., "Active-Passive Hybrid Optimization of Rotor Blades with Trailing Edge Flaps," *Journal of the American Helicopter Society*, Vol. 49, No. 1, January 2004, pp. 54-65.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., "Stability of Segmented Supercritical Driveline with Non-Constant Velocity Couplings Subjected to Misalignment and Torque," *Journal of Sound and Vibration*, Vol. 227, 2004, pp. 895-918.

Keller, J.A. and Smith, E.C., "Active Control of Gimballed Rotors Using Swashplate Actuation During Shipboard Engagement Operations," *AIAA Journal of Aircraft*," Vol. 40, No. 4, July-August 2003, pp. 726-733.

Szefi, J.T., Smith, E.C., and Lesieutre, G.A., "Formulation and Validation of A Ritz-Based Analytical Model Of High Frequency Periodically-Layered Isolators in Compression," *Journal of Sound and Vibration*, Vol. 268, No.1, July 2003, pp. 85-1001.

Brackbill, C.R., Smith E.C., and Lesieutre, G.A., "Application Of A Refined Time Domain Elastomeric Damper Model to Helicopter Rotor Aeroelastic Response and Stability," *Journal of the American Helicopter Society*, Vol. 47, No.3, July 2002, pp. 186-197.

DeSmidt, H.A., Wang, K.W., and Smith E.C., "Coupled Torsion-Lateral Stability of a Shaft-Disk System Drive Through a Universal Joint," *Journal of Applied Mechanics*, Vol. 69, No. 3, May 2002, pp. 261-273.

Centolanza, L.R., Smith, E.C., and Morris A., "Induced-Shear Piezoelectric Actuators For Rotor Blade Trailing Edge Flaps and Active Tips," *Journal of Smart Materials and Structures*, Vol. 11, No. 1, February 2002, pp. 24-35.

Heverly, D., Smith, E.C., and Wang, K.W., "An Optimal Actuator Placement Methodology for Active Control of Helicopter Airframe Vibrations," *Journal of American Helicopter Society*, Vol. 46, No. 4, October 2001, pp. 251-261.

Brackbill, C.R., Lesieutre, G.A., Smith, E.C., and Ruhl, L.E., "Characterization and Modeling of the Low Strain Amplitude and Frequency Dependent Behavior of Elastomeric Damper Materials," *Journal of the American Helicopter Society*, Vol. 45, No. 1, January 2000, pp. 34-42.

Keller, J.A., and Smith, E.C., "Experimental and Theoretical Correlation of Helicopter Rotor Blade-Droop Stop Impact," *Journal of Aircraft*, Vol. 36, No. 2, March – April 1999, pp. 443-450.

Geyer Jr., W.P, Smith, E.C., and Keller, J.A., "Aeroelastic Analysis of Transient Blade Dynamics During Shipboard Engage/Disengage Operations," *Journal of Aircraft*, Vol. 35, No. 3, May-June 1998, pp. 445-453.

Floros, M.W., and Smith, E.C., "Finite Element Modeling of Open-Section Composite Beams with Warping Restraint Effects," *AIAA Journal*, Vol. 35, No. 8, August 1997, pp. 1341-1347.

Brackbill, C.R., Lesieutre, G.A., and Smith, E.C., and Govindswamy, K., "Thermomechanical Modeling for Elastomeric Materials," *Journal of Smart Materials and Structures*, Vol. 5, No. 5, October 1996, pp. 529-539.

Smith, E.C., Govindswamy, K., Beale, M.R., and Lesieutre, G.A., "Formulation Validation, and Application of a Finite Element Model for Elastomeric Lag Dampers," *Journal of the American Helicopter Society*, Vol. 41, No. 3, July 1996, pp. 247-256.

Smith, E.C., Govindswamy, K., Beale, M.R., Vascsinec, M.J., and Lesieutre, G.A., "Aeroelastic Response and Stability of a Helicopter with Elastomeric Lag Dampers," *Journal of the American Helicopter Society*, Vol. 41, No. 3, July 1996, pp. 257-266.

Smith, E.C., "Vibration and Flutter of Stiff-Inplane Elastically Tailored Composite Rotor Blades", *Mathematical and Computer Modelling: Special Edition on Rotorcraft Modelling*, Vol. 20, No. 1 & 2, February 1994.

Smith, E.C. and Chopra, I., "Air and Ground Resonance of Helicopters with Elastically Tailored Composite Blades," *Journal of the American Helicopter Society*, Vol. 38, No. 4, October 1993, pp. 50-61.

Smith, E.C. and Chopra, I., "Aeroelastic Response, Loads, and Stability of a Composite Rotor in Forward Flight", *AIAA Journal*, Vol. 31, No. 7, July 1993, pp. 1265-1273.

Smith, E.C. and Chopra, I., "Formulation and Evaluation of an Analytical Model for Composite Box-Beams," *Journal of the American Helicopter Society*, Vol. 36, No. 3, July 1991, pp. 23-35.

Bhagat, R.B., Amateau, M.F., and Smith, E.C., "Damping Behavior of Planer Random Carbon Fiber Reinforced 6061 Al Matrix Composites Fabricated by High Pressure Infiltration Casting," *ASTM Journal of Composites Technology Research*, Vol. 11, No. 3, Fall 1989.

Bhagat, R.B., Amateau, M.F., and Smith, E.C., "Damping Behavior of Mechanically Alloyed Aluminum and Aluminum Matrix Composites," *International Journal of Powder Metallurgy*, Vol. 25, No. 1-4, October 1989.

Conference Papers and Seminar Presentations

Scarborough III, L.H., Rahn, C.D., Smith, E.C., and Koudela, K.L., "Coupled Pitch Links for Multi-Harmonic Isolation Using Fluidic Circuits," *Proceedings of the ASME 2012 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*, Chicago, IL, August 12-15, 2012.

Kurczewski, N. A., Scarborough III, L. H., Rahn, C. D., and Smith, E. C., "Coupled Fluidic Vibration Isolators for Rotorcraft Pitch Link Loads Reduction". *Proceedings of the International Design Engineering Technical Conferences & Computers and*

Information in Engineering Conference, Chicago, IL, August, 2012.

Conlon, S.C., Evans, S.S., Smith, E.C., Romano, P.Q., and Barnard, A.R., "OH-58 Tailboom Damage Detection Study," *Proceedings of the American Helicopter Society 68th Annual Forum*, Fort Worth, Texas, May 1 – 3, 2012.

Miller, S.W., Little, E.J., Yukish, M.A., Bakis, C.E., and Smith, E.C., "Rate Effects and Environmental Sensitivity of Textile Energy Absorbers," *Proceedings of the American Helicopter Society 68th Annual Forum*, Fort Worth, Texas, May 1 – 3, 2012.

Han, Y., Palacios, J., and Smith, E., "An Experimental Correlation between Rotor Test Stand and Wind Tunnel Ice Shapes on NACA 0012 Airfoils," *SAE 2011 International Conference on Aircraft and Engine Icing and Ground Deicing*, Paper number: 2011-38-0092, Chicago, IL, June 13-17, 2011.

Overmeyer, A., Palacios, J., Roger, R., Smith, E., "Rotating Testing of a Low-Power, Non-Thermal Ultrasonic Deicing System for Helicopter Rotor Blades," *SAE 2011 International Conference on Aircraft and Engine Icing and Ground Deicing*, Paper number: 2011-38-0098, Chicago, IL, June 13-17, 2011

Brouwers, E., Peterson, A., Palacios, J., Centolanza, L., "Ice Adhesion Strength Measurements for Rotor Blade Edge Materials," *Proceedings of the 67th American Helicopter Society Forum*, Virginia Beach, VA, May 3-5, 2011.

Han, D., Smith, E. C. and Rahn, C. D., "Pitch Link Loads Analysis of a Variable Speed Rotor," *Proceedings of the 67th American Helicopter Society Forum*, Virginia Beach, Virginia, May 3-5, 2011.

Marr, C., Smith, E., Lesieutre, G., & Fuhrer, Z., Multi-State Lead-Lag Damper Development and Validation, *Proceedings of the 67th American Helicopter Society Forum*, Virginia Beach, VA, May 3-5, 2011.

Palacios, J., Kinzel, M., Overmeyer, A., Szeffi, J., "A Comparison of Active Gurney Flaps and Trailing-Edge Flaps for Rotorcraft," *Proceedings of the 67th American Helicopter Society Forum*, Virginia Beach, VA, May 3-5, 2011.

Slaby, J. and Smith, E., "Aeroelastic Stability of Folding Tiltrotor Aircraft in Cruise Flight with Composite Wings," *52nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference*, Denver, Colorado, April 4-7, 2011.

Han, D., Rahn, C. D. and Smith, E. C., "Loads Reduction using Coupled Fluidic Pitch Links," *52nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Material Conference*, Denver, Colorado, April 4-7, 2011.

Zhang J. and Smith, E., "Studies of a Ducted Rotor with Exit Vane Controls", *The International Powered Lift Conference*, October 5-7, 2010, Philadelphia, PA.

Scarborough III, L., Rahn, C. and Smith, E., "Fluidic Composite Tunable Vibration Isolators," *Conference on Smart Materials, Adaptive Structures and Intelligent Systems*, Philadelphia, PA, September 28 - October 1, 2010.

Kong, W. Smith, E., Yukish, M., Stump, G. & Bakis, C., "Optimization Study of Energy Absorbing Cargo Restraint Systems", *2010 International Crashworthiness Conference*, No. 2010-109, Leesburg, VA, September 22-24, 2010.

Brouwers, E., Palacios, J., Peterson A. & Smith, E., "The Experimental Investigation of a Rotor Icing Model with Shedding", *Proceedings of the 66th American Helicopter Society Forum*, Phoenix, AZ, May 11-13 2010.

Conlon, S.C., Shepherd, M.R., Hines, J.A., Barnard, A.R., Semperlotti, F., Romano, P.Q., and Smith, E.C., "Development of an Airframe Intensity Based Structural Health Monitoring System", *Proceedings of the 66th American Helicopter Society Forum*, Phoenix, AZ, May 11-13 2010.

Palacios, J., Brouwers, E., Han, Y., Smith, E., "Adverse Environment Rotor Tests Stand Calibration and Ice Shape Correlation," ", *Proceedings of the 66th American Helicopter Society Forum*, Phoenix, AZ, May 11-13 2010.

Saribay Z.B., Bill R.C., Rao S., and Smith E.C., "Elastohydrodynamic Lubrication Analysis of Face-Gear-Pair Meshing Concept for Nutating Gear Mechanisms and Pericyclic Variable Speed Transmission," *Proceedings of the 66th American Helicopter Society Forum*, Phoenix, AZ, May 11-13, 2010.

Zhu, Y., Palacios, J., Smith E. and Rose, J., "Tailored Waveguide De-Icing for Helicopter Blade Skin with Ultrasonic Guided Waves," *Proceedings of 51st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, AIAA-2010-3043, Orlando, Florida, April 12-15, 2010

Narayanan Nampy S. and Smith, E., "Stiffness Analysis of Closed Cross-Section Composite Grid-Stiffened Cylinders," *Proceedings of 51st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, AIAA-2010-2786, Orlando, Florida, Apr. 12-15, 2010.

Han, D. and Smith, E., "Pitch Link Loads Reduction Using Fluidlastic Isolators," *AHS Specialists Conference on Aeromechanics*, San Francisco, CA, January 20-22, 2010.

Han, D., Wang, J., Smith, E. and Lesieutre, G., "Transient Loads Control of a Variable Speed Rotor During Lagwise Resonance Crossing", *AHS Aeromechanics Specialist Conference*, San Francisco, CA, January 20-22, 2010.

Sollenberger, S. G., Bail, J. L, Kohlman, L., Ruggeri, C. R., Bakis, C. E., Roberts, G. D., and Smith, E. C., "Ballistic Impact Tolerance of Filament-Wound Composite Tubes with Rigid and Flexible Matrix Material," *Proceedings of 25th Technical Conference American Society for Composites*, J. B. Lanz, N. Takeda, B. M. Doudican, G. A.

Schoeppner, and S L. Donaldson, Eds., DEStech Publications, Lancaster, PA, 2010, ISBN 978-1-60595-025-9, Paper No. 1183, 12 p. (CD ROM).

Nampy, S.N. and Smith, E.C., "An Innovative Structural Design Concept for Heavy-Lift Rotor Blades," *Presented at the Technical Specialists Meeting on Rotorcraft Structures and Survivability The Hampton Roads Chapter of the American Helicopter Society*, Williamsburg, VA, October 27-29, 2009.

Han, D. and Smith, E.C., "Lagwise Resonance Crossing Analysis of Variable Speed Rotor," *The 3rd International Basic Research Conference on Rotorcraft Technology*, Nanjing, China, October 14-16, 2009.

Saribay Z.B., Bill R.C., Rao S., and Smith E.C., "Concept of Meshing Conjugate Face-Gear Pairs for Nutating Gear Mechanisms and the Pericyclic Variable Speed Transmission," *The 3rd AHS International Basic Research Conference on Rotorcraft Technology*, Nanjing, China, October 14-16, 2009.

Zhu, Y., Palacios, J., Smith, E., and Rose, J., "Influence of Tailored Waveguides on the Ultrasonic De-Icing Stresses of Aluminum Panels," *The 3rd International Basic Research Conference on Rotorcraft Technology*, Nanjing, China, October 14-16, 2009.

Lotfi-Gaskarimahalle, A., Scarborough III, L., Rahn, C., and Smith, E., "Fluidic Composite Tuned Vibration Absorbers," *Proceedings of Smart Materials Adaptive Structures and Intelligent Systems*, Oxnard, CA, September 20-24, 2009.

Montanye, P.L., Smith, E.C., Rahn, C.D., and Conlon, S.C., "Shipboard Helicopter Gust Response Alleviation Using Active Trailing Edge Flaps", *Proceedings of the 65th American Helicopter Society Forum*, Grapevine, Texas, May 27-29, 2009, Vol. 2, Pages 1604-1616.

Sollenberger, S.G., Bakis, C.E., and Smith, E.C., "Effect of Stress Concentrations in Flexible Matrix Composite Driveshafts", *Proceedings of the 65th American Helicopter Society Forum*, Grapevine, Texas, May 27-29, 2009, Vol. 2, Pages 1054-1060.

Tiwari, C., Smith, E.C., and Bakis, C.E., "Multi-Mechanism Energy Absorption in Extension-Twist Coupled Composite Tubes", *Proceedings of the 65th American Helicopter Society Forum*, Grapevine, Texas, May 27-29, 2009, Vol. 2, Pages 1533-1550.

Zhang, J., and Smith, E.C., "Aeroelastic and Structural Analysis of Ducted Composite Rotors in Edgewise Flight," *Proceedings of the 65th American Helicopter Society Forum*, Grapevine, Texas, May 27-29, 2009, Vol. 1, Pages 667-676.

Tiwari, C., Smith, E.C., and Bakis, C.E., "Energy Absorption and Load Limiting via Extension-Torsion Coupled Stitch Ripping Composite Tubes," *Proceedings of the 50th AIAA Structures Structural Dynamics and Materials Conference*, Palm Springs, CA, May 4-7, 2009.

Semperlotti, F., Schmidt, W.T., Smith, E.C., Conlon, S.C., and Banks, J.C., "A Parametric Study for a Structural Intensity based Damage Detection Technique", *AHS Specialists' Meeting on Condition Based Maintenance*, Huntsville, Alabama, February 10-11, 2009, Pages 79-94.

Saribay, Z., Bill, R., Smith, E., Rao, S., Wang, K., "Design Analysis of Pericyclic Variable-Speed Transmission System for a 600 HP Class Unmanned Rotorcraft," *Proceedings of the American Helicopter Society International - International Specialists Meeting on Unmanned Rotorcraft*, Phoenix, AZ, January 20-22, 2009, Pages 529-545.

Tiwari, C., Smith, E.C., Bakis, C.E., "Innovative Energy Absorbing Composite Tubes Incorporating Extension-Torsion Coupling, Stitch Ripping, and Foam Crushing," IUTAM-MMSS2008 Conference; *IUTAM Symposium on Multi Functional Material Structures and Systems*, Bangalore, India, December 10 - December 13, 2008.

Kong, W., Tiwari, C., Hagon, M., Bakis, C.E., Smith, E.C., and Yukish, M.A., "Innovative Energy Absorbing Mounting Systems for High Mass Rotorcraft Payloads," Poster FP-09, *26th Army Science Conference*, Orlando, FL, December 1 - 4, 2008.

Nampy, S., Smith, E., and Bakis, C., "Next Generation Rotor Blades with Helical Grid-Stiffened Spar," *American Helicopter Society International Southwest Region Specialists Meeting on Next Generation Vertical Lift Technologies*, Dallas-Fort Worth, Texas, October 15-17 2008, Pages. 96-124.

Hagon, M.J., William K., Bakis, C.E., Yukish, M.A., and Smith E.C., "Energy-Absorbing Textile Devices for Heavy Cargo Restraints," *Proceedings of the 64th American Helicopter Society Forum*, Montreal, Canada, April 29 - May 1, 2008.

Marr, C., Lesieutre, G.A., and Smith, E.C., "Nonlinear, Temperature-Dependent, Fluidlastic Lead-Lag Damper Modeling," *Proceedings of the 64th American Helicopter Society Forum*, Montreal, Canada, April 29 - May 1, 2008, Vol. 3, Pages 2370-2381.

Palacios, J.L., Smith, E.C., and Rose, J.L., "Investigation of an Ultrasonic Ice Protection System for Helicopter Rotor Blades," *Proceedings of the 64th American Helicopter Society Forum*, Montreal, Canada, April 29 - May 1, 2008.

Han, D., and Smith, E.C., "Lagwise Loads Analysis of a Rotor Blade with an Embedded Chordwise Absorber," AIAA 2008-2182, *Proceedings of the 49th Structural Dynamics and Materials Conference*, Schaumburg, IL, April 7-10, 2008.

Nampy, S.N., and Smith, E.C., "Structural Behavior of Grid-stiffened Tubes Under Axial, Bending and Torsion Loads," AIAA 2008-2169, *Proceedings of the 49th Structural Dynamics and Materials Conference*, Schaumburg, IL, April 7-10, 2008.

Zhu, Y., Palacios, J.L., Rose, J., and Smith, E.C., "De-Icing of Multi-Layer Composite Plates Using Ultrasonic Guided Waves," AIAA 2008-1862, *Proceedings of the 49th*

Structural Dynamics and Materials Conference, Schaumburg, IL, April 7-10, 2008.

Zhang, J., Smith, E.C., and Horn, J.F., "Dynamics of A Ducted Rotor in Forward Flight," *AHS Specialist's Conference on Aeromechanics*, San Francisco, California, January 23-25, 2008.

Hagon, M. J., Bakis, C.E., Yukish, M.A., and Smith, E.C., "A New Look at Lightweight Energy Absorbing Devices for Heavy Cargo Restraints," *Proceedings of the 63rd American Helicopter Society Annual Forum*, Virginia Beach, Virginia, May 1-3, 2007.

Palacios, J.L., Smith, E.C., Zhu, Y., and Rose, J.L., "Global Ultrasonic Shear Wave Anti-Icing Actuator for Helicopter Blades," *Proceedings of the 63rd American Helicopter Society Annual Forum*, Virginia Beach, Virginia, May 1-3, 2007.

Saribay, Z.B., Smith, E.C., Lemanski, A.J., Bill, R.C., Wang, K.W., and Rao, S., "Compact Pericyclic Continuously Variable Speed Transmission Systems: Design Features and High-Reduction Variable Speed Case Studies," *Proceedings of the 63rd American Helicopter Society Annual Forum*, Virginia Beach, Virginia, May 1-3, 2007.

Walchko, J.C., Kim, J-S., Wang, K.W., and Smith, E.C., "Hybrid Feedforward-Feedback Control for Active Helicopter Vibration Suppression," *Proceedings of the 63rd American Helicopter Society Annual Forum*, Virginia Beach, Virginia, May 1-3, 2007.

Kim, J-S., Wang, K.W., and Smith, E.C., "Synthesis and Control of Piezoelectric Resonant Actuation Systems with Buckling-Beam Motion Amplifier," *Proceedings of the 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics & Materials Conference*, Waikiki, Hawaii, April 23-26, 2007.

Badre-Alam, A., Lesieutre, G.A., McGuire, D., Smith, E.C., and Szeffi, J.T., "Design of Fluidic, High Frequency Periodically Layered Isolators for Model 427 Gearbox Isolation," *Proceedings of the 62nd American Helicopter Society Forum*, Phoenix, AZ, May 9 -11, 2006.

Centolanza, L., Mockensturm, E., Rehrig, P., Smith, E., Szeffi, J., and Wang, K., "Development of a Novel High Authority Piezoelectric Actuator for Rotor Blades with Trailing Edge Flaps," *Proceedings of the 62nd American Helicopter Society Forum*, Phoenix, AZ, May 9 -11, 2006.

Gao, H., Palacios, J.L., Rose, J.L., and Smith, E.C., "Ultrasonic Shear Wave Anti-Icing System for Helicopter Rotor Blades," *Proceedings of the 62nd American Helicopter Society Forum*, Phoenix, AZ, May 9 -11, 2006.

Kim, J-S., Smith, E.C., and Wang, K.W., "Helicopter Blade Loads Control via Multiple Trailing-Edge Flaps," *Proceedings of the 62nd American Helicopter Society Forum*, Phoenix, AZ, May 9 -11, 2006.

Lesieutre, G.A., Marr, C., Smith, E.C., and Szeffi, J.T., "Time Domain Fluidlastic® Lag

Damper Modelin," *Proceedings of the 62nd American Helicopter Society Forum*, Phoenix, AZ, May 9 -11, 2006.

Narayanan Nampy, S., Smith, E.C., "Design Evaluation of Model and Full-Scale Flexible Matrix Composite Tiltrotor Blades with Extension-Twist Coupling," *Proceedings of the 62nd American Helicopter Society Forum*, Phoenix, AZ, May 9 -11, 2006.

Zhang, J. and Smith E.C., "Structural Design and Optimzation of Composite Blades for a Low Weight Roto," *2nd International Basic Research Conference on Rotorcraft Technology*, Nanjing, China, November 7-9, 2005.

Kim, J.S., Wang, K.W., and Smith, E.C., "Design and Analysis of Piezoelectric Transducer Based Resonant Actuation Systems," *IMECE2005-80335, ASME IMECE 2005*, Orlando, FL, November 6-11, 2005.

Mayrides, B.D., Shan, Y., Bakis, C.E., Smith, E.C., and Wang, K.W., "Recent Advances in the Evaluation of Flexible Composite Driveshafts for Rotorcraft Applicaitons," *National Technical Specialists" Meeting on Rotorcraft Structures and Survivability*, Williamsburg, VA, October 25-27, 2005.

Nampy, S.N., Smith, E.C., Shan Y., and Bakis, C.E., "Extension-Twist Coupled Tiltrotor Blades using Flexible Matrix Composites," *National Technical Specialists" Meeting on Rotorcraft Structures and Survivability*, Williamsburg, VA, October 25-27, 2005.

Smith, E.C. and Zhang, J., "Structural Design and Analysis of Composite Blades for Weight Reduction," *National Technical Specialists" Meeting on Rotorcraft Structures and Survivability*, Williamsburg, VA, October 25-27, 2005.

Kim, J.S., Smith, E.C., and Wang, K.W., "Active Loads Control via Mutiple Trailing-Edge Flaps," *11th International Workshop on Rotorcraft Dynamics and Aeroelasticity*, Deerfield Beach, FL, October 12-14, 2005.

Kim, J.S., Wang, K.W., and Smith, E.C., "Resonant Actuation Systems based on Smart Materials for Active Flap Rotors," *11th International Workshop on Rotorcraft Dynamics and Aeroelasticity*, Deerfield Beach, FL, October 12-14, 2005.

Marr, C. and Smith, E.C., "Recent Advances in Rotor Blade Lag Damping Devices: Embedded Damper Prototype Testing and Fluidlastic Damper Modeling," *11th International Workshop on Rotorcraft Dynamics and Aeroelasticity*, Deerfield Beach, FL, October 12-14, 2005.

Palacios, J.L., Gao, H., Smith, E.C., and Rose, J.L., "Horizontal Shear Wave Anti-Icing System For Helicopter Rotorblades," *11th International Workshop on Rotorcraft Dynamics and Aeroelasticity*, Deerfield Beach, FL, October 12-14, 2005.

Szeffi, J.T., Mockensturm, E., Smith, E.C., and Wang, K.W., "Development of High Authority Piezoelectric Actuators for Rotor Baldes with Trailing Edge Flaps," *11th International Workshop on Rotorcraft Dynamics and Aeroelasticity*, Deerfield Beach, FL, October 12-14, 2005.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., "Multi-Harmonic Adaptive Vibration Control of Misaligned Driveshaft Systems - An Experimental Study," *Proceedings of the 12th International Congress on Sound and Vibration*, Lisbon, Portugal, July 2005.

Kim, J.S., Wang, K.W., and Smith, E.C., "Development of a Resonant Actuation System for Active Flap Rotors," *Proceedings of the 61st American Helicopter Society Forum*, Grapevine, TX, June 1-3, 2005, Vol. 2, Pages 1627-1637.

Mayrides, B.D., Smith, E.C., and Wang, K.W., "Analysis and Synthesis of Highly Flexible Helicopter Drivelines with Flexible Matrix Composite Shafting," *Proceedings of the 61st American Helicopter Society Forum*, Grapevine, TX, June 1-3, 2005, Vol. 2, Pages 1582-1595.

Petrie, J.S., Lesieutre, G.A., and Smith E.C., "Design and Model Testing of Helicopter Rotor Blade Lag Fluid Elastic Embedded Chordwise Inertial Dampers," *Proceedings of the 61st American Helicopter Society Forum*, Grapevine, TX, June 1-3, 2005, Vol., 1 Pages 994-1004.

LeHen, F., Smith, E.C., Lesieutre, G.A., and Szefi, J.T., "Actively Enhanced Periodically Layered Isolator for Helicopter Gearbox Isolation," AIAA Paper No. 2005-2250, 2005, *Proceedings of the 46th AIAA/AHS/ASME/ASCE/ASC Structures, Structural Dynamics, and Materials Conference*, Austin, TX, April 18-21, 2005.

Palacios, J.L. and Smith, E.C., "Dynamic Analysis and Experimental Testing of Thin-Walled Structures Driven by Shear Tube Actuators," AIAA Paper No. 2005-2112, *Proceedings of the 46th AIAA/AHS/ASME/ASCE/ASC Structures, Structural Dynamics, and Materials Conference*, Austin, TX, April 18-21, 2005.

Sreenivas, N.N. and Smith, E.C., "Extension-Twist Coupled Tiltrotor Blades using Flexible Matrix Composites," AIAA Paper No. 2005-2182, *Proceedings of the 46th AIAA/AHS/ASME/ASCE/ASC Structures, Structural Dynamics, and Materials Conference*, Austin, TX, April 18-21, 2005.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., "Adaptive Control of Flexible Matrix Composite (FMC) Rotorcraft Driveslines," *Proceedings of the American Helicopter Society 60th Annual Forum*, Baltimore, MD, June 8-10, 2004.

Kim, J.S., Smith, E.C., and Wang, K.W., "Helicopter Vibration Suppression via Multiple Trailing Edge Flaps Controlled by Resonance Actuation System," *Proceedings of the American Helicopter Society 60th Annual Forum*, Baltimore, MD, June 8-10, 2004.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., "Multi-Harmonic Adaptive Vibration Control of Magnetic Bearing-Driveshaft with Auxiliary Feedback: Theory and Experiment," *Proceedings of 45th AIAA/ASME/ASCE/ AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Palm Springs, CA, April 19-22, 2004.

Petrie, J.S., Lesieutre, G.A., and Smith, E.C., "Helicopter Blade Lag Damping Using Embedded Fluid Elastic Inertial Dampers," *Proceedings of 45th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Palm Springs, CA, April 19-22, 2004.

Szefi, J.T., Lesieutre, G.A., and Smith, E.C., "Design and Testing Of A Compact Layered Isolator For High-Frequency Helicopter Gearbox Isolation," *Proceedings of 45th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Palm Springs, CA, April 19-22, 2004.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., "Multi-Harmonic Adaptive Vibration Control of AMB-Driveline Systems with Non-Constant Velocity Flexible Couplings," *Proceedings of ASME Design Engineering Technical Conference*, DETC2003/VIB-48545, Chicago, IL, September 2-6, 2003.

DeSmidt, H.A., Wang, K.W., and Smith, E.C., and Provenza, A.J., "Stability Control of Driveline System with Internal Damping and Non-Constant Velocity Couplings," *Proceedings of ISCORMA Conference*, Gdansk Poland, August 4-8, 2003.

Kim, J.S., Wang, K.W., and Smith, E.C., "Active Authority Enhancement of Piezoelectric Actuator Design via Mechanical Resonance and Electrical Tailoring," *Proceedings of the Fifth International Conference on Intelligent Materials*, University Park, PA, June 14-17, 2003.

Shin, E., Wang, K.W., and Smith, E.C., "Characterization of Flexible Matrix Composite Rotorcraft Driveshafts," *Proceedings of the American Helicopter Society 59th Annual Forum*, Phoenix, AZ, May 6-8, 2003.

Szefi, J.T., Smith, E.C., and Lesieutre, G.A., "Design Analysis, and Testing of High-Frequency Periodically Layered Isolators with Passive Design Enhancements for Helicopter Gearbox Isolation," *Proceedings of the American Helicopter Society 59th Annual Forum*, Phoenix, AZ, May 6-8, 2003.

Kim, J.S., Smith, E.C., and Wang, K.W., "Active Loads Control of Composite Rotor Blade via Dual Trailing Edge Flaps," *Proceedings of the 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Norfolk, VA, April 7-10, 2003.

Szefi, J.T., Smith, E.C., and Lesieutre, G.A., "Design and Analysis of High-Frequency Periodically Layered Isolators for Helicopter Gearbox Isolation," AIAA-2003-1784, *Proceedings of the 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Norfolk, VA, April 7-10, 2003.

Centolanza, L., and Smith, E.C., "Induced-Shear Piezoelectric Actuators for Active Twist Rotor Blades," AIAA-02-1446, *43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Denver, CO, April 22-25, 2002.

Heverly II, D., Wang, K.W., and Smith, E.C., "A New Dual Stack Piezoelectric Actuation Device with Improved Performance, 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Denver, CO, April 22-25, 2002.

Kang, H.A., Smith, E.C., and Lesieutre, G.A., "The Effects of Embedded Chordwise Absorbers on Blade Aeroelastic Stability," AIAA-02-1433, 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Denver, CO, April 22-25, 2002.

Ramrakhiani, D., Lesieutre, G.A., and Smith, E.C., "Efficient Modeling of Elastomeric Materials Using Fractional Derivatives and Plastic Yielding," AIAA-02-1436, 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Denver, CO, April 22-25, 2002.

Brackbill, C., Smith, E.C., and Lesieutre, G.A., "Aeromechanical Stability and Response of Helicopters with Interblade Elastomeric Dampers," *Presented at the 9th Army Research Office Workshop on Aeroelasticity of Rotorcraft Systems*, Ann Arbor, MI, October 21-24, 2001.

Centolanza, L., Smith, E., "Induced-Shear Piezoelectric Actuators for Active Rotor Blade Twist," *Presented at the 9th Army Research Office Workshop on Aeroelasticity of Rotorcraft Systems*, Ann Arbor, MI, October 21-24, 2001.

Heverly II, D., Smith, E., and Wang, K., "Smart Fuselage Realization and Active Vibration Control of a Scaled Helicopter Tailboom Model," *Presented at the 9th Army Research Office Workshop on Aeroelasticity of Rotorcraft Systems*, Ann Arbor, MI, October 21-24, 2001.

Howard, A., and Smith, E., "Tiltrotor Air and Ground Resonance: Full-Span Model with Fuselage Motion," *Presented at the 9th Army Research Office Workshop on Aeroelasticity of Rotorcraft Systems*, Ann Arbor, MI, October 21-24, 2001 (First author supervised by candidate).

Kang, H., Smith, E., and Lesieutre, G., "Helicopter Blade Lag Damping Using Embedded Chordwise Absorbers," *Presented at the 9th Army Research Office Workshop on Aeroelasticity of Rotorcraft Systems*, Ann Arbor, MI, October 21-24, 2001.

Smith, E., "How to Tame a Wild Rotor with a Rubber Band," *Presented at the 9th Army Research Office Workshop on Aeroelasticity of Rotorcraft Systems*, Ann Arbor, MI, October 21-24, 2001.

McCormick, B., and Smith, E.C., "Summary of Tiltrotor Vortex Ring Characteristics, Autorotation, and Aeromechanics Issues," *Presentation at NASA Ames Research Center, Moffett Field, CA*, June 19, 2001.

Kang, H., Smith, E., and Lesieutre, G., "Helicopter Blade Lag Damping Using Embedded Chordwise Absorbers," *Proceeding of the American Helicopter Society 57th Annual Forum*, Washington DC, May 9-11, 2001.

Stevens, P., and Smith, E., "Active Interrogation of Helicopter Rotor Faults Using Trailing Edge Flap Actuation," *Proceeding of the American Helicopter Society 57th Annual Forum*, Washington DC, May 9-11, 2001.

Centolanza, L., Smith, E., and Morris, A., "Induced-Shear Piezoelectric Actuators for Rotor Blade Trailing Edge Flaps and Active Tips," AIAA-01-1559, *Proceeding of the 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Seattle, WA, April 14-19, 2001.

Ramrakhiani, R., Lesieutre, G.A., and Smith, E.C., "Efficient Modeling of Elastomeric Materials Using Fractional Derivatives and Plastic Yielding," AIAA Paper 01-1592, *Proceeding of the 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Seattle, WA, April 14-19, 2001, Vol. 4, Pages 3030-3038.

Szefi, J., Smith, E.C, and Lesieutre, G.A, "Formulation and Validation of a Ritz-Based Analytical Model for Design of Periodically-Layered Isolators in Compression," AIAA Paper 01-1684, *Proceedings of the 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Seattle, WA, April 14-19, 2001, Vol. 5, Pages 3690-3704.

Stevens, P., and Smith, E., "Active Interrogation of Helicopter Rotor Faults Using Trailing-Edge Flaps," *Proceeding of the IMAC-XIX Conference & Exposition on Structural Dynamics*, Kissimmee, FL, February 5-8, 2001.

Brackbill, C., E.C. Smith, and G.A. Lesieutre, "Aeromechanical Stability and Response of Helicopters with Interblade Elastomeric Dampers," *Proceeding of the American Helicopter Society Rotorcraft Dynamics and Aeromechanics Specialists Meeting*, Atlanta, Georgia, November 13 – 15, 2000.

Floros, M., and E.C. Smith, "Elastically Tailored Rotor Blades for Stall Alleviation and Vibration Reduction," *Proceeding of the American Helicopter Society Rotorcraft Dynamics and Aeromechanics Specialists Meeting*, Atlanta, Georgia, November 13 – 15, 2000.

Howard, A., and E.C. Smith, "The Influence of Aeroelastic Coupling on Ground and Air Resonance Stability of a Soft-Inplane Tiltrotor," *Proceeding of the American Helicopter Society Rotorcraft Dynamics and Aeromechanics Specialists Meeting*, Atlanta, Georgia, November 13 – 15, 2000.

Keller, J. and E.C. Smith, "Control of the Transient Aeroelastic Response of Rotors During Shipboard Engagement Operations," *Proceeding of the American Helicopter Society Rotorcraft Dynamics and Aeromechanics Specialists Meeting*, Atlanta, Georgia, November 13 – 15, 2000.

Centolanza, L., and E.C. Smith, "Design and Experimental Testing of an Induced-Shear Piezoelectric Actuator For Rotor Blade Trailing Edge Flaps," *Proceeding of the American Helicopter Society Region National Specialist's Meeting*, Bridgeport, CT, October 4-5, 2000.

Heverly, D., E.C. Smith and K.W. Wang, "Smart Fuselage Sections for Optimally Distributed Control of Helicopter Airframe Vibrations," *Proceeding of the American Helicopter Society Region National Specialist's Meeting*, Bridgeport, CT, October 4-5, 2000.

Keller, J. and E.C. Smith, "Control of the Transient Response of Gimballed Rotors During Shipboard Engagement Operations," *Proceeding of the American Helicopter Society Region National Specialist's Meeting*, Bridgeport, CT, October 4-5, 2000.

Stevens, P., and E.C. Smith, "Active Interrogation of Helicopter Rotor Faults Using Trailing Edge Flaps," *Proceeding of the American Helicopter Society Region National Specialist's Meeting*, Bridgeport, CT, October 4-5, 2000.

Zhang, J., E.C. Smith, and K.W. Wang, "Dynamic Analysis and Hybrid Design of Rotor Blades with Trailing Edge Flaps for Vibration Reduction and Performance Enhancement," *Proceeding of the American Helicopter Society Region National Specialist's Meeting*, Bridgeport, CT, October 4-5, 2000.

Zhang, J., E.C. Smith, and K.W. Wang, "Active-Passive Hybrid Optimization of Rotor Blades with Trailing Edge Flaps," *Proceeding of the American Helicopter Society 56th Annual Forum*, Virginia Beach, Virginia, May 2- 4, 2000.

Brackbill, C., E.C. Smith, and G.A. Lesieutre, "Helicopter Aeroelastic Response and Stability Using A Refined Time Domain Elastomeric Damper Model," AIAA-00-1689, *Proceeding of the 41st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Atlanta, Georgia, April 3 – 6, 2000.

Centolanza, L., and E.C. Smith, "Design and Experimental Testing of an Induced-Shear Piezoelectric Actuator For Rotor Blade Trailing Edge Flaps," AIAA-2000-1713, *Proceeding of the 41st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Atlanta, Georgia, April 3 – 6, 2000.

Szeffi, J., and E.C. Smith, "Analysis and Design of High Frequency Periodically Layered Isolators in Compression," *Proceeding of the 41st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Atlanta, Georgia, April 3 – 6, 2000.

Keller, J.A. and EC. Smith, "Analysis and Control of the Transient Shipboard Engagement Behavior of Rotor Systems," *Proceeding of the American Helicopter Society 55th Annual Forum*, Montreal, Quebec, May 1999.

Heverly II, D.E., E.C. Smith, and K.W. Wang, "A Distributed Actuator Approach For Active Control Of Helicopter Airframe Vibrations, AIAA-99-1505, *Proceedings of the 40th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, St. Louis, Missouri, April 1999.

Ruhl, L.E., Brackbill, C.R., G.A. Lesieutre, and E.C. Smith, "Thermomechanical Modeling of Elastomeric Damper Materials," AIAA-99-1221, *Proceedings of the 40th*

AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, St. Louis, Missouri, April 1999.

Zhang, J., E.C. Smith, and K.W. Wang, "An Active-Passive Hybrid Method for Optimization of Rotor Blades with Trailing Edge Flaps," AIAA-99-1222, *Proceedings of the 40th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, St. Louis, Missouri, April 1999.

Keller, J.A. and E.C. Smith, "Experimental/Theoretical Correlation of Analysis for Helicopter Blade-Droop Stop Impacts," submitted for publication in the *Proceedings of the 38th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Orlando, April, 1997.

Brackbill, C.R., G.A. Lesieutre, and E.C. Smith. June 1996. Formulation and Validation of a Thermomechanical Model for Elastomeric Materials, *Proceedings of the 52nd American Helicopter Society Forum*, Washington, D.C., June, 1996.

Geyer, W.G., J. Keller, and E.C. Smith, "Validation and Application of a Transient Response Analysis for Shipboard Engage/Disengage Operations," *Proceedings of the 52nd American Helicopter Society Forum*, Washington, D.C., June, 1996.

Stevens, P., D. Hall, and E.C. Smith, "A Multidisciplinary Approach to Rotorcraft Health and Usage Monitoring," *Proceedings of the 52nd American Helicopter Society Forum*, Washington, D.C., June, 1996.

Byers, L., E.C. Smith, and G.A. Lesieutre, "Transient Response Behavior of Elastomeric Materials," *Proceedings of the 37th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Salt Lake City, Utah, April, 1996.

Centolanza, L.R., E.C. Smith, and B. Kumar, "Refined Structural Modeling and Structural Dynamics of Tailored Composite Rotor Blades," AIAA Paper 96-1549, *Proceedings of the 37th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Salt Lake City, Utah, April, 1996.

Floros, M. and E.C. Smith, "Finite Element Modeling of Open-Section Composite Beams with Warping Restraint Effects," AIAA Paper 96-1472, *Proceedings of the 37th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, Salt Lake City, Utah, April, 1996.

Geyer, W., and E.C. Smith, "Aeroelastic Analysis of Transient Blade Dynamics During Shipboard Engage/Disengage Operations," *Proceedings of the American Helicopter Society Aeromechanics Specialists Conference*, Bridgeport, Connecticut, October, 1995.

Govindswamy, K., E.C. Smith, and G.A. Lesieutre, "Aerothermoelastic Behavior of Helicopters with Elastomeric Lag Dampers," *Proceedings of the American Helicopter Society Aeromechanics Specialists Conference*, Bridgeport, Connecticut, October, 1995.

Smith, E.C., Beale, M.R., Govindswamy, K., Vascinec, M.J., and Lesieutre, G.A., "Formulation and Validation of a Finite Element Model for Elastomeric Lag Dampers", *Proceedings of the 51st American Helicopter Society Forum*, May 1995.

Govindswamy, K., Lesieutre, G.A., Smith, E.C., and Beale, M.R., "Characterization and Modeling of Strain-Dependent Dynamic Behavior of Viscoelastic Elastomers in Simple Shear", *Proceedings of the 36th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, April 1995.

Smith, E.C., "Modeling Issues for Tailored Composite Rotor Systems and Elastomeric Lag Dampers", *Army/NASA Comprehensive Analysis Workshop Seminar*, NASA Ames Research Center, CA, March 1995.

Smith, E.C., "Aeroelastic and Aeromechanical Aspects for Helicopters with Elastically Tailored Composite Rotor Blades", *Proceedings of the 5th Workshop on Dynamics and Aeroelastic Stability Modeling of Rotorcraft Systems*, Rennsalaer Polytechnic Institute, October 1993.

Smith, E.C., "Vibration and Flutter of Stiff-Inplane Elastically Tailored Composite Rotor Blades", *Proceedings of the 34th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference*, La Jolla, California, April 1993.

Smith, E.C., "Aeroelastic and Aeromechanical Aspects of Elastically Coupled Composite Rotor Blades," *U.S. Army Research Office Beamology Workshop*, Aeroflightdynamics Directorate, ATCOM, NASA Ames Research Center, Moffett Field, CA, October 1992.

Smith, E.C. and Chopra, I., "Aeromechanical Stability of Helicopters with Composite Rotor Blades in Forward Flight", *Proceedings of the 48th American Helicopter Society Annual Forum*, Phoenix, Arizona, June 3-5, 1992.

Smith, E.C. and Chopra, I., "Aeroelastic Response and Blade Loads of a Composite Rotor in Forward Flight", *Proceedings of the 33rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference*, Dallas, Texas, April 1992.

Smith, E.C. and Chopra, I., "Aeromechanical Stability Prediction of Composite Rotors," *Proceedings of the 4th Workshop on Aeroelastic Stability Modeling of Rotorcraft Systems*, College Park, Maryland, November 1991.

Smith, E.C. and Chopra, I., "Formulation and Evaluation of an Analytical Model for Composite Box-Beams," *Proceedings of the 31st AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference*, Long Beach, CA Apr 1990.

Intellectual Property Activities

Invention: "Energy Absorbing Stitch Ripping Composite Tubes Containing Collapsible Cells," Tiwari, C., Smith, E., Bakis, C., Yukish, M., and Kong, W., Patent file number: PSU-2008-3475, Docket number: 090530, Application number: 12538978, International application number: PCT/US09/53418, Official filing date: August 11, 2009.

Invention: "Energy Absorbing and Load Limiting Extension-Torsion Coupled Stitch Ripping Composite Tubes," Tiwari, C., Smith, E., Bakis, C., Yukish, M., and Kong, W., Patent file number: PSU-2008-3475, Serial Number: 61088458, Docket number: 080535, Official acceptance date: August 13, 2008.

Invention: "Ultrasonic De-Icing System for Composite Helicopter Blades with Tailored Waveguide," Zhu, Palacios, Smith, Royer, and Rose PSU Invention Disclosure Number 2008-3519.

Preliminary Patent APP: "A Deicing and Ice Avoidance System for Structures," Rose, Smith, Palacios, Royer, and Owens--PSU Invention Disclosure Number 2007-3364.

Provisional Patent: "Ultrasonic Guided Wave Anti-Icing System for Helicopter Rotor Blades and Fixed Wing Aircraft," Rose, Smith, Gao, Palacios, and Zhu--PSU Invention Disclosure Number 2006-3291.

Funded Research Activities

High Fidelity Helicopter Lag Damper Model for Comprehensive Rotor Analysis, (G. Lesieutre and E. Smith), Advanced Rotorcraft Technology, Inc., \$44,991, October 2011-October 2012.

DURIP: Dynamic Test Stand for Fundamental Experiments in Rotor Energy Harvesting Aeroelastic Stability, and Loads, (G. Lesieutre and E. Smith) Army Research Office, \$55,000 August 2011-August 2012.

Advanced Aircraft Crashworthiness TAJI, (E. Smith, C. Bakis and E. Little) Vertical Lift Consortium, Inc., \$87,500, March 2011-April 2012.

Advanced Drive Systems 2011, (E. Smith, C. Bakis, Z. Saribay, R. Bill and R. Kunz) Vertical Lift Consortium, Inc., \$165,000, March 2011-April 2012.

Centrifugally Powered Pneumatic Actuation of Miniature Trailing Edge Effectors (MiTEs), (E. Smith, M. Maughmer and J. Palacios) Vertical Lift Consortium, Inc., \$75,000, March 2011-April 2012.

Condition Based Maintenance Technology Verification and Validation for Maintenance

Credits 2011, (E. Smith, J. Rose, S. Conlon and K. Reichard) Vertical Lift Consortium, Inc., \$100,000, March 2011-April 2012.

Modeling of Rotor Blade Ultrasonic Deicing and Experimental Comparison with Electrothermal Ice Protection, (E. Smith and J. Palacios) Vertical Lift Consortium, Inc., \$92,000, March 2011-April 2012.

Acoustically Tailored Composite Rotorcraft Fuselage Panels, (S. Hambric, E. Smith and K. Koudela) National Aeronautics and Space Administration, \$992,588, December 2010-January 2011.

Actuator Development Support of AERTS Projects, (J. Palacios and E. Smith) Invercon, \$6,000, December 2010.

Wind Turbine Ice Protection Coating Performance and Adverse Environment Erosion Testing, (E. Smith and J. Palacios) GE Global Research, \$186,500, October 2010-June 2012.

High Fidelity CFD Analysis and Validation of Rotorcraft Gear Box Aerodynamics, (R. Kunz, L. Long, P. Morris, R. Noach, and E. Smith) NASA, \$222,603, September 2010-September 2011.

OH-58 Tailboom Damage Detection Study, (S. Conlon, S. Evans and E. Smith) Army Aviation and Missile Command, \$200,000, September 2010-March 2011.

Automated Identification, Selection and Execution of UAS Cargo Delivery to a Landing Zone with Optional Man in the Loop, (S. Evans and E. Smith) SkEyes Unlimited Corporation, \$21,000, June 2010-January 2011.

Innovative Concepts for Composite Leading Edge Self-Monitoring Anti/De-icing System (Base Phase I), (E. Smith) Feature Based Systems, Inc., \$15,000, May 2010-November 2010.

Innovative Concepts for Composite Leading Edge Self-Monitoring Anti/De-icing System (Base Phase 1 Option), (E. Smith and J. Palacios) Feature Based Systems, Inc., \$10,000, May 2010-August 2011.

Centrifugally Powered Pneumatic Actuation of Miniature Trailing Edge Effectors (MiTEs), (E. Smith, and M. Maughmer) Vertical Lift Consortium, Inc., \$75,000/year. April 2010-May 2011.

Modeling of Rotor Blade Ultrasonic Deicing and Experimental Comparison with Electrothermal Ice Protection, (E. Smith and J. Palacios) Vertical Lift Consortium, Inc., \$85,000/yer, April 2010-August 2011.

Advanced Drive Systems TAJI 2010, (E. Smith, C. Bakis, and Z. Saribay) Center for Rotorcraft Innovation, \$110,000, January 2010-February 2011.

Condition Based Maintenance Technology Verification & Validation for Maintenance Credits 2010, (E. Smith, J. Rose) Vertical Lift Consortium, Inc., \$165,000, January 2010- June 2011.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering AIAA & AHS Student Projects/Activities (E. Smith) Boeing Company Charitable Trust, \$7,500, January 2010- December 2010.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$12,000, January 2010- December 2010.

Penn State Vertical Lift Research Center of Excellence Support, (E. Smith) Lord Corporation, \$100,000, January 2010 - December 2010.

Refrigeration System Upgrade and Undergrad Student Funding, (E. Smith and J. Palacios) Goodrich Corporation, \$12,000, January 2010- December 2010.

Vehicle Management Systems: Handling Qualities and Gust Alleviation Characteristics of Helicopters Using Active Rotors 2010, (J. Horn, C. Rahn, E. Smith, S. Conlon and J. Zhang) Center for Rotorcraft Innovation, \$130,000, January 2010-May 2011.

Vertical Lift Research Center of Excellence: Vibration Condition Indicator Development, (S. Evans and E. Smith) US Dept of Army, \$40,000, January 2010-September 2011.

Advanced Aircraft Crashworthiness TAJI, (E. Smith, C. Bakis and E. Little) Center for Rotorcraft Innovation, \$75,000, September 2009 - December 2010.

Fellowship Award Stanton Sollenberger, (E. Smith and C. Bakis) Bell Helicopter Textron, \$20,000, August 2009- December 2009.

Health Usage Monitoring Device Human Factors Comparison, (S. Evans and E. Smith) Goodrich Corporation, \$37,000, July 2009 - December 2009.

Actuator Development and Wind Tunnel Testing of Dynamic Roughness Elements for Control of Flow Separation, (E. Smith) Office of Naval Research, \$191,882, June 2009 - June 2012.

Energy Harvesting for Direct Loads Monitoring on Rotor Hub Components, (E. Smith) KCF Technologies, Inc., \$32,000, June 2009 - June 2011.

Innovative Composite Materials for Crashworthy Mounting Systems, (C. Bakis, E. Smith and M. Yukish) Office of Naval Research, \$285,153, June 2009 - May 2012.

Control Design Methodologies for Improving Rotorcraft Gust Rejection with On-Blade Control, (J. Horn, E. Smith and C. Rahn) National Aeronautics and Space Administration, \$140,000, May 2009 - May 2011.

GSRP: Aeroelastic Divergence and Flutter Study of Swept Forward Composite Wings for Folding Tiltrotor Application for Jason Slaby, (E. Smith) National Aeronautics and Space Administration, \$60,000, May 2009 - May 2011.

Vertical Lift Research Center of Excellence: Experimental Measurement of Ice Accretion on Rotating and Simultaneously Oscillating Airfoils, (E. Smith) US Dept of Army, \$241,857, May 2009 - September 2011.

Advanced Drive System TAJI, (E. Smith, C. Bakis and R. Kunz) Center for Rotorcraft Innovation, \$150,000, March 2009 - July 2010.

Condition Based Maintenance Technology Verification and Validation, (E. Smith and J. Rose) The Center for Rotorcraft Innovations, \$140,000, February 2009 - June 2010.

Vehicle Management Systems: Handling Qualities and Gust Alleviation Characteristics Of Helicopters Using Active Rotors, (J. Horn, C. Rahn and E. Smith) Center for Rotorcraft Innovation, \$130,000, February 2009 - May 2010.

Distributed Conformal Actuation for Simultaneously Controlling Flow Separation and Transition Dynamic Roughness, (E. Smith) Physical Sciences, Inc., \$15,000, January 2009 - July 2009.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering/Student AIAA & AHS Activities, (E. Smith) Boeing Company Charitable Trust, \$7,500, January 2009 - December 2009.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$12,000, January 2009 - December 2009.

Penn State Vertical Lift Research Center of Excellence Support, (E. Smith) Lord Corporation, \$80,000, January 2009 - December 2009.

Rotocraft Transmission Noise Path Model Including Distributed Fluid Film Bearing Impedance Modeling, (E. Smith and S. Hambric) NASA, \$200,000, October 2008 - March 2010.

Innovative Rotor Blade Anti-Icing/De-Icing Technologies - SBIR Phase II, (E. Smith) Feature Based Systems Inc., \$160,000, September 2008 - September 2010.

Vertical Lift Research Center of Excellence - Additional Funding for Equipment, (E. Smith) US Dept of Army, \$102,000, September 2008 - September 2011.

Vibration Data Analysis for Support of On-Board CBM Systems, (E. Smith) Center for Rotorcraft Innovation (U.S Department of the Army), \$75,000, September 2008 - August 2009.

Ice Phobic Coating and Piezoelectric Screening at the Penn State University Icing Laboratory, (E. Smith and J. Rose) Boeing Company, \$469,000, August 2008 - July

2011.

Naval Rotorcraft Technologies for Enhanced Safety, Survivability and Performance, (E. Smith, K. Brentner, J. Horn, L. Long, K. Wang, C. Rahn, C. Bakis, F. Gandhi, and D. McLaughlin) US Dept of the Navy, \$1,465,093, July 2008 - 2010.

DURIP: Experimental Instrumentation for Active Durable Rotors, (E. Smith) Army Research Office, \$70,000, June 2008 - June 2009.

DURIP: Experimental Instrumentation for Research on Safety, Survivability, and Enhanced Performance of Naval Rotocraft, (C. Bakis, E. Smith and K. Wang) Office of Naval Research, \$158,800, April 2008- July 2009.

Intensity Based Structural Health Monitoring for Aviation Platforms, (S. Colon and E. Smith) US Dept of Army, \$832,395, April 2008 - March 2010.

Design, Systems Evaluation and Testing of Flexible Composite Driveshafts - Year 3, (E. Smith and C. Bakis) Center for Rotorcraft Innovation, \$130,000, January 2008 - July 2009.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering/Student AIAA & AHS Activities, (E. Smith) Boeing Company Charitable Trust, \$7,000, January 2008- December 2008.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$9,000, January 2008 - December 2008.

Penn State Vertical Lift Research Center of Excellence Support, (E. Smith) Lord Corporation, \$80,000, January 2008 - December 2008.

Innovative Rotor Blade Anti-Icing/De-Icing Technologies – SBIR Phase I, (E. Smith) Feature Based Systems, Inc., \$15,000, October 2007 - April 2008.

Development of Lead-Lag Damper Temperature Model for M430 Fluidlastic Damper, (E. Smith) Bell Helicopter Textron Inc., \$20,000, August 2007 - January 2008.

Condition Based Maintenance Damage Detection Technology - Year 2, (E. Smith, K. Wang, J. Rose and S. Conlon) The Center for Rotorcraft Innovations, \$140,000, June 2007 - July 2008.

X-Hawk Fancraft Preliminary Risk Reduction Effort, (E. Smith and D. McLaughlin) Office of Naval Research, \$478,000, May 2007 - February 2008.

DURIP: Experimental and Computational Instrumentation for Research on Safety, Survivability, and Enhanced Performance of Naval Research, (E. Smith, J. Horn, K. Brentner, C. Bakis, K. Wang and B. Bill) Office of Naval Research, \$301,374.00, March 2007- July 2008.

Center of Excellence in Structural Health Monitoring, (C. Lissenden and E. Smith) Ben Franklin Tech. Center of Central & Northern PA, \$50,000, January 2007 - June 2009.

Comprehensive Modeling and Analysis of Rotorcraft Variable Speed Propulsion System with Coupled Engine/Transmission/Rotor Dynamics, (E. Smith, K. Wang and H. DeSmidt) NASA, \$654,832, January 2007 - April 2010.

Design, Systems Evaluation and Testing of Flexible Composite Driveshafts - Year 2, (E. Smith, C. Bakis and K. Wang) Center for Rotorcraft Innovation, \$125,086, January 2007 – July 2008.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering/Student AIAA & AHS Activities, (E. Smith) Boeing Company Charitable Trust, \$6,750 January 2007- December 2007.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$9,000, January 2007 - December 2007.

Optimized Ultrasonic Shear Wave Anti-Icing Actuator for Helicopter Blades, (E. Smith and J. Rose) Bell Helicopter Textron, Inc., \$60,000, January 2007 - December 2007.

Penn State Vertical Lift Research Center of Excellence Support, (E. Smith) Lord Corporation, \$40,000, January 2007 - December 2007.

Penn State Vertical Lift Research Center of Excellence Support, (E. Smith) Aerospace Transmissions, LLC (Purdy Systems), \$150,000, September 2006 - September 2011.

Vertical Lift Research Center of Excellence, (E. Smith, K. Brentner, L. Long, C. Camci, C. Bakis, K. Koudela, J. Rose, J. Horn, F. Gandhi, M. Maughmer, G. Lesieutre, P. Morris, G. Rajagopalan, N. Koratkar, E. Duque, R. Parker and R. Leach) US Dept of Army, \$4,508,217, September 2006 - September 2011.

Development and Testing of a Nonthermal Rotor Blade Anti-Icing System, (E. Smith, and J. Rose) Bell Helicopter Textron, \$60,000, August 2006 - December 2006.

Conditioned Based Maintenance Damage Detection Technology - Year 1, (E. Smith, K. Wang, J. Rose and S. Conlon) Center for Rotorcraft Innovation, \$140,000, July 2006 - October 2007.

MDO Design and Advanced Simulation of Propulsion - Transmission Systems for High Endurance, (E. Smith, K. Wang, R. Kunz and R. Medvitz) Center for Rotorcraft Innovation, \$115,000, July 2006 - August 2007.

Fluid Elastic Damper, (E. Smith and G. Lesieutre) Bell Helicopter Textron, \$30,000, June 2006 - December 2006.

Design, Systems Evaluation, and Testing of Flexible Composite Driveshafts - Year 1, (E.

Smith, C. Bakis, and K Wang) Center for Rotorcraft Innovation, \$105,000, May 2006 - March 2007.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering/Student AIAA & AHS Activities, (E. Smith) Boeing Company Charitable Trust, \$6,750 January 2006- December 2006.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$10,000, January 2006 - December 2006.

Naval Rotorcraft Technologies for Enhanced Safety, Survivability and Performance, (E. Smith, J. Horn, L. Long, K. Wang, C. Bakis, F. Gandhi, D. McLaughlin, K. Brentner, S. Rao, and M. Yukish) US Dept of the Navy, \$1,204,902.00, January 2006 - June 2008.

Penn State Vertical Lift Research Center of Excellence Support, (E. Smith) Lord Corporation, \$40,000, January 2006 - December 2006.

Alleviation of Aeromechanical Stability and Whirl via Blade-Embedded Elastomer Tuned Mass Dampers for Lag Damping and SMA-based Passive Wing Damping, (E. Smith) Lord Corporation, \$45,000, January 2005 - December 2005.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering/Student AIAA & AHS Activities, (E. Smith) Boeing Company Charitable Trust, \$7,000, January 2005 - December 2005.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$9,000, January 2005 - December 2005.

Optimization and Design of Advanced Low-Weight Rotor Systems II, (E. Smith and M. Maughmer) NASA Ames Research Center, \$80,000, January 1, 2005 – December 31, 2005.

Single Crystal Piezoelectric Actuators for Adaptive Structures, (E. Smith), TRS Ceramics Inc., \$33,000, January 22, 2004 – September 21, 2004.

Alleviation of Aeromechanical Stability and Whirl Flutter via Blade-Embedded Elastomer Tuned Massed Dampers of Lag Damping and SMA-based Passive Wing Damping Area. (E. Smith and G. Lesieutre), Lord Corporation, \$30,000, January 1, 2004 – December 31, 2004.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering/Student AIAA & AHS Activities, (E. Smith) Boeing Company Charitable Trust, \$9,000, January 2004 - December 2004.

Modeling and Characterization of Elastomeric Dampers, (E. Smith, and G. Lesieutre), Bell Helicopter Textron Inc., \$60,000, January 1, 2004 – December 31, 2004.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$10,000, January 2004 - December 2004.

Optimization and Design of Advanced Low-Weight Rotor Systems, (E. Smith) NASA Ames Research Center, \$85,000, January 1, 2004 – December 31, 2004.

Active Vibration Control of a Coupled Tailboom-Driveshaft Structure, (E. Smith, and K. Wang), NASA Glenn Research Center, \$24,000, August 15, 2003 – January 2, 2004.

Interdisciplinary Rotorcraft Design Projects in Rotorcraft Engineering/Student AIAA & AHS Activities, (E. Smith) Boeing Company Charitable Trust, \$1,500, January 2003 - December 2003.

Multidisciplinary Design Projects in Rotocraft Engineering, (E. Smith) United Technologies Corporation, \$10,000, January 2003 - December 2003.

Semi-Autonomous Hand-Launched Rotor-Wing Unmanned Air Vehicles (UAV), (E. Smith, L. Long, and J. Horn), NASA Ames Research Center, \$109,000, August 1, 2002 – January 31, 2005.

Experimental and Computational Instrumentation for Rotorcraft Research at the Penn State Rotorcraft Center, (E. Smith, L. Long, C. Camci, K. Wang, K. Brentner, and J. Horn), U.S. Army Research Office, \$197,700, (\$57,400 additional in Penn State Cost sharing) April 1, 2002 - March 31, 2004.

Fluid and Elastomeric Lag Damper Modeling (E. Smith, and G. Lesieutre), Bell Helicopter, \$64,000, April 1, 2002 – December 31, 2003.

Composite Blade Modeling and Aeroelastic Analysis, (E. Smith and M. Floros), National Renewable Energy Laboratory, \$20,000 January 8, 2002 – July 8, 2002.

Alleviation of Aeromechanical Stability and Whirl via Blade-Embedded Elastomer Tuned Mass Dampers for Lag Damping and SMA-based Passive Wing Damping, (E. Smith) Lord Corporation, \$45,000, January 2002 - December 2002.

Multidisciplinary Engineering Team for Test and Evaluation of Rotor Wing Unmanned Autonomous Air Vehicles (UAVs), (E. Smith) Boeing Company Charitable Trust, \$25,000, January 2002 - December 2002.

NASA GRSP for Hans DeSmidt, (E. Smith, and K. Wang), National Aeronautics and Space Administration, \$22,000, August 15, 2001 – August 14, 2002.

Tiltrotor Aeromechanical Stability Analysis, (E. Smith), Bell Helicopter Textron Inc., \$28,387, July 2, 2001 – November 30, 2001.

Hands on Helicopters 101, (E. Smith), Penn State University, \$5,000, May 15, 2001 – June 30, 2002.

Elastomeric Damper Analysis and Experiments, (E. Smith, and G. Lesieutre), NASA Ames Research Center, \$19,995, February 1, 2001 – January 31, 2002

National Rotorcraft Technology Center/Rotorcraft Centers of Excellence (RCOE), (E. Smith, and L. Long), Research funding divided among 11 Penn State Faculty, NASA Ames Research Center, \$3,020,000, (\$1,291,620 additional in Penn State Cost Sharing and \$40,000 in Penn State Undergraduate Wages), February 1, 2001 – January 31, 2006.

Alleviation of Aeromechanical Stability and Whirl via Blade-Embedded Elastomer Tuned Mass Dampers for Lag Damping and SMA-based Passive Wing Damping, (E. Smith) Lord Corporation, \$30,000, January 2001 - December 2001.

Multidisciplinary Engineering Team for Test and Evaluation of Rotor Wing Unmanned Autonomous Air Vehicles (UAVs), (E. Smith), Boeing Company Charitable Trust, \$30,000, January 1, 2001 – December 31, 2001.

Training for Use of the Simulation of the Transient Analysis of Rotorcraft Startups and Shutdowns Program, (E. Smith) U.S. Navy, \$15,000, November 1, 2000 – March 31, 2001.

Optimization of Periodically Layered Elastomeric Mounts, (E. Smith), United Technologies Research Center, \$20,017, April 15, 2000 – December 22, 2000.

Aeroelastic Tailoring of Composite Rotor Blades for Vibration Reduction, Stability Augmentation, and Blade Loads Control, (E. Smith), Sikorsky Aircraft Corporation, \$19,763, April 10, 2000 – October 31, 2000.

NASA GRSP for Hans DeSmidt, (E. Smith, and K. Wang), National Aeronautics and Space Administration, \$22,000, August 15, 1999 – August 14, 2000.

Active Control of Rotorcraft Noise and Vibration, (E. Smith, L. Long, F. Gandhi, and K. Wang), U.S. Army Research Office of Maryland, \$380,364, May 15, 1999 – January 30, 2002.

Eighth ARO Workshop on Aeroelasticity of Rotorcraft Systems, (E. Smith), U.S. Army Research Office, \$15,000, April 1, 1999 – March 31, 2000.

Optimization of Layered Elastomeric Mounts, (E. Smith and G. Lesieutre), United Technologies Research Center, \$20,000, April 1, 1999 – August 31, 1999.

Development and Validation of a High Frequency Elastomeric Mount Model, (E. Smith and G. Lesieutre), UTRC, \$20,000, August 1, 1998 – December 31, 1999.

M-10000 Development and Evaluation, (E. Smith), TechKor Instrumentation, \$30,000, July 1, 1998 – June 30, 1999.

Experimental & Computational Instrumentation for Rotorcraft Noise & Vibration Control Research at the Penn State Rotorcraft Center, (E. Smith, L. Long, K. Wang, and G. Koopmann), U.S. Army Research Office, \$250,000, March 2, 1998- March 1, 1999.

Multidisciplinary Engineering Team for Test and Evaluation of Rotor Wing Unmanned Autonomous Air Vehicles (UAVs), (E. Smith), Boeing Company Charitable Trust, \$25,000, January 1, 1998 – December 31, 1998.

Characterization and Analysis for High Frequency Elastomeric Mounts, (E. Smith and G. Lesieutre), UTRC, \$20,000, June 1997 - December 1997.

Computational and Experimental Investigation of Air Vehicle Aeromechanics During Shipboard Dynamic Interface Operations, (E. Smith and L. Long), Naval Research Office, \$466,771, April 1, 1997 - March 31, 2000.

Rotorcraft Center Equipment Augmentation, (E. Smith and L. Long), National Rotorcraft Technology Center, 130,000 (includes 65K in Penn State Cost Sharing), November 1996 - December 1996.

Advanced Image Processing System for Non-Destructive Test and Evaluation, (E. Smith), Ben Franklin Technology Program, \$60,000, October 1996 - June 1997.

Experimental Characterization of Elastomeric Vibration Mounts, (E. Smith and G. Lesieutre), United Technologies Research Center, \$10,000, October 1996 - December 1996.

Active Control of Coupled Rotor-Drivetrain-Airframe Dynamics, (E. Smith and K. Wang), U.S. Army Research Office via University of Maryland MURI on Active Control of Rotorcraft Aeroacoustics and Vibration, \$75,000, August 1996 - August 1999.

Design, Fabrication, and Testing of a Platform for Evaluation of Rotary-Wing Unmanned Autonomous Air Vehicle (UAV) Control Concepts, (E. Smith), Boeing Defense and Space Group - Helicopters Division, \$10,000, January 1, 1996 - December 31, 1998.

Experimental Characterization and Analytical Modeling of Thermomechanical and Transient Behavior for Elastomeric Damper and Bearings Materials, (E. Smith and G. Lesieutre), Boeing Helicopters, \$35,000, January 1, 1996 – December 31, 1996.

National Defense Science & Engineering Graduate Fellowship in Aerospace Engineering for Louis Centolanza, (E. Smith), U.S Department of the Army, \$111,000, January 1, 1996 – December 31, 1999.

Penn State Rotorcraft Center of Excellence, (E. Smith and L. Long) Research funding divided among 8 Penn State Faculty, National Rotorcraft Technology Center (NASA Ames), \$2,305,226 (includes \$626,376 in Penn State Cost sharing and \$345,000 in Ben Franklin Technology Program Cost Sharing), January 1, 1996 - December 31, 1998.

Elastically Tailored Composite Rotor Blades for Alleviation of Blade Stall Effects in High Speed Flight, (E. Smith), NASA Langley Research Center - NASA Graduate Students Researchers Program for Anna Howard, \$88,000, August 15, 1995 – August 15, 2000.

Aeromechanical Analysis for Elastically Tailored Tiltrotors with Soft Inplane Rotor Systems (E. Smith), NASA Langley Research Center, \$66,000, August 1995 - August 1998.

Analytical Modeling of Rotor Head Failure and Fault Signatures (E. Smith), Office of Naval Research via Penn State Integrated Predictive Diagnostics MURI, \$150,000, March 15, 1995 – March 14, 1998.

Development and Integration of Interactive Software Tools for Aerospace Dynamic Systems Education, (E. Smith), Penn State College of Engineering, \$5,000, January 1995 – July 1995.

Experimental Characterization and Analytical Modeling of Elastomeric Bearings and Dampers (E. Smith and G. Lesieutre), Boeing Helicopters, \$34,000, January 1, 1995-December 31, 1995.

Refined Modeling for Aeromechanical Stability and Aeroelastic Response of the RAH-66 Comanche Snubber-Damper (E. Smith and G. Lesieutre), Advanced Rotorcraft Technologies and US Army ATCOM, \$18,500, January 1, 1995-December 31, 1995.

Vibration, Stability, and Transient Response of Helicopters with Elastically Tailored Composite Rotor Blades (E. Smith), U.S. Army Research Office (Young Investigator Program), \$204,641 (\$54,641 additional in Penn State Cost Sharing), June 15, 1994 - June 14, 1997.

Transient Response Analysis for Investigation of H-46 Tunnel Strike Phenomenon (E. Smith), Naval Air Warfare Center-Patuxent River, \$72,471, March 1, 1994 – March 15, 1996.

Computer-Aided Animation for Aerospace Dynamic Systems Education (E. Smith), Penn State College of Engineering, \$4,500, January 1994 – July 1994.

Refined Modeling for the Aeroelastic and Aeromechanical Analysis of Helicopters with Elastomeric Lag Dampers (E. Smith and G. Lesieutre), Sikorsky Aircraft, \$15,000, January 1, 1994 – December 31, 1994.

A Multi-year Course in Sailplane Design and Fabrication (E. Smith, M. Maughmer, and D. Jensen), National Science Foundation, \$50,000, October 15, 1993 – October 15, 1994.