



Gaylord Texan Convention Center • Grapevine, TX

# AHS 65th Annual Forum & Technology Display –

*Galloping Towards New Vertical Flight Advancements*

May 27 - 29, 2009  
Grapevine, Texas

# **TECHNICAL SESSIONS**

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# Technical Sessions FORUM 65

## A: WEDNESDAY, MAY 27 – MORNING

### Acoustics I

8:00 a.m. - 11:30 a.m.  
Texas 3

*Session Chair:* Thomas Zientek,  
The Boeing Company

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**CHEESEMAN AWARD WINNING PAPER: Aeroacoustic Flight Test Data Analysis and Guidelines for Noise Abatement Procedure Design and Piloting**  
P. Spiegel, F. Guntzer, A. Le Duc, H. Buchholz, DLR

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**Numerical Investigation of the Aerodynamics and Acoustics of Head-On Blade-Vortex Interaction**  
A. Thom, K. Duraisamy, University of Glasgow

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**Sensitivity of Tail Rotor Noise to Helicopter Configuration in Forward Flight**  
T. Fletcher, K. Duraisamy, R. Brown, University of Glasgow

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

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Paper #4 - 10:00 a.m. - 10:30 a.m.  
**3D Sound Directivity Around a Turboshaft Engine**  
H. Gounet, S. Lewy, ONERA

Paper #5 - 10:30 a.m. - 11:00 a.m.  
**Reduced In-Plane, Low Frequency Helicopter Noise Using an Active Flap Rotor**  
B. Wel-C. Sim, UARC/AFDD; R. Janakiram, The Boeing Company; N. Barbely, NASA Ames Research Center

Paper #6 - 11:00 a.m. - 11:30 a.m.  
**Blade-Vortex Interaction Noise Characteristics of a Full-Scale Active Flap Rotor**  
R. JanakiRam, F. Straub, The Boeing Company; C. Kitaplioglu, NASA Ames Research Center; B. Sim, UARC/AFDD, Ames Research Center

### Advanced Vertical Flight

8:00 a.m. - 12 noon  
Grapevine 5 & 6

*Session Chair:* Dr. Mark Couch,  
Institute for Defence Analyses

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**Optimally Scheduled Deployments of Miniature Trailing Edge Effectors for Rotorcraft Power Reduction**  
E. S. Bae, F. Gandhi and M. Maughmer, The Pennsylvania State University

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**Cycloidal Rotor with Generally Non-Circular and Dynamic Variable Blade Orbit**  
P. Bogrash, Efficient Flying Machines, Inc.

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**Investigation of an Extremely Flexible Stowable Rotor**  
J. Sirohi, University of Texas at Austin

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

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Paper #4 - 10:00 a.m. - 10:30 a.m.  
**VTOL Aircraft Thrust Control (Presentation Only)**  
Dan Dugan, NASA Ames Research Center

Paper #5 - 10:30 a.m. - 11:00 a.m.  
**DARPA Heliplane Program (Presentation Only)**  
Don Woodbury, Defense Advanced Research Projects Agency (DARPA)

Paper #6 - 11:00 a.m. - 12 noon  
**The Fairey Rotodyne (Presentation Only)**  
David Gibbings, AgustaWestland (Retired)

### Dynamics I

8:00 a.m. - 11:30 a.m.  
Grapevine 1 & 2

*Session Chair:* Dr. Hyeonsoo Yeo,  
US Army AFDD

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**Adaptive Algorithms for Rotorcraft Active Vibration Control**  
D. Heverly, R. Singh and J. Pappas, Bell Helicopter Textron, Inc.

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**A Physics-Based Investigation of Gurney Flaps for Rotor Noise and Vibration Reduction**  
B. Y. Min, L. Sankar, J. V. R. Prasad, D. Schrage, Georgia Institute of Technology

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**Hydromechanical Analysis of a Helicopter Lag Damper Incorporating Temperature Effects**  
G. Ngatu, N. Wereley, University of Maryland; C. Kothera, Techno-Sciences

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

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Paper #4 - 10:00 a.m. - 10:30 a.m.  
**Correlation of SMART Active Flap Rotor Loads**  
S. Kottapalli, NASA Ames Research Center; F. Straub, The Boeing Company

Paper #5 - 10:30 a.m. - 11:00 a.m.  
**Dynamics and Active Flap Control of the SMART Rotor**  
F. Straub, V. Anand, The Boeing Company; S. Hall, Massachusetts Institute of Technology; B. Lau, NASA Ames Research Center

Paper #6 - 11:00 a.m. - 11:30 a.m.  
**Validation of Active Twist Modeling Based on Whirl Tower Tests**  
F. Hoffmann, S. Opitz, J. Riemenschneider, DLR

### Flight Simulation I

8:00 a.m. - 12 noon  
Texas 4

*Session Chair:* Dean Carico,  
NAVAIR and Duc Tran, NASA Ames Research Center

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**Development of Unified Simulation and Control Tool to Enhance Shipboard Operation**  
D. Lee, C. He, Advanced Rotorcraft Technology, Inc.

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**On-Line Identification of Ship Airwake Disturbances on Rotorcraft**  
J. Horn, S. Sparbanie, Pennsylvania State University; J. Cooper, J. Schierman, Barron Associates Inc.

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**Extracting Analytical Models of Ship Airwake from a Database Toward Qualitative Analysis and Real-Time Simulation**  
G. Gaonkar, R. Mohan, Florida Atlantic University

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

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Paper #4 - 10:00 a.m. - 10:30 a.m.  
**Robust Adaptive Control and Motion Planning of Twin-Rotor Aircraft in Shipboard Operation**  
P. Krishnamurthy, IntelliTech Microsystems, Inc.; F. Khorrami, IMI; Q. Lam, Orbital Sciences Corporation

Paper #5 - 10:30 a.m. - 11:00 a.m.  
**Feasibility Studies for VTOL UAV Autonomous Operations with the Possibility of Shipboard Auto Recovery using Simulation Techniques**  
B. Ferrier, BMT syntek Technology; J. Duncan UK MOD (DPA); D. Ludwig, US Navy; F. Chen, Nothrop-Grumman Corp.

Paper #6 - 11:00 a.m. - 11:30 a.m.  
**A High Fidelity Brownout Model for Flight Simulations and Trainers**  
D. Wachspress, G. Whitehouse, J. Keller, K. Yu, Continuum Dynamics, Inc.; P. Gilmore, M. Dorsett, K. McClure, SAIC

Paper #7 - 11:30 a.m. - 12:00 noon  
**Secondary Effects Significant to Predicting Rotor Performance During Edge-of-the-Envelope Maneuvering**  
K. Strope, US Army

# Technical Sessions FORUM 65

## A: WEDNESDAY, MAY 27 – MORNING

### HUMS I

8:00 a.m. - 12 noon  
San Antonio 4, 5 & 6

*Session Chair:* Mark Davis,  
Sikorsky Aircraft Corp.

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*Signal Detection Theory Applied to Helicopter Transmission Diagnostic Thresholds*  
P. Dempsey, NASA Glenn Research Center; J. Keller, D. Wade, U.S. Army (AED)

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*Correlation of HUMS CIs with a Physics-Based Prognostic Model for Remaining Useful Life of UH-60M Black Hawk Tail Rotor Gearbox Bearings*  
N. Bolander and C. Baker, Sentient Corporation

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Experimental Determination of AH-64 Apache Tailshaft Hangar Bearing Vibration Characteristics with Seeded Faults*  
B. Dykas, T. Krantz, H. Decker, D. Lewicki, US Army Research Lab

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

Paper #4 - 10:00 a.m. - 10:30 a.m.  
*On Quantification of Bearing Damage for Lifecycle Prognostics*  
R. Li, D. He, University of Illinois-Chicago; E. Bechhoefer, Goodrich

Paper #5 - 10:30 a.m. - 11:00 a.m.  
*Gear Fault Detection Effectiveness As Applied To Tooth Surface Pitting Fatigue Damage*  
D. Lewicki, U.S. Army Research Lab; P. Dempsey, NASA Glenn Research Center; G. Heath, P. Shanthakumaran, The Boeing Company

Paper #6 - 11:00 a.m. - 11:30 a.m.  
*Quantification of Condition Indicator Performance on a Split Torque Gearbox*  
E. Bechhoefer, Goodrich SIS and R. Li, D. He, The University of Illinois-Chicago

Paper #7 - 11:30 a.m. - 12:00 noon  
*Advanced Mechanical Diagnostics and Lessons Learned from S-92® Aircraft*  
M. Kingsley, Sikorsky Aircraft Corp.

### Propulsion I

8:00 a.m. - 11:30 a.m.  
Grapevine 3 & 4

*Session Chair:* Sam Spring, GE Aircraft Engines

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*Preliminary Axial Flow Turbine Design and Off-design Analysis Methods for the Rotary Wing Aircraft Engines I - Validation*  
S. C. Chen, NASA Glenn Research Center

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*Preliminary Axial Flow Turbine Design and Off-design Analysis Methods for the Rotary Wing Aircraft Engines II - Application*  
S. C. Chen, NASA Glenn Research Center

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Compressor Study to Meet Large Civil Tilt Rotor Engine Requirements*  
J. Veres, NASA Glenn Research Center

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

Paper #4 - 10:00 a.m. - 10:30 a.m.  
*Gas Turbine Characteristics for a Large Civil Tilt-Rotor (LCTR)*  
C. Snyder, NASA Glenn Research Center; D. Thurman, US Army Research Lab

Paper #5 - 10:30 a.m. - 11:00 a.m.  
*Rotary-Wing Relevant Compressor Aero Research and Technology Development Activities at Glenn Research Center*  
G. Welch, M. Hathaway, G. Skoch, ARL-VTD; C. Snyder, NASA Glenn Research Center

Paper #6 - 11:00 a.m. - 11:30 a.m.  
*Establishing a Ballistic Test Methodology to Document the Containment Capability of Small Gas Turbine Engine Compressors*  
K. Heady, US Army AMRDEC, AED; J. Pereira, NASA Glenn Research Center; G. Bobula, US Army AMRDEC, AED; C. Ruggeri, NASA Glenn Research Center

### Systems Engineering

8:00 a.m. - 11:30 a.m.  
Texas 1 & 2

*Session Chair:* Dr. Dan Schrage, Georgia Institute of Technology

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*Understanding System Engineering Technical Reviews*  
M. Gaydar, NAVAIR

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*Methodologies and Tools to Support the Architecture of Complex Helicopter Avionics Systems*  
M. Manninen, R. Butler, J. Lewis, Rockwell Collins

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Strategic Research Planning & Management*  
S. W. Harris and C. Shepard, Bell Helicopter Textron, Inc.

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

Paper #4 - 10:00 a.m. - 10:30 a.m.  
*An Architecture Based Approach for Modeling Hardware and Software*  
J. Pham and P. Hensley, Sikorsky Aircraft Corp.

Paper #5 - 10:30 a.m. - 11:00 a.m.  
*The Georgia Tech Professional Masters Degree in Applied Systems Engineering (PMSE)*  
D. P. Schrage and C. A. Bishop, Georgia Institute of Technology

Paper #6 - 11:00 a.m. - 11:30 a.m.  
*Quantitative Risk Management Methodologies As Applied to Rotorcraft Product Development*  
A. Lewis and T. Saunders, Sikorsky Aircraft Corp.

### Test & Evaluation I

8:00 a.m. - 12 noon  
Texas 5 & 6

*Session Chair:* Barry Walden, NAVAIR

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*Wind Tunnel Test of the SMART Active Flap Rotor*  
F. Straub, V. Arbab, T. Birchette, and B. Lau, The Boeing Co.

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*Evaluation of Scaling Methods for Rotorcraft Icing*  
J. C. Tsao, Ohio Aerospace Institute; R. Kreeger, NASA Glenn Research Center

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Control Evaluation of a MagnetoRheological Fluid Elastomeric (MRFE) Lag*  
C. Kothera, Techno-Sciences, Inc.; G. Ngatu and N. Wereley, University of Maryland

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### Refreshments

**9:30 a.m. - 10:00 a.m.**

Paper #4 - 10:00 a.m. - 10:30 a.m.  
*The Validation of the AH-64D Composite Main Rotor Blade Temperature Predictions Using Thermal Imagery*  
T. Reinert, M. Kuehn, A. Llanos and P. Jouin, The Boeing Company

Paper #5 - 10:30 a.m. - 11:00 a.m.  
*Development of a Large Field-of-View PIV System for Rotorcraft Testing in the 14x22 Subsonic Wind Tunnel*  
L. Jenkins, C. S. Yao, S. Bartram, J. Harris, B. Allan, NASA Langley Research Center; O. Wong, US Army; D. Mace, Jr., Sierra Lobo, Inc.

Paper #6 - 11:00 a.m. - 11:30 a.m.  
*An Overview of the AH-64D Apache Block III Engine Nose Gearbox Fairing*  
L. Buck, N. Adams, N. Rodriguez, The Boeing Company; J. Higman, H. Wiersma, US Army

Paper #7 - 11:30 a.m. - 12:00 noon  
*Full-Scale Wind Tunnel Test of a UH-60 Individual Blade Control System for Performance Improvement and Vibration, Loads, and Noise Control*  
T. Norman, P. Shinoda, NASA

# Technical Sessions FORUM 65

## B: THURSDAY, MAY 28, 2009 – MORNING

### Acoustics II (Aeroacoustics)

8:00 a.m. - 11:45 a.m.  
Texas 3

**Session Chair:** Dr. Randolph Cabell, NASA Langley

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
*HART-II Acoustic Predictions using a Coupled CFD/CSD Method*  
D. Boyd, Jr., NASA Langley Research Center

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
*Simulation of Active Rotor Control by Comprehensive Rotor Code with Prescribed Wake using HART II Data*  
B. van der Wall, J. Yin, German Aerospace Center (DLR)

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
*Aerodynamic/Structural/Acoustic Prediction of HART II Rotor Using Weakly Coupled CFD-CSD Analysis*  
C. Yang, T. Aoyama, Japan Aerospace Exploration Agency (JAXA); H. K. Lee, S. J. Shin, Seoul National University

### Refreshments

9:30 a.m. - 10:15 a.m.

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
*Effect of Rotor Stiffness and Lift Offset on the Aeroacoustics of a Coaxial Rotor in Level Flight*  
H. W. Kim, K. Duraisamy, R. Brown, University of Glasgow

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
*Time-domain Approach for Acoustic Scattering of Rotor Noise*  
S. Lee, K. Brentner, P. Morris, The Pennsylvania State University

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
*Measurements and XFD-Based Acoustic Computations of Experimentally Simulated Blade-Vortex Interaction (BVI) Noise*  
S. Koushik, G. Gopalan, F. Schmitz, University of Maryland

### Aircraft Design I

8:00 a.m. - 11:45 a.m.  
Texas 1 & 2

**Session Chair:** Richard Markiewicz, DSTL

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
*Challenges in the Aerodynamic Optimization of High-Efficiency Proprotors*  
J. G. Leishman, Rotor Systems Research LLC and K. Rosen, Aero-Sciences Technologies Associates LLC

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
*Optional Aeroelastic Trim with Surrogate Structural Constraints*  
T. Schank, Bell Helicopter Textron, Inc.

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
*Application of Low and High Fidelity Simulation Tools to Helicopter Rotor Blade Optimization*  
K. Collins, L. Sankar, Georgia Institute of Technology

### Refreshments

9:30 a.m. - 10:15 a.m.

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
*Aeroelastic and Structural Analysis of Ducted Composite Rotors in Edgewise Flight*  
J. Zhang, E. Smith, Pennsylvania State University

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
*Dynamic Blade Shape for Improved Helicopter Rotor Performance*  
H. Kang, Advanced Rotorcraft Technology Inc.; F. Gandhi, The Pennsylvania State University

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
*Blade Shape Optimization for Aero-Acoustic Performance Improvement of Helicopter in Hover*  
S. Chae, Pusan National University; C. Yang, Japan Aerospace Exploration Agency; S. Jeong, Tohoku University; T. Aoyama, Japan Aerospace Exploration Agency; K. Yee, Pusan National University; S. Obayashi, Tohoku University

### Dynamics II

8:00 a.m. - 12:15 p.m.  
Grapevine 1 & 2

**Session Chair:** Mr. Claudio Monteggia, AgustaWestland

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
*Incorporation of VABS Composite Beam Sectional Analysis Into a Comprehensive Rotorcraft Analysis Code with Application to Aeroelastic Tailoring*  
P. Friedmann and B. Glaz, University of Michigan; R. Palacios, Imperial College

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
*Modeling Spanwise Nonuniformity in the Cross-Sectional Analysis of Composite Rotor Blades*  
J. Ho, D. Hodges, Georgia Institute of Technology; W. Yu, Utah State University

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
*Development of a Methodology for Coupling Rotorcraft Aeromechanics and Vehicle Dynamics to Study Helicopters in Maneuvering Flight*  
N. Rajmohan, V. Manivannan, L. Sankar, M. Costello, O. Bauchau, Georgia Institute of Technology

### Refreshments

9:30 a.m. - 10:15 a.m.

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
*Three-dimensional Finite Element Formulation and Scalable Domain Decomposition for High Fidelity Rotor Dynamic Analysis*  
A. Datta, ELORET Corporation, W. Johnson, NASA Ames Research Center

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
*Structural Optimisation and Aero-Elastic Tailoring of the BERP IV Demonstrator Blade*  
S. Moffatt, N. Griffiths, AgustaWestland

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
*Computational Aeroelasticity of Rotating Wings with Deformable Airfoils*  
S. Thepvongs, C. Cesnik, University of Michigan; J. Cook, M. Smith, Georgia Institute of Technology

**Paper #7** - 11:45 a.m. - 12:15 p.m.  
*Validation of CHARM Wake Methodology for Computation of Loads and Vibrations*  
J. Y. Choi, M. Summers, J. Corrigan, Bell Helicopter Textron, Inc.

### Flight Simulation II

8:00 a.m. - 12:15 p.m.  
Texas 4

**Session Chair:** Mark Dreier, Bell Helicopter Textron, Inc.

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
*Integrated Simulation and Control Tool - Copter S Function Matlab® Control Law Desktop Simulator*  
J. Corrigan, J. Shue, H. Brown, Bell Helicopter Textron, Inc.

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
*Recursive Algorithm for Efficient Real-Time Simulation of Generic Drive-Train Systems*  
H. Perera and M. Dreier, Bell Helicopter Textron, Inc.

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
*Linearization of the GenHel S-76D Model with the Engine and Fuel Control Models*  
C. Quiding, Sikorsky Aircraft Corp.

### Refreshments

9:30 a.m. - 10:15 a.m.

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
*A Generic Rotorcraft Simulation using Matlab/Simulink*  
C. Friedman, University of Maryland; A. Fertman, O. Rand, Technion

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
*Open Source Multibody Aeroelastic Modeling, Simulation, and Video Rendering*  
G. D. Baldwin, Baldwin Technology Co., LLC

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
*Simulation Support for Development of ADS-33 Specifications for Heavy Lift Rotorcraft*  
C. He, M. H. Lim, Advanced Rotorcraft Technology, Inc.; D. Mitchell, Hoh Aeronautics, Inc.

**Paper #7** - 11:45 a.m. - 12:15 p.m.  
*Trajectory Optimization Procedures for Rotorcraft Vehicles Including Pilot Models, with Applications to ADS-33 MTEs, Cat-A Procedures and Engine Off Landings*  
F. Scorcelletti, AgustaWestland; C. L. Bottasso, Politecnico di Milano, G. Maisano, Politecnico di Milano

# Technical Sessions FORUM 65

## B: THURSDAY, MAY 28, 2009 – MORNING

### HUMS II

8:00 a.m. - 12:15 p.m.  
San Antonio 4, 5 & 6

**Session Chair:** Mike Augustin, Bell Helicopter Textron, Inc.

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
**Operations Support and Sustainment Technologies for Current and Future Aircraft**  
T. Baker, Aviation Applied Technology Directorate; C. Ferrie, M. Augustin, D. Yeary, Bell Helicopter Textron, Inc.

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
**Impact Damage Detection for Fiberglass Composite Rotor Blade**  
C. Budde, D. Adams, D. Koester, P. Meckl, and N. Yoder, Purdue University

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
**Synchronized System for Wireless Sensing, RFID, Data Aggregation, & Remote Reporting**  
S. Arms, C. Townsend, J. Galbreath, D. Churchill, MicroStrain, Inc.; N. Phan, US Navy

### Propulsion II

8:00 a.m. - 11:45 a.m.  
Grapevine 3 & 4

**Session Chair:** Bill Storey, Goodrich

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
**H-60 Tail Rotor Drive Shaft Thomas Coupling Transient Overload Capacity**  
E. Ames, C. Parker, U.S. Army

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
**Load Sharing Test of the CH-53K Split Torque Main Gearbox**  
Y. Gmirya, S. He, G. Buzel, Sikorsky Aircraft Corp.; L. Leigh, NAVAIR SYSCOM HQ

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
**Double Helical Gear Performance in High Speed Helical Gear Trains**  
R. Handschuh, NASA Glenn Research Center; R. Ehinger, E. Sinusas, C. Kilmain, Bell Helicopter Textron, Inc.

### Structures & Materials 1

8:00 a.m. - 12:15 p.m.  
Grapevine 5 & 6

**Session Chair:** Tim Davis, US Army AATD

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
**Redesign of the Top Cover of the Apache Transmission Housing Using Composites**  
J. Sen, M. Arrington, G. Pyle, D. Ruffner, P. Sharpe, A. Murphy, The Boeing Co.

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
**Effect of Stress Concentrations in Flexible Matrix Composite Driveshafts**  
S. Sollenberger, C. Bakis, E. Smith, Pennsylvania State University

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
**Analysis of a Ramp Roller Clutch System**  
L. Liu, D. Strickland, Sikorsky Aircraft Corp.

### Test & Evaluation II

8:00 a.m. - 12:15 p.m.  
Texas 5 & 6

**Session Chair:** Philip Alldridge, Sikorsky Aircraft Corp.

**Paper #1** - 8:00 a.m. - 8:30 a.m.  
**Applications of Infrared Technology to Helicopter Flight Testing**  
G. Laurent, Eurocopter; P. Herve, D. Ramel, Paris X University

**Paper #2** - 8:30 a.m. - 9:00 a.m.  
**Development Testing of the X2 Technology™ Demonstrator**  
D. Walsh, R. Blackwell, S. Weiner, K. Arifian, A. Bagai, T. Lawrence, Sikorsky Aircraft Corp.

**Paper #3** - 9:00 a.m. - 9:30 a.m.  
**Flight Testing an Engine Inlet Barrier Filter for the EC145**  
C. Ockier, H. Müller, W. Linke, C. Kolb, S. Benedict, Eurocopter

### Refreshments

**9:30 a.m. - 10:15 a.m.**

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
**Structural Health Monitoring for Bell 407 Tailboom**  
A. Purekar, Techno-Sciences, Inc.; Y. T. Choi, N. Wereley, University of Maryland; H. Wilson, Bell Helicopter Textron, Inc.; N. Bordick, Aviation Applied Technology Directorate

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
**AH-64 Prototype Composite Vertical Stabilizer with an Embedded Sensor Network**  
M. Bender, Dynetics, Inc.; D. McCarthy, The Boeing Company; L. Ayers, US Army AMRDEC; J. Federici, New Jersey Institute of Technology

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
**An Embedded, Physics-Based Approach for Turboshaft Engine Continuous Power Assurance and Performance Monitoring**  
J. Goericke, K. Moeckly, A. Stramiello, Honeywell Aerospace; A. Kouros, Bell Helicopter Textron, Inc.; B. Smith, AATD

**Paper #7** - 11:45 a.m. - 12:15 p.m.  
**Rotorcraft Airframe Structural Health Monitoring System**  
M. Davis, Sikorsky Aircraft Corp.

### Refreshments

**9:30 a.m. - 10:15 a.m.**

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
**RDS-21 Demonstrator Gearbox Testing**  
B. Hansen, Sikorsky Aircraft Corp.

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
**Face Gear Development Under the Rotorcraft Drive System for the 21st Century Program**  
G. Heath, S. Slaughter, M. Morris, The Boeing Co.; J. Fetty, U.S. Army AATD; D. Lewicki, U.S. Army Research Laboratory

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
**LICHTEN AWARD WINNING PAPER: CFD Investigation of Engine Exhaust Swirling Flow in High Aspect Ratio Rectangular Ducts**  
Laura Buck, The Boeing Co.

### Refreshments

**9:30 a.m. - 10:15 a.m.**

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
**The Yaw Return Maneuver - the Regulatory History, Future, and Impact on the Structural Design Loads**  
S. Kelly, Bell Helicopter Textron, Inc.; D. Avampato, Sikorsky Aircraft Corp.

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
**Maneuver-to-Maneuver Load Cycle Case Study**  
R. Benton, J. H. Chang, US Army RDECOM

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
**Development of Life Prediction of Erosion Resistant Turbine Low Conductivity Thermal Barrier Coatings**  
D. Zhu, R. Miller, M. Kuczmariski, NASA Glenn Research Center

**Paper #7** - 11:45 a.m. - 12:15 p.m.  
**Effects of Moisture on Mechanical and Fracture Response of Rotorcraft Composites**  
R. Brack, X. Li, J. Shull, K. Boucher, Bell Helicopter Textron, Inc.

### Refreshments

**9:30 a.m. - 10:15 a.m.**

**Paper #4** - 10:15 a.m. - 10:45 a.m.  
**Extension of the ACT/FHS Experimental Flight Envelope**  
M. Hamers, H. Graser, N. Bickel, M. Doktorczyk, Eurocopter Deutschland; H. Kistler, R. Lantzsich, W. Krebs, DLR

**Paper #5** - 10:45 a.m. - 11:15 a.m.  
**Using Chase Aircraft for Rotary Wing Flight Test - A Comprehensive Review**  
S. Bruce, Bell Helicopter Textron, Inc.

**Paper #6** - 11:15 a.m. - 11:45 a.m.  
**KA32 Flight Testing for Training Simulator Development**  
P. Booi, J. van der Vorst, H. Brugman, National Aerospace Laboratory NLR; D. K. Jeon, H. S. Choi, H. S. Jun, Korean Aerospace Research Institute, KARI

**Paper #7** - 11:45 a.m. - 12:15 p.m.  
**MV-22B Osprey Short Takeoff and Minimum Run-on Landing Tests Aboard LHD Class Ships**  
V. Mitchell, W. Geyer Jr., NAWCAD

# Technical Sessions FORUM 65

## C: THURSDAY, MAY 28, 2009 – AFTERNOON

### Aerodynamics 1

1:45 p.m. - 6:00 p.m.  
Texas 5 & 6

Session Chair: Dr. Mahendra Bhagwat, US Army AFDD

Paper #1 - 1:45 p.m. - 2:15 p.m.  
*Simulation of an Isolated Tiltrotor in Hover with an Unstructured Overset-Grid RANS Solver*  
E. Lee-Rausch, R. Biedron, NASA Langley Research Center

Paper #2 - 2:15 p.m. - 2:45 p.m.  
*Aerodynamic Shape Optimization of Hovering Rotors Using a Discrete Adjoint of the RANS Equations*  
A. Dumont, A. Le Pape, J. Petert, ONERA; S. Huberson, LEA

Paper #3 - 2:45 p.m. - 3:15 p.m.  
*Adjoint-Based Design of Rotors Using the Navier-Stokes Equations in a Noninertial Reference Frame*  
E. Nielsen, E. Lee-Rausch, W. Jones NASA Langley Research Center;

### Refreshments

**3:15 p.m. - 4:00 p.m.**

Paper #4 - 4:00 p.m. - 4:30 p.m.  
*Aerodynamic Optimization Study of a Coaxial Helicopter Rotor*  
M. Syal, J. G. Leishman, University of Maryland

Paper #5 - 4:30 p.m. - 5:00 p.m.  
*A CFD-based Nonlinear Reduced-order Aerodynamic Model for Comprehensive Simulation of Rotorcraft with Active Microflaps*  
P. Friedmann, F. X. Bagnoud, A. Padthe, L. Liu, University of Michigan

Paper #6 - 5:00 p.m. - 5:30 p.m.  
*Unsteady Aerodynamics of Flapped Airfoils and Rotors Using CFD and Approximate Methods*  
P. Friedmann, L. Liu, A. Padthe, University of Michigan; E. Quon, M. Smith, Georgia Institute of Technology

Paper #7 - 5:30 p.m. - 6:00 p.m.  
*An Analytical Formulation for Lifting Rotor Induced Power*  
R. Ormiston, US Army AFDD

### Aircraft Design II

1:45 p.m. - 6:00 p.m.  
Texas 1 & 2

Session Chair: Dr. Martin Sekula, NASA Langley Research Center

Paper #1 - 1:45 p.m. - 2:15 p.m.  
*2008 UNDERGRADUATE STUDENT DESIGN COMPETITION WINNER: Smart Copter -- Razor Rescue*  
E. Brouwers, S. Cullison, P. DiBiase, H. Steadman, M. Takach, The Pennsylvania State University

Paper #2 - 2:15 p.m. - 2:45 p.m.  
*2008 GRADUATE STUDENT DESIGN COMPETITION WINNER: Volterra -- The Era of Green*  
B. Bush, D. Sargent, R. Sickenberger, M. Syal, N. Wilson, E. Ulrich, University of Maryland; C. Lee, J. Sa, Konkuk University

Paper #3 - 2:45 p.m. - 3:15 p.m.  
*Design Parameters for Coaxial Rotary Wing MAVs with Passive Roll and Pitch Stability*  
C. Bermes, D. Schafroth, S. Bouabdallah, R. Siegwart, Swiss Federal Institute of Technology, Zurich

### Refreshments

**3:15 p.m. - 4:00 p.m.**

Paper #4 - 4:00 p.m. - 4:30 p.m.  
*Design and Development of a Hover-capable Cyclocopter Micro Air Vehicle*  
M. Benedict, T. Jarugumilli, I. Chopra, University of Maryland

Paper #5 - 4:30 p.m. - 5:00 p.m.  
*Design and Characterization of Millimeter-Scale Flapping Wings*  
C. Kroninger, J. Pulskamp, R. Polcawich, US Army Research Laboratory; J. Bronson, Oak Ridge Associated Universities; E. Wetzel, US Army Research Laboratory

Paper #6 - 5:00 p.m. - 5:30 p.m.  
*Design of the SAMARAI Monowing Rotorcraft Nano Air Vehicle*  
H. Youngren, AeroCraft Consulting; S. Jameson, B. Satterfield, Lockheed Martin Advanced Technology Labs

Paper #7 - 5:30 p.m. - 6:00 p.m.  
*Design and Development of a Quad-Shrouded-Rotor Micro Air Vehicle*  
J. Pereira, D. Bawek, S. Westfall, I. Chopra, University of Maryland

### Avionics & Systems

1:45 p.m. - 6:00 p.m.  
Texas 3

Session Chair: Ryland Barlow, US Army TAPO

Paper #1 - 1:45 p.m. - 2:15 p.m.  
*Mission Systems For Future Force Aviation (Invited, Presentation Only)*  
P. Meyers, The Boeing Co

Paper #2 - 2:15 p.m. - 2:45 p.m.  
*Rotorcraft Visual Situational Awareness -- Solving the Pilotage Problem for Landing in Degraded Visual Environments*  
B. Sykora, K. Yang, BAE Systems

Paper #3 - 2:45 p.m. - 3:15 p.m.  
*Global Positioning System (GPS) Altitude for Obstacle Clearance*  
B. Thompson, R. Corley, US Army

### Refreshments

**3:15 p.m. - 4:00 p.m.**

Paper #4 - 4:00 p.m. - 4:30 p.m.  
*US Army Aviation Network Technologies Demonstrated at JEFX08*  
S. Gannon, SAIC; B. Speir, The Boeing Co.

Paper #5 - 4:30 p.m. - 5:00 p.m.  
*Apache Mission Processor Software Architecture: Architectural Decisions*  
R. Koontz, The Boeing Co.

Paper #6 - 5:00 p.m. - 5:30 p.m.  
*Precision Approach to Rigs*  
A. Mehra, R. Doepfner, D. Fowler, Sikorsky Aircraft Corp.

### Crash Safety I

1:45 p.m. - 6:00 p.m.  
Grapevine 5 & 6

Session Chair: David Friedmann, US Army AATD

Paper #1 - 1:45 p.m. - 2:15 p.m.  
*The Influence of the Structural Stiffness of Dynamic Test Fixturing on Seat to Airframe Interface Loads for Lightweight Wall Mounted Crashworthy Troop Seats*  
H. Moore, Naval Air Systems Command

Paper #2 - 2:15 p.m. - 2:45 p.m.  
*Rotorcraft Fuel System Drop Test Simulation Methodology*  
S. Rajan, C. H. Tho, M. Smith, Bell Helicopter Textron, Inc.

Paper #3 - 2:45 p.m. - 3:15 p.m.  
*Developing Soil Models for Dynamic Impact Simulations*  
E. Fasanella, K. Jackson, K. Lyle, NASA Langley Research Center

### Refreshments

**3:15 p.m. - 4:00 p.m.**

Paper #4 - 4:00 p.m. - 4:30 p.m.  
*Injury and Fatality Patterns in US Navy Rotary Wing Mishaps, a Descriptive Review of Class A & B Mishaps from 1985-2005*  
R. Kent, USAF School of Aerospace Medicine

Paper #5 - 4:30 p.m. - 5:00 p.m.  
*Evaluation of Material Models within LS-DYNA® for a Kevlar/Epoxy Composite Honeycomb*  
M. Polanco, ATK Space Systems; K. Jackson, S. Kellas, NASA Langley Research Center

Paper #6 - 5:00 p.m. - 5:30 p.m.  
*The Development of a Floor Former Concept Incorporating Energy-Absorbing Composite Tubes*  
D. Ludin, M. Renninger, The Boeing Co.

Paper #7 - 5:30 p.m. - 6:00 p.m.  
*Multi-Mechanism Energy Absorption in Extension-Twist Coupled Composite Tubes*  
C. Tiwari, E. Smith, C. Bakis, The Pennsylvania State University

# Technical Sessions FORUM 65

## C: THURSDAY, MAY 28, 2009 – AFTERNOON

### Crew Stations & Human Factors

1:45 p.m. - 6:00 p.m.  
Grapevine 1 & 2

Session Chair: **Margaret Lampazzi**, Sikorsky Aircraft Corp.

**Paper #1** - 1:45 p.m. - 2:15 p.m.  
*The Application of Holographic Optical Waveguide Technology to Q-Sight Family of Helmet Mounted Displays*  
A. Cameron, BAE Systems Electronic & Integrated Solutions 2

**Paper #2** - 2:15 p.m. - 2:45 p.m.  
*Research on Pilot Assistance for Rotorcraft*  
S. Haisch, S. Hess, S. Jank, W. Kreitmair-Steck, Eurocopter Deutschland GmbH

**Paper #3** - 2:45 p.m. - 3:15 p.m.  
*Techniques for Measuring Workload for the CH-47F: Coupled Flight Director Developmental Testing*  
J. Crispino, E. Tharp, T. Frezell, US Army (ATTC)

### Refreshments

**3:15 p.m. - 4:00 p.m.**

**Paper #4** - 4:00 p.m. - 4:30 p.m.  
*Human Factors in Helicopter Accidents: Results from the Analysis Performed by the European Helicopter Safety Analysis Team within the IHST*  
M. Masson, M. Van Hijum, A. Healey, J. Vincent, EASA; A. Evans, AviatQ

**Paper #5** - 4:30 p.m. - 5:00 p.m.  
*Low Light Comparison of Target Visibility with Night Vision Goggles: Flight Tests*  
G. Craig, National Research Council of Canada; M. Brulotte, Transport Canada; S. Carignan, National Research Council of Canada; T. Macuda, Gladstone Aerospace Consulting

**Paper #6** - 5:00 p.m. - 5:30 p.m.  
*Sandblaster: The Development of Flight Symbolism on a 3D Synthetic Vision Perspective Display to Support the Approach to Landing Task in Degraded Visual Environments*  
L. Stiles, M. MacIsaac, J. Salvetti, C. Flaws, Sikorsky Aircraft Corp.

**Paper #7** - 5:30 p.m. - 6:00 p.m.  
*Symbolism for Brown-Out Landings: the 3D-LZ Program*  
Z. Szoboszlai, US Army; A. McKinley, ARRL

### Handling Qualities I

1:45 p.m. - 6:00 p.m.  
Texas 4

Session Chair: **Dr. Joe Horn**, Pennsylvania State University

**Paper #1** - 1:45 p.m. - 2:15 p.m.  
*An Investigation of Rotorcraft Stability-Phase Margin Requirements in Hover*  
C. Blanken, U.S. Army; W. Decker, NASA Ames Research Center

**Paper #2** - 2:15 p.m. - 2:45 p.m.  
*Achieving the Best Compromise between Stability Margins and Disturbance Rejection Performance*  
M. Mansur, M. Tischler, U.S. Army AMRDEC AFDD; T. Berger; UARC, UC Santa Cruz

**Paper #3** - 2:45 p.m. - 3:15 p.m.  
*Relationship Between Pilot Workload and Turbulence Intensity for Helicopter Operations in Harsh Environments*  
N. Matayoshi, Japan Aerospace Exploration Agency; J. Forrest, University of Liverpool; S. Hodge, BAE Systems; G. Padfield, I. Owen, University of Liverpool

### Refreshments

**3:15 p.m. - 4:00 p.m.**

**Paper #4** - 4:00 p.m. - 4:30 p.m.  
*Shipboard Helicopter Gust Response Alleviation Using Active Trailing Edge Flaps*  
P. Montanye, The Boeing Co.; E. Smith, C. Rahn, S. Conlon, The Pennsylvania State University

**Paper #5** - 4:30 p.m. - 5:00 p.m.  
*Helicopter Flight Control with Variable Rotor Speed and Torque Limiting*  
W. Guo, J. Horn, The Pennsylvania State University

**Paper #6** - 5:00 p.m. - 5:30 p.m.  
*Methods for Real-Time Rotorcraft Stall Detection*  
J. V. R. Prasad, I. Grill, Georgia Institute of Technology

**Paper #7** - 5:30 p.m. - 6:00 p.m.  
*VRS Avoidance as Active Function on Side-Sticks*  
M. Abildgaard, DLR; L. Binet, ONERA; W. Grünhagen, DLR; A. Taghizad, ONERA

### HUMS III

1:45 p.m. - 6:00 p.m.  
San Antonio 4, 5 & 6

Session Chair: **Ed Martin**, US Army Aviation Engineering Directorate

**Paper #1** - 1:45 p.m. - 2:15 p.m.  
*Comparison of HUMS Benefits-A Readiness Approach*  
J. Hasty and K. Speaks, RMCI, Inc.; J. Kennedy, AMCOM G3

**Paper #2** - 2:15 p.m. - 2:45 p.m.  
*Emerging CBM Capabilities on the UH-60 Blackhawk Utilizing IVHMS Data Correlation and Analysis*  
H. Kunselman, Goodrich Corporation; Rena Durham, AED, AMRDEC

**Paper #3** - 2:45 p.m. - 3:15 p.m.  
*Practical Prognostics for CBM*  
K. Pipe, Humaware

### Refreshments

**3:15 p.m. - 4:00 p.m.**

**Paper #4** - 4:00 p.m. - 4:30 p.m.  
*A Novel Configuration-Driven Data Mining Framework for Health and Usage Monitoring Systems*  
M. Al-Kateb, The University of Vermont; P. Joshi, M. Imadabathuni, The University of Illinois at Chicago; E. Bechhoefer, Goodrich Sensors and Integrated Systems; D. He, The University of Illinois at Chicago

**Paper #5** - 4:30 p.m. - 5:00 p.m.  
*Dynamic Alert Generation Technology for HUM Systems*  
K. Pipe, Humaware

**Paper #6** - 5:00 p.m. - 5:30 p.m.  
*Open Systems Capabilities and Experience with the Integrated Vehicle Health Management System*  
S. Tayloe, T. Flynn, Goodrich; J. Isom, Sikorsky Aircraft Corp.

**Paper #7** - 5:30 p.m. - 6:00 p.m.  
*Cost Effective Implementation of HUMS, AME/ALE, and CBM+ Through Multi-Platform Collaboration on Open Source Development*  
S. Maley, D. Cole, M. Davis, M. Stonebraker, US Navy

### Propulsion III

1:45 p.m. - 6:00 p.m.  
Grapevine 3 & 4

Session Chair: **Sam Spring**, GE Aircraft Engines

**Paper #1** - 1:45 p.m. - 2:15 p.m.  
*Thermohydrodynamic Model Predictions and Performance Measurements of Bump-Type Foil Bearing for Oil-Free Turboshift Engines in Rotorcraft Propulsion Systems*  
T. H. Kim, L. S. Andres, Texas A&M University

**Paper #2** - 2:15 p.m. - 2:45 p.m.  
*The Case for Distributed Engine Control in Turboshift Engine Systems*  
D. Culley, NASA Glenn Research Center; B. Storey, P. Paluszewski, Goodrich Pump and Engine Control Systems; B. Smith, US Army AATD

**Paper #3** - 2:45 p.m. - 3:15 p.m.  
*Measurement of Drag Torque, Lift-Off Journal Speed and Temperature in a Metal Mesh Foil Bearing*  
T. Chirathadam, K. Ryu, L. S. Andres, Texas A&M University

### Refreshments

**3:15 p.m. - 4:00 p.m.**

**Paper #4** - 4:00 p.m. - 4:30 p.m.  
*Foil Bearing Starting Considerations and Requirements for Rotorcraft Engine Applications*  
K. Radil, US Army Research Laboratory; C. DellaCorte, NASA Glenn Research Center

**Paper #5** - 4:30 p.m. - 5:00 p.m.  
*Advancements Toward Oil-Free Rotorcraft Propulsion*  
S. Howard, R. Bruckner, NASA Glenn Research Center; K. Radil, US Army Research Laboratory

**Paper #6** - 5:00 p.m. - 5:30 p.m.  
*Engine Test Results for the T55-L-714 Engine Advanced Adaptive Control System Testing*  
W. Storey, P. Koziol, J. Mattice, M. Desai, Goodrich Pump and Engine Control Systems; B. Smith, US Army

**Paper #7** - 5:30 p.m. - 6:00 p.m.  
*Test and Evaluation of Foil Air Bearings for Use in an Advanced Turboshift Engine*  
M. Kaminske, GE Aviation; B. Ertas, GE Global Research Center

# Technical Sessions FORUM 65

## D: FRIDAY, MAY 29, 2009 – MORNING

### Aerodynamics II

8:00 a.m. - 12:15 p.m.  
Texas 5 & 6

Session Chair: Dr. Marvin Moulton,  
US Army AED

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*Micro-PIV Measurements and Challenges Towards Characterizing Active Flow Control Actuators for Rotor Applications*

M. Ramasamy, University of California Santa Cruz; J. Wilson, P. Martin, US Army AFDD

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*A Full-Scale Particle Image Velocimetry Investigation of "Young" Rotor Blade Tip Vortices*  
K. Kindler, K. Mulleners, H. Richard, M. Jonson, M. Kuhn, M. Raffel, German Aerospace Center (DLR).

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Investigation of Sediment Entrainment in Brownout Using High-Speed Particle Image Velocimetry*  
B. Johnson, J. G. Leishman, A. Sydney, University of Maryland

### Aircraft Design III

8:00 a.m. - 11:15 a.m.  
Texas 1 & 2

Session Chair: Richard Markiewicz,  
DSTL

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*Green Swashplateless Helicopter Rotor*  
A. Brindejone, Eurocopter; F. Malburet, ENSAM

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*Reducing Trailing Edge Flap Deflection Requirements in Swashplateless Primary Control via a Moveable Horizontal Tail*  
J. Bluman, US Military Academy; F. Gandhi, The Pennsylvania State University

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Rotorcraft Operating Envelope Expansion Using Extendable Chord Sections*  
O. Leon, E. Hayden, F. Gandhi, The Pennsylvania State University

### Handling Qualities II

8:00 a.m. - 12:15 p.m.  
Grapevine 3 & 4

Session Chair: Dave Miller, The Boeing Company

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*New ADS-33 Requirements for Cargo and Maritime Operations*  
D. Mitchell, T. Nicoll, Hoh Aeronautics, Inc.; M. Fallon, S. Roark, NAVAIR

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*Handling Qualities Engineering Features of the AW101 Design and Development Programme*  
Paul Taylor, QinetiQ; G. McWilliams, AugustaWestland

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Longitudinal and Lateral Control Sensitivity Damping Analysis for Larger Rotorcraft in Helicopter Mode*  
S. Shue, J. Corrigan, T. Wood, A. Ewing, Bell Helicopter Textron, Inc.

### IMPACT I

8:00 a.m. - 12:15 p.m.  
Texas 3

Session Chair: Dr. Tran Ngoc, The Boeing Company

Paper #1 - 8:00 a.m. - 8:30 a.m.  
*Integrated Design and Manufacturing (IDM) Tradeoffs through Product Lifecycle Management (PLM) for Rotorcraft Applications*  
D. P. Schrage, M. Costello, Georgia Institute of Technology

Paper #2 - 8:30 a.m. - 9:00 a.m.  
*Tooling Development for Intersecting "I" Grid Stiffened Structures*  
M. Renninger, D. Ludin, The Boeing Company

Paper #3 - 9:00 a.m. - 9:30 a.m.  
*Optimization of Tail Rotor Spar Press Cure Using Six-Sigma Process Certification*  
R. Lepard and D. Ursenbach, Sikorsky Aircraft Corp.

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### Refreshments

**9:30 a.m. - 10:15 a.m.**

Paper #4 - 10:15 a.m. - 10:45 a.m.  
*Exploring Aerodynamic Methods for Mitigating Brownout*  
G. Whitehouse, D. Wachspress, T. Quackenbush, J. Keller, Continuum Dynamics, Inc.

Paper #5 - 10:45 a.m. - 11:15 a.m.  
*Numerical Analysis of Unsteady Vortical Flows Generated by a Rotorcraft Operating on Ground: a First Assessment of Helicopter Brownout*  
A. D'Andrea, AugustaWestland

Paper #6 - 11:15 a.m. - 11:45 a.m.  
*Rotor Performance in the Wake of a Large Structure*  
T. Quinliven, NAVAIR; K. Long, Aerospace Computing, Inc.

Paper #7 - 11:45 a.m. - 12:15 p.m.  
*A Navier-Stokes Simulation of a Heavy Lift Slowed-Rotor Compound Helicopter Configuration*  
B. Allan, L. Jenkins, C. Yao, S. Bartram, J. Hallissy, J. Harris, NASA Langley Research Center; K. Noonan, O. Wong, H. Jones, B. Malovrh, D. Reis, US Army AFDD; W. Mace, Sierra Lobo, Inc.

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### Refreshments

**9:30 a.m. - 10:15 a.m.**

Paper #4 - 10:15 a.m. - 10:45 a.m.  
*Lifetime Extension of the EC135 Rotor Isolation System*  
A. Doleschel, Eurocopter

Paper #5 - 10:45 a.m. - 11:15 a.m.  
*Field Installable Wedges for Helicopter Rotor Blade Tracking*  
R. Loftus and M. McNulty, The Boeing Co.

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### Refreshments

**9:30 a.m. - 10:15 a.m.**

Paper #4 - 10:15 a.m. - 10:45 a.m.  
*A Method to Determine Maximum Flight Control Authority Through Hardover Failure Testing*  
K. Christensen, H. Koelzer, P. Hollifield, Bell Helicopter Textron, Inc.; L. Wiggins, M. Olmstead, U.S. Army Aviation and Missile Command

Paper #5 - 10:45 a.m. - 11:15 a.m.  
*Agusta A109E and GPS WAAS: Poised for Takeoff*  
J. Hilmer and M. Dioli, C. Haney, AugustaWestland

Paper #6 - 11:15 a.m. - 11:45 a.m.  
*4D Automatic Flight Path Control in Pilot Assistance System*  
J. Bantle, C. Melz, Eurocopter Deutschland GmbH

Paper #7 - 11:45 a.m. - 12:15 p.m.  
*S-92 Fly-by-Wire Progress Report*  
K. Wittmer, L. Stiles, G. Knaust, Sikorsky Aircraft Corp.

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### Refreshments

**9:30 a.m. - 10:15 a.m.**

Paper #4 - 10:15 a.m. - 10:45 a.m.  
*Process Modeling for Robust Composite Manufacturing*  
Y. F. Chen, D. Ursenbach, Sikorsky Aircraft Corp.

Paper #5 - 10:45 a.m. - 11:15 a.m.  
*Thermoplastic Rapid Prototyping for Rotorcraft Components*  
K. Boszak, Bell Helicopter Textron, Inc.

Paper #6 - 11:15 a.m. - 11:45 a.m.  
*Enhanced Capability of Optical Lay-Up Template for Manual Lay-Up of Complex Composite Structures*  
T. Ganguly, The Boeing Co.

Paper #7 - 11:45 a.m. - 12:15 p.m.  
*Three-dimensional Model-Based Manufacturing Work Instructions*  
D. Lichtner, C. Senesac, R. Hagan, The Boeing Co.

# Technical Sessions FORUM 65

## D: FRIDAY, MAY 29, 2009 – MORNING

### Operations I

8:00 a.m. - 12:15 p.m.  
Texas 4

Session Chair: Rupert Seals, The Boeing Company

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**Helicopter Remote Manipulation of External Sling Loads (HERMES): A Small Business Innovative Research Concept to Improve Air and Ground Crew Safety During Manned and Unmanned Sling Load Operations**  
S. Granade, Advanced Optical Systems, Inc.; B. Miller, US Army AMRDEC

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**The First Combat Deployment of the CH-47F Improved Cargo Helicopter**  
S. Magonigal, US Army Aviation Technical Test Center, T. West, U.S. Army

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**Individual Blade Root Control of Helicopter Blade Sailing for Articulated Shipboard Rotors**  
R. Ramos, D. de Andrade, L. C. Góes, Technological Institute of Aeronautics

### Refreshments

9:30 a.m. - 10:15 a.m.

Paper #4 - 10:15 a.m. - 10:45 a.m.  
**Threat Requirement Decomposition - The Importance of Historical Data & Clear Requirements with Respect to Vulnerability**  
S. DeGarmo, Sikorsky Aircraft Corp.

Paper #5 - 10:45 a.m. - 11:15 a.m.  
**Flight Operations Quality Assurance (FOQA-HOMP)**  
R. Healing, R<sup>3</sup> Consulting LLC

Paper #6 - 11:15 a.m. - 11:45 a.m.  
**Helicopter/Ship Securing Test and Analytic Options**  
D. Carico, A. Rodgers, NAWCAD; G. Cabot, NAVAIR

Paper #7 - 11:45 a.m. - 12:15 p.m.  
**Potential Rotorcraft Technology Applications for Delaware Bay Patrol**  
N. Strauss, The Boeing Co., J. Redlawsk, US Coast Guard Auxiliary

### Structures & Materials II

8:00 a.m. - 11:45 a.m.  
Grapevine 5 & 6

Session Chair: Dr. Suresh Moon, L-3 Communications

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**Integration Technologies for Silicon Nitride-Based Ceramic Systems for Advanced Rotorcraft Applications**  
M. Singh, Ohio Aerospace Institute; R. Asthana, University of Wisconsin at Stout; M. Halbig, U.S. Army Research Laboratory

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**Finite Element-Based Simulations of Damage in Composites**  
Y. Nikishkov, A. Makeev, Y. He, G. Seon, Georgia Institute of Technology

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**Cumulative-Damage Reliability for Normal Random-Independent (Normal- or Weibull-Distributed) Fatigue Stress, Random-Fixed Strength, and Deterministic Usage**  
R. Benton, US Army RDECOM

### Refreshments

9:30 a.m. - 10:15 a.m.

Paper #4 - 10:15 a.m. - 10:45 a.m.  
**Weak Bonds Characterization and Detection in Composite Structures**  
J.S. Leclerc, Bell Helicopter Textron Canada Limited

Paper #5 - 10:45 a.m. - 11:15 a.m.  
**Spectrum Loading and Surface Finish Effects in AL7075-T73**  
M. Urban, Sikorsky Aircraft Corp.

Paper #6 - 11:15 a.m. - 11:45 a.m.  
**A New Class of Hygrothermally Stable Laminates with Extension-twist Coupling**  
R. Haynes, R. Carey, Georgia Institute of Technology, E. Armanios, University of Texas at Arlington

### Uninhabited VTOL Aircraft

8:00 a.m. - 12:15 p.m.  
Grapevine 1 & 2

Session Chair: Christopher Mentzer, Southwest Research Institute

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**Autonomous Flight of a Samara MAV**  
E. Ulrich, D. Pines, S. Gerardi, University of Maryland

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**UAV Flight Control for Artificial Icing Testing**  
R. McKillip, Jr., T. Quackenbush, J. Keller, G. Whitehouse, D. Wachspress, Continuum Dynamics, Inc.

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**Vision-Based Obstacle Recognition and Autonomous Flights Through Obstacle Arches with a Small UAV**  
F. M. Adolf, F. Andert, L. Goormann, J. Dittrich, Institute of Flight Systems, DLR

### Refreshments

9:30 a.m. - 10:15 a.m.

Paper #4 - 10:15 a.m. - 10:45 a.m.  
**Planning and Operational Algorithms for Autonomous Helicopter**  
O. Rand, S. Potyagaylo, Technion - Israel Institute of Technology

Paper #5 - 10:45 a.m. - 11:15 a.m.  
**Minimum-time Approach to Obstacle Avoidance Constrained by Envelope Protection for Autonomous UAVs**  
J. Moon, J. V. R. Prasad, Georgia Institute of Technology

Paper #6 - 11:15 a.m. - 11:45 a.m.  
**Comparison of Terrain Characterization Methods for Autonomous UAVs**  
P. Fabiani, ONERA; M. Whalley, ARMDEC; G. Le Besnerais, M. Sanfourche, R. Mampey, ONERA

Paper #7 - 11:45 a.m. - 12:15 p.m.  
**Field-Testing of a Helicopter UAV Obstacle Field Navigation and Landing System**  
M. Whalley, US Army; M. Takahashi, Perot Systems Government Services; G. Schulein, P. Tsenkov, San Jose State University Research Foundation

### Vertical Flight History

8:00 a.m. - 12:15 p.m.  
San Antonio 4, 5 & 6

Session Chair: Dr. Bruce H. Charnov, Hofstra University

Paper #1 - 8:00 a.m. - 8:30 a.m.  
**From Helicopters to Vespas-The Aeronautical Engineering of Corradino d'Ascanio**  
J. G. Leishman, B. Johnson, University of Maryland; A. Filippone, University of Manchester

Paper #2 - 8:30 a.m. - 9:00 a.m.  
**Aerial Application and the Rise of American Rotorcraft**  
R. Connor, Smithsonian Institution

Paper #3 - 9:00 a.m. - 9:30 a.m.  
**An Interview with the Father of Army Aviation LTG Robert R. Williams, USMA '40**  
P. Fardink, The Resource Center

### Refreshments

9:30 a.m. - 10:15 a.m.

Paper #4 - 10:15 a.m. - 10:45 a.m.  
**The Lockheed Helicopters**  
R. Prouty, Consultant

Paper #5 - 10:45 a.m. - 11:15 a.m.  
**From Rolf Von Bahr to Jukka Tervamäki: The Scandinavian Influence on European Gyroplane History**  
B. Charnov, Hofstra University

Paper #6 - 11:15 a.m. - 11:45 a.m.  
**Canadian Low Disk-Loading V/STOL Concepts of the 20th Century**  
M. Hirschberg, CENTRA Technology; T. Mueller, Aviation Historian; S. Priestley, *Canadian American Strategic Review*

Paper #7 - 11:45 a.m. - 12:15 p.m.  
**A Personal View of the Development and Certification Flight Test of the Sikorsky S-76 (Presentation Only)**  
N. Lappos, Bell Helicopter Textron, Inc.

# Technical Sessions FORUM 65

## E: FRIDAY, MAY 29, 2009 – AFTERNOON

### Aerodynamics III

1:30 p.m. - 5:00 p.m.  
Texas 5 & 6

Session Chair: **Dr. Marilyn Smith**,  
Georgia Institute of Technology

Paper #1 - 1:30 p.m. - 2:00 p.m.  
**Assessment of Helicopter Hub Drag Prediction with an Unstructured Flow Solver**  
B. Wake, E. Hagen, S. Ochs, C. Matalanis, UTRC; M. Scott, Sikorsky Aircraft Corp.

Paper #2 - 2:00 p.m. - 2:30 p.m.  
**Improved Two-Dimensional Dynamic Stall Prediction with Structured and Hybrid Numerical Methods**  
K. Richter, German Aerospace Center (DLR); A. Le Pape, ONERA; T. Knopp, A. D. Garner, DLR; M. Costes, V. Gleize, ONERA

Paper #3 - 2:30 p.m. - 3:00 p.m.  
**The Effect of Blade Aerodynamic Modelling on the Prediction of High-Frequency Rotor Airloads**  
M. Kelly, R. Brown, University of Glasgow

Paper #4 - 3:00 p.m. - 3:30 p.m.  
**CFD-CSD Analysis of Active Control of Helicopter Rotor for Performance Improvement**  
R. Jain, K. Szema, R. Munipalli, HyPerComp; H. Yeo, US Army AFDD; I. Chopra, University of Maryland

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#### Refreshments

**3:30 p.m. - 4:00 p.m.**

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Paper #5 - 4:00 p.m. - 4:30 p.m.  
**Coupled CFD/CSD Prediction of the Effects of Leading Edge Slat on Rotor Performance**  
A. Mishra, J. Baeder, University of Maryland; D. Opoku, B. Wake, R. Lin, UTRC

Paper #6 - 4:30 p.m. - 5:00 p.m.  
**Prediction of UH-60A Aerodynamic and Structural Rotor Loads During Maneuvering Flight using Coupled CFD/CSD Analysis**  
B. Silbaugh, A. Abhishek, S. Ananthan, J. Baeder, I. Chopra, University of Maryland

### Crash Safety II

1:30 p.m. - 3:00 p.m.  
Grapevine 3 & 4

Session Chair: **Lindley Bark**, MSC  
Software

Paper #1 - 1:30 p.m. - 2:00 p.m.  
**Water Impact Drop Tests on Metallic and Composite Skin Panels and Numerical Simulations with ALE and SPH Approaches**  
E. Francesconi, M. Anghileri, Politecnico di Milano

Paper #2 - 2:00 p.m. - 2:30 p.m.  
**Dynamic Testing of a Semi-Active Magnetorheological Helicopter Crew Seat Suspension for Vibration Isolation**  
G. Hiemenz, Techno-Sciences, Inc.; W. Hu, N. Wereley, University of Maryland; W. Glass, Naval Air Warfare Center

Paper #3 - 2:30 p.m. - 3:00 p.m.  
**Characterization of Triaxial Braided Composite Material Properties for Impact Simulation**  
G. Roberts, NASA Glenn Research Center; J. Littell, ATK Space Systems, Inc.; R. Goldberg, NASA Glenn Research Center; W. Binienda, W. Arnold, L. Kohlman, The University of Akron

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#### Refreshments

**3:30 p.m. - 4:00 p.m.**

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### Dynamics III

1:30 p.m. - 3:00 p.m.  
Grapevine 1 & 2

Session Chair: **Dr. Chris Brackbill**,  
US Army Aviation Engineering Directorate

Paper #1 - 1:30 p.m. - 2:00 p.m.  
**Significance of Floquet Eigenvalues and Eigenvectors for the Dynamics of Time-Varying Systems**  
D. Peters and S. Lieb, Washington University at St. Louis

Paper #2 - 2:00 p.m. - 2:30 p.m.  
**Whirl Tower Demonstrations of the SHARCS Hybrid Control Concept**  
D. Feszty, F. Nitzsche, A. Mander, Carleton University; G. Coppotelli, F. Vetranò, Università of Rome; J. Riemenschneider, P. Wierach, DLR

Paper #3 - 2:30 p.m. - 3:00 p.m.  
**Active Rotor Development for Primary and Secondary Flight Control**  
B. Wake, Z. Chaudhry, UTRC; P. Lorber, A. Bagai, Sikorsky Aircraft Corporation; A. Collins, Hamilton Sundstrand

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#### Refreshments

**3:30 p.m. - 4:00 p.m.**

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### Handling Qualities III

1:30 p.m. - 3:30 p.m.  
Texas 1 & 2

Session Chair: **Rick Simmons**, FAA

Paper #1 - 1:30 p.m. - 2:00 p.m.  
**Modeling the Human Pilot Controlling a Rotorcraft With Time-Varying Dynamics**  
R. Hess, University of California; F. Marchesi, University of Brescia

Paper #2 - 2:00 p.m. - 2:30 p.m.  
**A Stochastic Model of Unsteady Ship Airwake Disturbances on Rotorcraft**  
S. Sparbanie, J. Horn, The Pennsylvania State University; D. Geiger, V. Sahasrabudhe, Sikorsky Aircraft Corp.

Paper #3 - 2:30 p.m. - 3:00 p.m.  
**Innovative Methods for Modeling and Simulation of Tiltrotor Aircraft**  
J. Cooper, D. Ward, Barron Associates, Inc.; P. Thompson, Systems Technology, Inc.

Paper #4 - 3:00 p.m. - 3:30 p.m.  
**Tiltrotor Autorotation Characteristics Using Comprehensive Analysis**  
J. Vorwald, Marine and Aviation Division, Naval Surface Warfare

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#### Refreshments

**3:30 p.m. - 4:00 p.m.**

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# Technical Sessions FORUM 65

## E: FRIDAY, MAY 29, 2009 – AFTERNOON

### IMPACT II

1:30 p.m. - 3:00 p.m.  
Texas 3

Session Chair: **Dan Ursenbach**, Sikorsky Aircraft Corp.

Paper #1 - 1:30 p.m. - 2:00 p.m.  
*Universal Product Review, A Global View of Material Review Board Engineering*  
W. R. Charlton, Jr., The Boeing Co.

Paper #2 - 2:00 p.m. - 2:30 p.m.  
*Design for Manufacturing – One-Piece, Fibre-Placed Composite Tailboom for a Bell Model 407 Helicopter*  
C. Marsden, R. Fewes, Bell Helicopter Textron Canada

### Operations II

1:30 p.m. - 3:00 p.m.  
Texas 4

Session Chair: **Suzan DeGarmo**, Sikorsky Aircraft Corp.

Paper #1 - 1:30 p.m. - 2:00 p.m.  
*DESCENT Analysis for Rotorcraft Survivability with Power Loss*  
M. Floros, U.S. Army Research Laboratory

Paper #2 - 2:00 p.m. - 2:30 p.m.  
*BDRVT - UAV Control for Frontline Soldiers*  
R. Higgins, US Army AATD

Paper #3 - 2:30 p.m. - 3:00 p.m.  
*Firefighting: Effects on the Environment and National Security*  
W. Jacobs, DynCorp International

### Product Support

1:30 p.m. - 5:30 p.m.  
San Antonio 4, 5 & 6

Session Chair: **John M. Guasto**, The Boeing Company

Paper #1 - 1:30 p.m. - 2:00 p.m.  
*Supplier Teardown Analysis and Reporting System*  
G. Stathis, Sikorsky Aircraft Corp.

Paper #2 - 2:00 p.m. - 2:30 p.m.  
*Architecture for Dynamic Component Life Tracking in Advanced HUMS, RFID, and Direct Load Sensor Environment*  
N. Iyyer, S. Bradfield, S. Sarkar, C. McColl, D. Algera, TDA Inc.; N. Phan, E. Flores, U.S. Naval Air Systems Command

Paper #3 - 2:30 p.m. - 3:00 p.m.  
*Enhanced Erosion Protection for Rotor Blades*  
W. Thomas, Bell Helicopter Textron, Inc.; S. Hong, Hontek Corporation; C. J. Yu, E. Rosenzweig, Naval Air Systems Command

Paper #4 - 3:00 p.m. - 3:30 p.m.  
*Structural Damage Detection in a Sandwich Honeycomb Composite Rotor Blade Material Using Three-Dimensional Laser Velocity Measurements*  
S. Underwood, D. Koester, D. Adams, B. Zwink, M. Plumlee, Purdue University

### Structures & Materials III

1:30 p.m. - 3:30 p.m.  
Grapevine 5 & 6

Session Chair: **Dr. Mark Gurvich**, UTRC

Paper #1 - 1:30 p.m. - 2:00 p.m.  
*Searching for the Usage Monitor Reliability Factor Using an Advanced Fatigue Reliability Assessment Model*  
D. Adams, J. Zhao, Sikorsky Aircraft Corp.

Paper #2 - 2:00 p.m. - 2:30 p.m.  
*Strain-Based Fatigue for High Strength Aluminum Alloys*  
N. Dowling, A. Arcari, C. Calhoun, Virginia Tech

Paper #3 - 2:30 p.m. - 3:00 p.m.  
*Uncertainty Quantification Methods for Helicopter Fatigue Reliability Analysis*  
J. McFarland, D. Riha, Southwest Research Institute

Paper #4 - 3:00 p.m. - 3:30 p.m.  
*Effects of Uncertainty on Hub Vibration Response of Composite Helicopter Rotor Blade*  
Y. Yu, P. Pawar, S. Jung, Konkuk University

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**Refreshments**  
**3:30 p.m. - 4:00 p.m.**

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**Refreshments**  
**3:30 p.m. - 4:00 p.m.**

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**Refreshments**  
**3:30 p.m. - 4:00 p.m.**

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Paper #5 - 4:00 p.m. - 4:30 p.m.  
*A Systems Approach to the Design & Development of a Helicopter Fleet Management System - Phase 1 and 2*  
A. Sinha, A. Schauenburg, RMIT University

Paper #6 - 4:30 p.m. - 5:00 p.m.  
*CBM Component Testing at the University of South Carolina: AH-64 Tail Rotor Gearbox Grease Flow Studies*  
N. Goodman, A. Bayoumi, V. Blechertas, Y. J. Shin, R. Shah, University of South Carolina

Paper #7 - 5:00 p.m. - 5:30 p.m.  
*US Marines MV-22 R&M*  
LT Col Skinner, NAVAIR

**Plan now to attend**



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