

*The Annual Reliability
and Maintainability Symposium* **RAMS**®

www.rams.org

OUR 56th YEAR



Banquet

*January 27, 2010
Doubletree Hotel San Jose
San Jose, CA USA*

Menu

★ ★ ★ ★

TOMATO & CHEESE NAPOLEON SALAD
Fresh Mozzarella & Plum Tomato
Served with Balsamic Mustard Dressing

★ ★ ★ ★

CHOICE OF DINNER ENTRÉE

DUET MAIN COURSE

CITRUS MARINATED PETITE CHICKEN BREAST
&

GRILLED BEEF FILET
Seasonal Vegetables &
Butternut Flavored Mashed Potatoes

(or)

VEGETARIAN OPTION

TERRINE OF GRILLED VEGETABLES
Served with Truffle Risotto and Basil Pesto Oil
Seasonal Vegetables

Warm Dinner Rolls & Butter

★ ★ ★ ★

DESSERT

MOCHA MOUSSE TOWER
Served with Chocolate Sauce Berries

★ ★ ★ ★

Freshly Brewed Coffee, Decaffeinated Coffee
& Selection of Herbal Teas

Banquet Program

National Anthem

Welcoming Remarks

Dinner

Introductions

Dr. John Healy

General Chair

2010 Reliability and Maintainability Symposium

Presentation of Awards

Society Awards

Student Paper Awards

Alan O. Plait Award

Ralph A. Evans/P.K. McElroy Award

Speaker

Ken Bowersox

Vice President

Astronaut Safety and Mission Assurance Department

Space Exploration Technologies (SpaceX)

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financial support of our Corporate Patrons***

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Banquet Speaker

Ken Bowersox

Vice President

Astronaut Safety and Mission Assurance Department

Space Exploration Technologies (SpaceX)



Bowersox is a retired US Naval Aviator, with over 19 years of experience at the National Aeronautics and Space Administration (NASA). Selected to the astronaut corps in 1987, he has flown five times on NASA's Space Shuttle, serving as pilot, commander and mission specialist, and once on a Russian Soyuz, where he served as the flight engineer during descent. During his five orbital missions, Bowersox has logged over 211 days in space, including five and a half months aboard the International Space Station (ISS), where he was the mission commander of the 6th expedition. He was also a crew member for the first two Hubble Space Telescope repair flights and two United States Microgravity Laboratory flights.

Subsequent to his mission aboard the ISS, Bowersox served as the director of the Johnson Space Center's Flight Crew Operations Directorate, where he was responsible for the NASA Astronaut Office and all aircraft operations at the Johnson Space Center. Prior to joining SpaceX, Bowersox worked as an independent aerospace consultant, serving on the NASA standing review boards for Space Shuttle, ISS, Constellation, Orion and the Constellation Suit System.

About SpaceX

SpaceX is revolutionizing access to space with a family of launch vehicles and spacecraft designed to increase the reliability and reduce the cost of both manned and unmanned space transportation, ultimately by a factor of ten. As a winner of the NASA Commercial Orbital Transportation Services competition (COTS), SpaceX will conduct three flights of its Falcon 9 launch vehicle and Dragon spacecraft, culminating in Dragon berthing with the ISS. In addition, NASA recently selected the SpaceX Falcon 9 launch vehicle and Dragon spacecraft for the ISS Cargo Resupply Services (CRS) contract award. The contract includes 12 flights between 2010 and 2015 and represents a guaranteed minimum of 20,000 kg to be carried to the ISS.

Founded in 2002, the SpaceX team now numbers more than 700 full time employees, primarily located in Hawthorne, California, with additional locations in Texas, at SpaceX's Test Facility in McGregor near Waco; offices in Washington DC; and launch facilities at Cape Canaveral, Florida, and the Marshall Islands in the Central Pacific.

On the Speakers' Platform

Richard B. Jones, *Chairperson, RAMS Board of Directors, HSB Solomon Associates*
Richard Cassady, *2010 RAMS Vice General Chair, University of Arkansas*
Ed Pohl, *Program/Tutorial Committee Chair, University of Arkansas*
John Healy, *2010 RAMS General Chair, Federal Communications Commission*
Ken Bowersox, *Banquet Speaker, SpaceX*
Lisa Maillart, Ph.D., *University of Pittsburgh, Alan O. Plaigt Award Winner*
J. Brian Hall, Ph.D., *U.S. Army Evaluation Center, Ralph A. Evans/P.K. McElroy Winner*
Ali Mosleh, Ph.D., *University of Maryland, Ralph A. Evans/P.K. McElroy Winner*

At the Round Tables **Management Committee**

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1954	Leon Bass	1980	Mac Smith
1956	Walter Greer	1981	Kurt Green
1957	Max Tall	1982	Howard Kennedy
1958	Max Tall	1983	Tom Fagan
1959	Irv Schoeninger	1984	Ken Ravizza
1960	Cliff Ryerson	1985	Hal Jones
1961	W. T. (Bill) Sumerlin	1986	Norm Kutner
1962	Marion Smith	1987	Jim Sindt
	Dick Flygare	1988	Ralph Dudley
1963	Ralph Kuehn	1989	Herm Rue
	John Coutinho	1990	Tony Coppola
1964	Ed Jahr	1991	Ed Anderson
	John Coutinho	1992	Rich Sackett
1965	W. M. (Bill) Rombach	1993	Irwin Feigenbaum
	John Coutinho	1994	Bob Loomis
1966	Landis Gephart	1995	Jackie Wollner
	Stan Rosenthal	1996	Larry Phaller
1967	Stan Zwerling	1997	Naomi McAfee
	Charlie Russell	1998	Bob Schueppert
1968	Harry Reese	1999	Henry Hartt
	Les Ball	2000	Charlie Plotkin
1969	Don Hulme	2001	Way Kuo
	F. A. (Tommy) Thompson	2002	Woody Rabon
1970	Val Monshaw	2003	John English
	Lionel Levy	2004	Norman Butler
1971	John Condon	2005	Alfred Stevens
	John Losee	2006	Ron Adib
1972	Ridge Park	2007	Vernon W. Wessel
1973	J. W. (Bill) Thomas	2008	Dawn E. Onalfo
1974	John Simm	2009	Richard B. Jones
1975	Lee Webster		Honorary Richard Hahn
1976	Carl Bird		Honorary Alan Plait
1977	Jack Weisen		Honorary Ralph Evans
1978	Dave Barber		Honorary William Robertson
1979	Herm Wuerffel		Honorary Marvin Pinard

In 1972, the Annual Reliability and Maintainability Symposium became the title of the organization formed as a result of the merger of the Annual Reliability Symposium and the Reliability and Maintainability Conference.

Alan O. Plait Award for 2009 Tutorial Excellence
Best Tutorial (2007 - 2009)

Introduction to Markov-Chain Modeling, Analysis and Optimization
Dr. Lisa Maillart *University of Pittsburgh*



Dr. Lisa Maillart is an Assistant Professor in the Industrial Engineering Department at the University of Pittsburgh. Prior to joining the faculty at Pitt, she served on the faculty of the Department of Operations in the Weatherhead School of Management at Case Western Reserve University. She received her M.S. and B.S. in industrial and systems engineering from Virginia Tech, and her Ph.D. in industrial and operations engineering from the University of Michigan. Her primary research interest is in sequential decision making under uncertainty, with applications in medical decision making and maintenance optimization. She is a member of INFORMS, SMDM and IIE.

*Ralph A. Evans/P.K. McElroy Award
for 2009 Best Paper*

Bayesian Methods for Evaluating Discrete Reliability Growth
J. Brian Hall, *U.S. Army Evaluation Center*, and **Ali Mosleh**, *University of Maryland*

Bayesian estimation procedures are derived herein that may be utilized to evaluate reliability growth of discrete-use systems, such as guns, rockets, missile systems, torpedoes, etc. One advantage of these Bayesian procedures is that they directly quantify the epistemic uncertainties in model parameters, i.e., the shape parameters of the beta distribution, as well as several reliability growth metrics of basic interest to program management. These metrics include: (1) the initial system reliability; (2) the projected reliability following failure mode mitigation; (3) reliability growth potential, i.e., the theoretical upper-limit on reliability achieved by finding and fixing all failure modes via a specified level of effectiveness; (4) the expected number of failure modes observed during testing; (5) the probability of observing a new failure mode and; (6) the fractional contribution of correctable failure modes to the initial probability of failure. These metrics and associated model equations give reliability practitioners the means to: (1) assess reliability achievement of discrete-use systems undergoing development; (2) address model goodness-of-fit concerns and; (3) quantify programmatic risk, and system maturity.

Analytical results are presented to obtain Bayes' estimates of the beta shape parameters under a delayed corrective action strategy, i.e., when corrective actions are installed on system prototypes at the end of the current test phase. A Monte Carlo simulation approach is utilized for constructing Bayesian epistemic uncertainty distributions on each of the aforementioned reliability growth management metrics. These methods are illustrated by a simple numerical example. In particular, Bayes' estimates of the beta shape parameters are obtained from a small dataset and compared against the true parameter values. These estimates are then used to stochastically generate failure histories whereby uncertainty distributions are constructed for each metric. This methodology is useful to program managers and reliability practitioners who wish to quantitatively assess the reliability maturity of discrete-use systems developed under a delayed corrective action strategy. Without loss of generality, a similar approach may be utilized under an arbitrary corrective action strategy.



J. Brian Hall, Ph. D. is the Division Chief for Aviation, Missiles, and C3I in the Reliability and Maintainability Directorate of the U.S. Army Evaluation Center; Aberdeen Proving Ground, Maryland. He is responsible for overseeing independent reliability evaluations of all U.S. Army systems in these commodity areas. He has worked for the Department of the Army for over 10 years in the area of Test and Evaluation.

Dr. Hall earned a BS in Mathematics from Loyola College; Baltimore, Maryland, and a MS in Mathematics from the Whiting School at The Johns Hopkins University; Baltimore, Maryland. He earned his PhD and 2nd MS degrees in Engineering Reliability at the University of Maryland. Dr. Hall is a graduate of the U.S. Army Logistics Management College; Fort Lee, VA, as well as the U.S. Army Management Staff College; Fort Belvoir, VA. He is a certified member of the Defense Acquisition Corps. He is currently Vice President of the Chesapeake Chapter of the American Statistical Association, and a member of the Phi Kappa Phi, Tau Beta Pi, and Magna Cum Laude National Scholars Honor Societies.



Ali Mosleh, Ph. D., is the Nicole J. Kim Professor of Engineering, Director of the Reliability Engineering Program, and Director of the Center for Risk and Reliability at the University of Maryland. He also serves on several national and international advisory committees including the U.S. Nuclear Waste Technical Review Board to which he was appointed by President George W. Bush in 2004. Dr. Mosleh is a Fellow of the Society for Risk Analysis (SRA), recipient of several scientific achievement awards, and a consultant to many national and international organizations.

Professor Mosleh holds several patents, and has published over 300 technical papers, edited volumes, and guidebooks. Dr. Mosleh received his PhD in Nuclear Science and Engineering from the University of California, Los Angeles in 1981.

Alan O. Plait Award for 2009 Tutorial Excellence

Description and Selection Process

This award is named for Alan O. Plait who instituted and took charge of the Tutorials program in 1975 and then guided and encouraged its growth for 18 years. The award honors outstanding contributors to the Tutorials. There are two kinds of awards:

Continued Excellence (for over 5 years)

Best Tutorial (for the previous few years)

All tutorials are rated by attendees and the Tutorial Coordinators according to the 4 criteria:

- Presentation content
- Speaker elocution
- Visual materials
- Printed text.

The number of years a tutorial has been presented is an additional criterion for the *Continued Excellence* award. The *Symposium* may present one or both in any year, and each is accompanied by an honorarium.

Previous Recipients

2008 - David W. Coit, "Probabilistic Methods and Statistical Models in Reliability"	2005-2008
2007 - Carl S. Carlson, "Lessons Learned For Effective FMEAs"	2006-2007
2006 - Dr. Richard B. Jones, "Risk Management Principles and Techniques"	2005-2008
2005 - Pantelis Vassiliou, Adamantios Mettas, "Understanding Accelerated Life Testing Analysis"	2001-2005
2004 - Joseph R. Fragola, "Human Reliability Analysis"	2002,2004
2003 - Richard Cassady, Ed Pohl, "Introduction to Repairable-Systems Modeling"	2002-2004
2002 - Joanne Dugan, "Fault Tree Analysis of Computer Based Systems"	1999,2001
2001- Caroline Smith, "Statistical Analysis of Reliability, Maintainability & Supportability Data"	1998-2000
2000 - John D. Healy, Aridaman K. Jain, Jay M. Bennett, "Reliability Prediction"	1995-1999
2000 - James A. Hough, "Improved Commercial Reliability Program Planning"	1995-1999
1999 - Mladen A. Vouk, "Introduction to Software Reliability Engineering"	1998
1998 - John B. Bowles, "Failure Modes, Effects, and Criticality Analysis"	1993-1997
1998 - Edward A. Pohl, E.F. Mykytka, "Simulation Modeling for Reliability Analysis"	1996-1997
1997 - Reliability Analysis Lab, Westinghouse Defense & Electronics Systems Ctr. "Understanding Electronic-Part Failure Mechanisms"	1988-1996
1996 - Ralph A. Evans, "Practical Reliability Engineering & Management"	1988-1995
1995 - A. (Gus) Constantinides, "Basic Reliability"	1982-1994
1995 - L.M. Leemis, "Probabilistic Models and Statistical Methods in Reliability"	1990-1994

Ralph A. Evans/P.K. McElroy Award for 2009 Best Paper

Selection Process

Before the *Symposium*, the Program Committee rates every written paper for technical excellence and clarity of exposition. The five best papers are selected. A Committee of Past General Chairperson's of the *Symposium* attends the presentation of each of the five papers at the *Symposium*. The committee then selects the best paper on the basis of two criteria:

- The written paper is lucid, excellent and important to the theory and/or practice of R&M Engineering
- The presentation of the paper at the *Symposium* is likewise lucid and excellent.

Evolution of the Award

Almost from the first *Symposium* in 1954, awards have been presented for the best papers at each *Symposium*. Up until 1974, the best presented paper was selected in large part by the attendees and the best written paper was selected by the Program Committee. In 1974, the award for the best written paper was retitled to honor the memory of P. K. McElroy who had died a few months before the *Symposium*. In 1984, the two awards, one for the best presented paper and one for the best written paper, were combined to become the **P. K. McElroy Award** for the *Best Paper* — or less formally and more simply, the **P. K. Award**. This **P. K. Award** was conferred for the first time at the 1985 *Symposium* in Philadelphia. The *Symposium* best paper award now also acknowledges the excellence of Ralph A. Evans and is titled the **Ralph A. Evans/P.K. McElroy Award**. The *Plaque* for the **Ralph A. Evans/P. K. Award** is accompanied by an *Honorarium* of \$1500.

Previous Recipients *

2009-	“A Practical Method for Failure Analysis Using Incomplete Warranty Data” Karen Mohan, Brad Cline, Jennifer Akers, Relax Software Corp.	[2008, CD]
2008-	“Structural Reliability Methods For Improved Designs Against Fatigue” Clifford H. Lange, PhD, PE, Novellus System Inc., Ayako Flint, Novellus System Inc.	[2007, CD]
2007-	“Reliability & Crew Safety Assessment for a Solid Rocket Booster/J-2S Launcher” Joseph Fragola, J.D. Baum, Don Sauvageau, Scott Horowitz	[2006, CD]
2006-	“Simple Plots for Monitoring the Field Reliability of Repairable Systems”, David Trindade, Swami Nathan, Sun Microsystems	[2005, CD]
2005-	“Reliability Testing for Customer Satisfaction Attributes” Charles W. Plotkin, Ford Motor Company, Kee S. Moon, Michigan Technological University	[2004, pp 280-286]
2004-	“Reliability Prediction of Substitute Parts Based on Component Temperature Rating and Limited Accelerated Test Data” Andre V. Kleyner, Joseph P. Boyle (Delphi Delco Electronics, Kokomo)	[2003, pp 518-522]
2003-	“FMEA of Marine Systems: Moving from Prescriptive to Risk-based Design and Classification” John Farquharson, Joel McDuffie, A. K. Seah, Takeshi Matsumoto	[2002, pp 165-172]
2002-	“Model Based Reliability Analysis” Rene L. Bierbaum, Thomas D. Brown, Thomas J. Kerschen (Sandia National Labs.)	[2001, pp 326-332]
2001-	“System Reliability Prediction, Prioritization Strategy” David W. Coit (Rutgers University)	[2000, pp 175-180]
2001-	“Technology Replacement and Changing Repair Costs” Jason W. Rupe (US WEST Advanced Technologies)	[2000, pp 269-275]
2000-	“Assessment of a Safety-Critical System Including Software: A Bayesian Belief Network for Evidence Sources” Marc Bouissou (EDF, R&D Division/ESF, Clamart), Fabrice Martin (EDF, R&D Division/PEL, Clamart), Alain Ourghanlian (EDF, R&D vision/CCC, Chatou)	[1999, pp 142-150]
1999 -	“Functional Build: Integrating Automotive Body-Design & Process-Development” Patrick C. Hammett (University of Michigan) Karl Majeske, Jay S. Baron (University of Michigan)	[1998, pp 321-327]
1998 -	None given for [1997]	
1997 -	“Fault-Tree Models for the Analysis of Complex Computer-Based Systems” Laura L. Pullman (Quality Research Assoc. Inc.) Joanne Bechta Dugan (University of Virginia)	[1996, pp 200-207]
1996 -	“Dependent-Failures in Spacecraft: Root Causes, Coupling Factors, Defenses, and Design Implications” Peter J. Rutledge (University of Maryland, College Park) Ali Mosleh (University of Maryland, College Park)	[1995, pp 337-342]
1995 -	“HACCP: A Total Quality System for Assuring Food Safety & Quality” John K. McAnelly (University of Wisconsin, Madison)	[1994, pp 31-36]
1994 -	“Designing for Success: Reliability Technology in the Concurrent-Engineering Era” Joseph R. Fragola (Science Applications International Corporation)	[1993, pp 77-89]
1993 -	“Using Causal Reasoning for Automated Failure Modes & Effects Analysis (FMEA)” Daniel Bell (Martin Marietta) · Lisa Cox (Martin Marietta) Steve Jackson (Martin Marietta) · Phil Schaefer (Martin Marietta)	[1992, pp 343-353]
1992 -	“High-Reliability Fault-Tolerant 16 MBit Memory Chip” Charles H. Stapper (IBM Corporation) John A. Fifield (IBM Corporation) · Howard L. Miller (IBM Corporation)	[1991, pp 48-56]
1991 -	“Microelectronics Reliability Predictions Derived from Component-Defect Densities” John L. Stevenson (INTELSAT), Joel A. Nachlas (Virginia Tech)	[1990, pp 366-371]

* The year that the **Ralph A. Evans/P.K. Award** is conferred is in the left column. The bibliographic citation is in brackets [year, pages] in the right column. The *Best Paper* is judged according to two criteria:

- The written paper is lucid, excellent, and important to the theory or practice of R&M engineering.
- The presentation of the paper at the *Symposium* is likewise lucid and excellent.

For more information on the **Ralph A. Evans/P.K. Award**, see the front pages of a recent *Proceedings*.

Sponsoring Society Awards

Institute of Industrial Engineers (IIE) 2009 *William A.J. Golomski Award* was presented to **Amari Suprasad** and **Hoang Pham** for their paper entitled “Reliability Analysis of Dynamic Fiber Bundle Models.” The Golomski Award recognizes the outstanding RAMS paper authored or co-authored by a member of IIE.

Recipient of the American Society for Quality Electronics & Communications Division *Ralph A. Evans Award for Long Term Service* is **Charles W. Plotkin**.

The Society of Reliability Engineers is pleased to recognize **Dr. C. Richard Cassady**, **Dr. Joel A. Nachlas** and **Dr. Robert J. Loomis** as *Fellows of the SRE*.

IEEE Reliability Society Lifetime Achievement Award

Harry Shafft-for contributions to the development and refinement of measurements, methods, and standards critical to the reliability assessment of semiconductor devices, as well as long career-association with NIST.

IEEE Reliability Society Engineer of the Year

Prof Hoang Pham-for accomplishments in analytical techniques for modeling the reliability of software and systems.

Nat Ozarin-for accomplishments in innovative and practical techniques and tools for reliability engineering and contributions to reliability community education.

IEEE Fellow Elevations-2011

Dimitrois Ioannou-for contributions to reliability and characterization of silicon-on-insulator devices and materials.

Jeffrey Voas- for leadership in the development of trustworthy software, including improved metrics and process optimization.

Dates and Places for Future Annual Reliability & Maintainability Symposia

2011	Disney Contemporary Resort Lake Buena Vista, Florida USA
2012	John Ascuaga’s Nugget Reno, Nevada USA
2013	Shingle Creek Resort & Golf Club Orlando, Florida USA
2014	Broadmoor Hotel & Resort Colorado Springs, Colorado USA