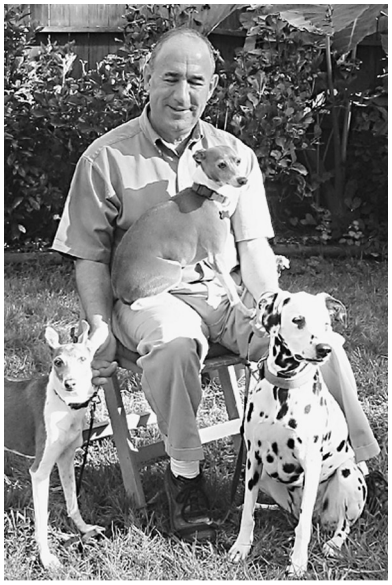
JOURNAL OF SPACECRAFT AND ROCKETS
Vol. 44, No. 1, January–February 2007

The End is Near

AS Editor-in-Chief, I would like to acknowledge all of the important contributors to this journal and thank them. These contributors are the authors, reviewers, Associate Editors, and AIAA editorial staff who have been associated with the Journal of Spacecraft and Rockets (JSR). The JSR has a diverse scope with application-oriented articles, and I hope that the technical community continues to find the papers of interest. I need to thank the authors who have chosen the JSR as the means to disseminate their research to the technical aerospace community. I hope that they felt that the peer review process was professional and constructive. The peer review process and the high quality of the AIAA journals would not exist without the reviewers who voluntarily give of their time and provide in-depth reviews. Although it is only a small token of appreciation, their names are listed in this issue. I hope that we have successfully included all of them. I do, however, thank all who gave their time. The Associate Editors provide the cornerstone of this peer review process. They have the responsibility for the technical evaluation of the proposed papers and for maintaining the high quality in the published version. For anyone who has had the responsibility of an Associate Editor position, a simple "thank you" probably seems insufficient. It is very difficult trying to balance your real job with one in which you offer your services to your profession with no question as to "what am I getting out of it?" This year John Korte, David Edwards, Stan Bouslog, Paul Weinacht, Peter Huseman, and Irwin Vas decided, even with all the fun they were having, to pursue other life experiences. Their dedication and professionalism is greatly appreciated. During the past several months, the JSR has had the good fortune to obtain the assistance of Dinesh Prabhu, Belinda Marchand and Kathryn Wurster to serve as AEs. Starting in January, we will be joined by Mark Costello, Olivier de Weck, and Joseph Minow. The biographies of the AEs are included in this issue. I want to thank Ms. Norma Brennan for her terrific help and just being a friend. Her ongoing assistance is invaluable. Also, I need to thank Ms. Amanda Maguire, whose help is always greatly appreciated.

E. Vincent Zoby
Editor-in-Chief



E. VINCENT ZOBY is employed by NASA and has been at Langley Research Center since 1962. He received a B.S.M.E. from Virginia Polytechnic Institute and State University and an M.S. in Thermal Engineering from Old Dominion University. Mr. Zoby has been responsible for developing and demonstrating the applicability of approximate codes that define the aeroheating environment about spacecraft at both Earth and planetary entry conditions. This work encompassed preliminary design and/or post flight heating calculations for the RAM C, Re-Entry F, and Space Shuttle, as well as the Pioneer Venus and Galileo probes. (Typically, a comment is usually made at this point about the dogs in the photo. There is Murphy, the Dalmatian, and Enzo and Banks, the two Italian Greyhounds. Sadly, Banks, the larger Greyhound, is no longer with us.) Vince has over 90 publications in the area of hypersonic aerothermodynamics to his credit, including studies for computing the equilibrium high-temperature properties of gas mixtures and surface catalytic effects, His recent assignments included the LaRC Technical team Aerothermodynamic lead for the X-37 vehicle; peer evaluator for the HYPERX-X43A return to flight studies and a member of the NASA Engineering and Safety Center Aerothermodynamics panel for the Return To Flight investigation. He is presently the lead for several Air Force Research Lab programs and is the LaRC Aerothermal Technical Manager for the CEV program. He is a Fellow of the American Institute of Aeronautics and Astronautics. He is also the Editor of the AIAA Journal of Spacecraft and Rockets.

Associate Editors

GREGORY S. AGNES is the Group Lead for Precision Deployable Structures at the Jet Propulsion Laboratory (JPL). Before coming to JPL, he served 11 years in the U.S. Air Force, achieving the rank of Major. He conducted research at the Air Force Research Laboratory and taught at the Air Force Institute of Technology. He received his B.S. in Aeronautical Engineering from Rensselaer, his M.S. in Aerospace Engineering from the University of Maryland, and his Ph.D. in Engineering Mechanics from Virginia Polytechnic Institute and State University. His research interests include vibrations, precision structures, nonlinear dynamics, and adaptive structures. When not in the laboratory, he can usually be found in the company of his wife and three children on the soccer fields of the Santa Clarita Valley. Dr. Agnes is an Associate Fellow of the AIAA and serves on the Adaptive Structures TC.

IAIN D. BOYD received a B.S. in Mathematics (1985) and a Ph.D. in Aeronautics and Astronautics (1988) from the University of Southampton in England. He worked for four years as a contractor at NASA Ames Research Center in the area of rarefied gas dynamics. Dr. Boyd was a faculty member in Mechanical and Aerospace Engineering at Cornell University for six years and recently joined the Department of Aerospace Engineering at the University of Michigan. His research interests involve development of physical models and numerical algorithms using particle methods with applications to a variety of nonequilibrium gas and plasma dynamic systems. He has authored over 60 journal papers. He is the recipient of the 1998 AIAA Lawrence Sperry Award and the 1997 AIAA Electric Propulsion Best Paper Award

MARK COSTELLO earned the B.S. degree in Aerospace Engineering from the Pennsylvania State University in 1987, and the M.S. and Ph.D. degrees in Aerospace Engineering from the Georgia Institute of Technology in 1989 and 1992, respectively. He is currently the Sikorsky Associate Professor within the School of Aerospace Engineering at Georgia Tech. Prior to his appointment at Georgia Tech, Mark served eight years on the faculty of the Department of Mechanical Engineering at Oregon State University and four years on the faculty of the United States Military Academy at West Point within the Department of Civil and Mechanical Engineering. He also worked as a research engineer in the Helicopter Division of the Boeing Company and at the Georgia Tech Research Institute. His research group is focused on the development of innovative flight mechanics and controls technologies for a variety of flight vehicles, including projectiles, rockets, micro air vehicles, and rotorcraft.

RUSSELL M. CUMMINGS graduated from California Polytechnic State University with a B.S. and M.S. in Aeronautical Engineering in 1977 and 1985, respectively, before receiving his Ph.D. in Aerospace Engineering from the University of Southern California in 1988. He was recently named Professor of Aeronautics at the U.S. Air Force Academy. Prior to that he was Professor of Aerospace Engineering at Cal Poly from 1986 through 2004, where he served as department chair for four years. He worked for Hughes Aircraft Company in the Missile Systems Group as a missile aerodynamicist from 1979 through 1986. He completed a National Research Council postdoctoral research fellowship at NASA Ames Research Center in 1990, working on the computation of high-angle-of-attack flowfields in the Applied Computational Fluids Branch. He was named an AIAA Associate Fellow in 1990, received the AIAA National Faculty Advisor Award in 1995, and is the past chairman of the AIAA Student Activities Committee. In addition, he has been awarded the Northrop Grumman Excellence in Teaching and Applied Research, TRW Excellence in Teaching, and Litton Excellence in Research and Development awards. He received a B.A. in music from Cal Poly in 1999.

OLIVIER DE WECK holds Master's degrees in industrial engineering from ETH Zurich (1993), and in aerospace systems engineering from MIT (S.M.1999, Ph.D. 2001). Before joining MIT he was a liaison engineer and later engineering program manager on the F/A-18 aircraft project at McDonnell Douglas (1993-1997) in St. Louis. Prof. de Weck is currently an Associate Professor at MIT with dual appointments in the Engineering Systems Division and the Department of Aeronautics & Astronautics. Prof. de Weck is an Associate Fellow of AIAA, member of INCOSE, INFORMS, IEEE, ASEE, and Sigma Xi. He was the General Chair for the 2nd AIAA Multidisciplinary Design Optimization Specialist Conference in May 2006. He won two best paper awards at the 2004 Systems Engineering Conference of the International Council on Systems Engineering (INCOSE), and the 2006 Frank E. Perkins Award for Excellence in Graduate Student Advising. He serves as a Review Editor for the journal *Structural and Multidisciplinary Optimization* and as an Associate Editor for the *Journal of Spacecraft and Rockets.* His research has been funded by NASA, BP, JPL, ArvinMeritor, DARPA/AFRL, GM and the Alfred P. Sloan Foundation.

NIKOLAOS A. GATSONIS received his undergraduate degree in Physics at the Aristotelian University of Thessaloniki, Greece (1983), an M.S. in Atmospheric Science at the University of Michigan (1996), and an M.S. (1987) and a Ph.D. (1991) in the Aeronautics and Astronautics Department of the Massachusetts Institute of Technology. From 1991 to 1993 he was a Postdoctoral Fellow at the Space Department of the Johns Hopkins University, Applied Physics Laboratory, where he worked on various aspects of spacecraft–space environment interactions in support of space experiments and missions. In 1994 he joined the Mechanical Engineering faculty at Worcester Polytechnic Institute, where he is currently an Associate Professor and Director of the Aerospace Program. His research areas include spacecraft–space environment interactions, spacecraft propulsion and micropropulsion, gasdynamics, and plasmadynamics. He has been pursuing his research interests with modeling, simulations, experiments, and participation in space experiments. A significant component of his research involves the development of fluid, particle, and hybrid numerical simulation methods for nonequilibrium, multicomponent, multiscale, gaseous, and plasma flows. He has authored or coauthored over sixty journal and conference proceedings papers. He is a member of the AIAA Electric Propulsion Technical Committee and served on the AIAA Space Science Technical Committee (1992–1996).

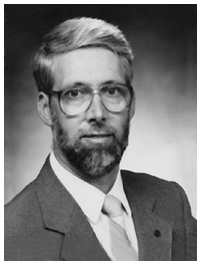
ANDREW D. KETSDEVER is currently a Group Leader and Senior Research Engineer at the U.S. Air Force Research Laboratory's (AFRL) Propulsion Directorate at Edwards Air Force Base, California. He has worked in the areas of nonequilibrium flows, rarefied gas dynamics, microfluidics, spacecraft-thruster interactions, and microspacecraft propulsion since starting at AFRL in 1992. Dr. Ketsdever received a Ph.D. in Aerospace Engineering from the University of Southern California (USC) in 1995, where he is currently a Research Professor in the Department of Aerospace and Mechanical Engineering. He regularly teaches graduate and undergraduate courses in rarefied gas dynamics, planetary atmospheres, microspacecraft design, and spacecraft--environment interactions and is the Director of the USC Student Microsatellite Program. He has been a member of the AIAA Thermophysics Technical Committee, has been involved with the AIAA Fluid Dynamics Technical Committee's Working Group in Microfluidics, has authored or coauthored over 50 technical papers, and has coedited an AIAA Progress in Astronautics and Aeronautics series book entitled *Micropropulsion for Small Spacecraft*.

ROGER L. KIMMEL is a Senior Research Engineer at the Air Vehicles Directorate of the Air Force Research Laboratory at Wright--Patterson Air Force Base in Dayton, Ohio. He received his B.S. in Mechanical Engineering from the Pennsylvania State University in 1982 and his Ph.D. in Mechanical and Aerospace Engineering from Princeton University in 1987. From 1986 to 1989 Dr. Kimmel served as a staff engineer for the Hughes Aircraft Company, Missile Systems Group, in Canoga Park, California. From 1989 to 1990 he served as a research engineer for Microcraft, Inc., at Wright--Patterson Air Force Base, and he has served there as an employee of the Air Force Research Laboratory since 1990. He is an Associate Fellow of AIAA and served on the Fluid Dynamics Technical Committee from 1998 to 2003. He is also a member of the American Society of Mechanical Engineers. His research has included shock--boundary-layer interactions, missile aerodynamics, transition and stability of hypersonic boundary layers, and plasma flow control. He was a member of the former U.S. Transition Study Group and is a current member of the AIAA Transition Study Group. Dr. Kimmel has authored or coauthored more than 60 technical papers.

CRAIG A. KLUEVER received his B.S. in aerospace engineering from Iowa State University in 1986. He worked at Rockwell International from 1986 to 1989 in the Space Shuttle Guidance, Navigation, and Control Group. He returned to Iowa State and completed his M.S. and Ph.D. degrees in aerospace engineering in 1990 and 1993, respectively. Since 1993, he has been with the University of Missouri--Columbia and is currently an Associate Professor in the Mechanical and Aerospace Engineering Department. His research interests include mission design and analysis, trajectory optimization, guidance and control of aerospace vehicles, reentry flight mechanics, and orbital mechanics. He is an Associate Fellow of AIAA and has served on its Astrodynamics Technical Committee and is currently a member of the AIAA Atmospheric Flight Mechanics Technical Committee.

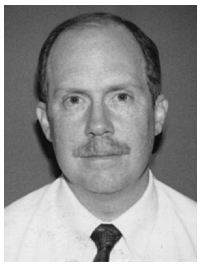
TONY C. LIN received his B.S. degree (1964) from National Taiwan University in Civil Engineering and his Ph.D. degree (1969) from Polytechnic Institute of Brooklyn in Aerospace Engineering. Over the years, he has worked at NASA Marshall Space Flight Center, Avco, and The Aerospace Corp. Since 1979, he has been with TRW/SSD and is currently a Department Manager. His primary fields of interest are aerothermodynamics, flight mechanics, computational fluid dynamics, and electromagnetic wave propagation

BELINDA MARCHAND specializes in the application of dynamical systems theory, optimization, and nonlinear control methods. Her undergraduate and graduate degrees were bestowed at Purdue University, by the School of Aeronautics and Astronautics. She obtained a B.S.A.A.E. in 1997, a M.S.A.A. in 2000, and completed her Ph.D. dissertation on August 2004, under the guidance of Professor Kathleen Howell. Dr. Marchand is currently an Assistant Professor at the University of Texas at Austin, in the Department of Aerospace Engineering and Engineering Mechanics. Her research activities have encompassed many subjects, including the application of a dynamical systems approach to the study of solar system transport dynamics and the generalized n-body problem, spacecraft mission design, formation flight dynamics and control, optimal control in dynamically uncertain systems, and sub-systems modeling in support of the robotic lunar exploration program. In the past, Dr. Marchand has collaborated with the Jet Propulsion Laboratory and Goddard Space Flight Center and provided analyses in support of missions like Genesis, and formation flight concepts such as MAXIM, Stellar Imager, and Constellation X. Additional professional affiliations include The Boeing Company and, more recently, The Applied Physics Laboratory.



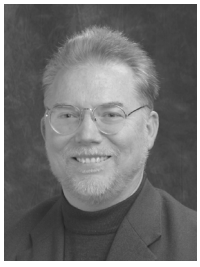
JAMES A. MARTIN holds a B.S. degree from West Virginia University, M.S. and Engineer degrees from the Massachusetts Institute of Technology, and a D.Sc. Degree from George Washington University. He has worked at the NASA Langley Research Center, the University of Alabama, and Boeing. His work has mostly involved the design and evaluation of reusable launch vehicles and space transfer concepts. Several of his papers deal with tripropellant rocket propulsion options. He was leader of the Orbit-on-Demand Study at NASA. Some recent work has been on the NASA and Boeing Solar Power Satellite Program, crew escape for the Shuttle, and the use of tethers for launch and orbit transfer.

CRAIG A. MCLAUGHLIN is an Assistant Professor in the Space Studies Department at the University of North Dakota. His research interests are in spacecraft engineering, particularly in astrodynamics. He currently focuses his research on orbit determination and prediction, upper atmospheric density, and spacecraft formation flying. In addition, he is actively involved in the American Astronautical Society's Space Flight Mechanics Committee and the AIAA's Astrodynamics Technical Committee. Dr. McLaughlin came to UND from the Space Vehicles Directorate of the U. S. Air Force Research Laboratory. There he served as principal investigator for formation flying for the TechSat 21 mission and as team lead for the Guidance, Navigation, and Control Team. Dr. McLaughlin received his M. S. and Ph. D. in Aerospace Engineering Sciences at the University of Colorado, and a B. S. in Aeronautical Engineering from Wichita State University.

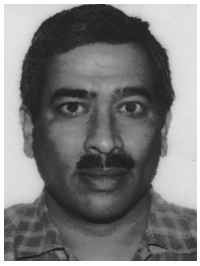


MARK S. MILLER received his B.S. and M.S. degrees in Aerospace Engineering from Auburn University and is an Associate Fellow of the AIAA. His areas of technical expertise include missile aerodynamic design, wind-tunnel testing, and performance analysis. He is currently Manager of the Missile Systems Department at Dynetics, Inc., where he directs a group of engineers supporting a variety of missile-related projects for the Department of Defense. He has also been the Principal Investigator on several Small Business Innovative Research Contracts evaluating advanced aerodynamic control technologies for a variety of atmospheric vehicles. Mr. Miller has been a member of both the AIAA Atmospheric Flight Mechanics and the Applied Aerodynamics Technical Committees, was the Technical Chair of the 1996 AIAA Applied Aerodynamics Conference, and has served as a coinstructor for the AIAA Short Course on Launch Vehicle and Missile Aerodynamics first taught in 2000.

JOSEPH I. MINOW graduated from Western State College, Colorado (1981) with a B.A. in Biology/Chemistry then decided to pursue a space physics career, completing his M.S. in Physics at University of Denver (1987) and Ph.D. in Physics from University of Alaska Fairbanks (UAF) in 1997. His doctoral research at UAF's Geophysical Institute focused on solar-terrestrial interactions and magnetospheric physics. Dr Minow held a Postdoctoral Fellowship at Embry-Riddle Aeronautical University (1997-1998) where he conducted research on airglow and auroral phenomena at polar latitudes. He joined the Natural Environments Branch at NASA's Marshall Space Flight Center (MSFC) in 1998 as a Senior Engineer with Sverdrup Technology (now Jacobs Engineering) and served as Sverdrup's Environments Group Supervisor (1999 to 2004). In 2004 he was hired by NASA/MSFC to lead the ionizing radiation and space plasma environments work for the Natural Environments Branch and provide spacecraft-space environment interactions support to NASA programs including ISS, Shuttle, Chandra, Expendable Launch Vehicles, and the new Constellation Program. Dr. Minow's professional activities include characterizing and modeling space radiation and plasma environments using data from research or operational spacecraft and evaluating their effects on space systems. Space environment analyses and engineering models developed by the Branch are used by NASA for defining program requirements, characterizing relevant test environments, guiding spacecraft design, operations support for space systems, and resolution of on-orbit anomalies. Dr. Minow is the author or co-author of over sixty publications and conference presentations and serves on the AIAA Atmospheric and Space Environments Technical Committee (since 2001).



LEE D. PETERSON is Associate Professor of Aerospace Engineering Sciences at the University of Colorado, Boulder. He has been an Associate Professor or Assistant Professor at the University of Colorado since 1991. Dr. Peterson is also Director of the McDonnell Douglas Aerospace Structural Dynamics and Control Laboratory and is a member of the Center for Aerospace Structures (CAS). From 1989 to 1991 Dr. Peterson was Assistant Professor of Aeronautics and Astronautics at Purdue University. Prior to his work at Purdue, Dr. Peterson was a member of the technical staff at Sandia National Laboratories, Albuquerque, New Mexico. He obtained his S.B. (1982), S.M. (1983), and Ph.D. (1987) in Aeronautics and Astronautics from the Massachusetts Institute of Technology. He has authored or coauthored more than 100 publications in the areas of space structure mechanics, dynamics, control, and design. His research interests are in the development of large, lightweight precision space structures for optical telescopes and interferometers. This includes experimental and theoretical research in the stability of structures and structural components at nanometer scales of deformation



DINESH K. PRABHU, Senior Research Scientist at ELORET Corporation, Sunnyvale, California, received his B.Tech. in aeronautical engineering from the Indian Institute of Technology at Madras, India in 1981, his M.S. in 1985 and his Ph.D. in 1987 from Iowa State University in aerospace engineering. He has worked as an on-site contractor at NASA Ames Research Center since 1987, and spent 4 years (1992-1996) as a research scientist in the Computational and Theoretical Fluid Dynamics Division of the National Aerospace Laboratories, India. His research interests are in the areas of computational aero/ aerothermodynamics and radiative heat transfer with applications to design of planetary atmospheric-entry systems, physics of high-temperature gases, and computational materials science. Dr. Prabhu is an Associate Fellow of AIAA and serves on the AIAA Thermophysics Technical Committee. He is the author or coauthor of over 40 publications.

DAVID B. SPENCER is an Assistant Professor of Aerospace Engineering at Pennsylvania State University. He teaches undergraduate and graduate courses in spacecraft dynamics and controls. Additionally, he conducts research in the areas of space debris dynamics, trajectory optimization, guidance, navigation, control, and theoretical and applied astrodynamics. Formerly, he was a member of the Technical Staff at The Aerospace Corporation in Los Angeles and held various technical and management positions at the U.S. Air Force Research Laboratory's Space Vehicles Directorate in Albuquerque, New Mexico. He has a B.S. in Mechanical Engineering from the University of Kentucky, an M.S. in Aeronautics and Astronautics from Purdue University, and a Ph.D. in Aerospace Engineering Sciences from the University of Colorado at Boulder. He was named an AIAA Associate Fellow in 1998, is the author of several technical publications, and serves on both the AIAA Astrodynamics Technical committee and the AAS Space Flight Mechanics Technical Committee.

KATHRYN WURSTER is a senior research engineer in the Vehicle Analysis Branch at NASA Langley Research Center where she has been employed for approximately thirty years since receiving her degrees from Rensselaer Polytechnic Institute. Ms Wurster has an extensive background in engineering methods for aerothermodynamic predictions and thermal analysis, and serves as the Government's point of contact for the MINIVER code, a suite of aerothermodynamic and thermal protection system (TPS) analysis and design tools utilized throughout industry. She is responsible for the continued development and validation of the code's prediction methods, using CFD and experimental data, and is also responsible for the enhancements necessary to accommodate increasingly complex advanced space transportation configurations and materials technologies. Her early work focused on methods development for the tailoring of entry trajectories for reusable launch vehicles, subject to aeroheating and TPS requirements, including turbulent heating constraints. She has provided the transient heating environment basis for TPS design for numerous conceptual and test demonstrator programs including; the HL-20 Personnel Launch System, Access to Space winged body concept, X33 lifting body and the X34. Ms Wurster's current focus is the integration of computational, experimental and engineering methods for the prediction of the transient aeroheating environments required for TPS analysis and design. She has served on numerous peer review panels including the NESC (NASA Engineering and Safety Center) evaluation of the damage assessment tools for Shuttle return to flight and the X43A return to flight peer assessor team. Most recently her work has concentrated on the development of engineering methods for aeroheating environment prediction for ballistic return vehicles such as NASA's Crew Exploration Vehicle, as well as several deployable heat-shield concepts for unmanned return vehicles.