

## Selected Invited Lectures

- Plenary Hour Address, Symposium on the Mathematical Theory of Networks and Systems, Beer Sheva, Israel: (June 12, 1983)  
“Some Infinite Dimensional Lie Algebras and related System Theoretic Problems”
- Berkeley-Ames Conference on Nonlinear Problems in Control and Fluid Mechanics, Berkeley, CA: (June 1983)  
“Symmetries in Nonlinear Control Theory”
- Decision and Control Seminar, Division of Applied Sciences, Harvard University, Cambridge: (August, 1983)  
“Lie-Poisson Structures and Dual-Spin Spacecraft”
- Joint Electrical Engineering and Mathematics Colloquium, University of California, Berkeley: (February 15, 1984)  
“Lie-Poisson Structures and Dual-Spin Spacecraft”
- Invited Lecture, NASA Langley Research Center, Hampton, Virginia: (June 5, 1984)  
“Geometric Methods for Nonlinear Control”
- Invited Lecturer and Panelist, AFOSR Forum on Space Structures, Vienna, Virginia: (July 16, 1984)
- Dynamics Seminar, Department of Mathematics, University of California, Berkeley: (February 20, 1985)  
“Hamiltonian Methods and Stability for Rigid Bodies with Flexible Attachments”
- Control Seminar, Department of Electrical Engineering, University of California, Berkeley: (February 21, 1985)  
“An Exposition of the Theory of Screws”
- Joint Princeton-Rutgers Systems Seminar, Department of Mathematics, Rutgers University, New Brunswick, New Jersey: (April 10, 1985)  
“New Methods for the Stability and Control of Mechanical Systems”
- Decision and Control Seminar, Division of Applied Sciences, Harvard University, Cambridge: (April 11, 1985)  
“Stability and Control of Mechanical Systems”
- LIDS Seminar, Massachusetts Institute of Technology, Cambridge: (April 12, 1985)  
“Stability and Control of Mechanical Systems”
- NASA/USRA Review Meeting, NASA Johnson Space Center, Houston, Texas: (December 4, 1985)

“Advanced Mission Design Project at Maryland”

Oak Ridge Associated Universities Meeting, Knoxville, Tennessee: (October 10, 1985)  
“The Systems Research Center”

Special Session on Hamiltonian and Lagrangian Systems, Symposium on the  
Mathematical Theory of Networks and Systems, Stockholm, Sweden: (June 10-14, 1985)  
“Hamiltonian Mechanics of Rigid Bodies with Flexible Attachments”

Student-Faculty Colloquium, Department of Mathematics, University of Maryland,  
College Park: (March 17, 1986)  
“Some Mathematical Problems in Robotics”

Symposium on Differential Geometry: The Interface between Pure and Applied  
Mathematics, San Antonio, Texas (April 23 - 25, 1986)  
“On the Control of Multibody Systems”

AT&T Bell Laboratories, Machine Perception Research Department, Holmdel, N.J.:  
(September 15, 1986)  
“The Intelligent Servomechanisms Project”

IEEE Symposium on Computer Aided Control Systems Design, Washington, D.C.:  
(September 24, 1986)  
“Control of a Flexible Arm: Design and Implementation”

AFOSR Workshop on Control of Systems Governed by Partial Differential Equations,  
Val-Deville, Quebec, Canada: (October 9, 1986)  
“Nonlinear Control and Stability of Interconnected Mechanical Systems”

Division of Applied Mechanics Colloquium, Stanford University, Stanford, CA: (October  
30, 1986)  
“Modeling and Control of Interconnected Mechanical Systems”

Department of Electrical Engineering Colloquium, Arizona State University, Tempe:  
(November 7, 1986)  
“Hamiltonian Structures for Interconnected Systems”

Department of Mathematics Colloquium, University of Maryland, College Park: (Fall  
1987)  
“Eulerian Many-Body Problems”

Symplectic Integration Working Group, Los Alamos National Laboratory, Los Alamos,  
New Mexico: (March 19 & 20, 1988)  
“Eulerian Many-Body Problems”

Dynamics Seminar, Cornell University, Ithaca: (September 20, 1989)

“Rigid Body Dynamics in a Central Gravitational Field”

Geometric Phases Workshop, MSI, Cornell University, Ithaca: (October 10, 1989)

“Geometric Phases and Optimal Maneuvers of Coupled Rigid Body Systems”

AFOSR/AIAA Microgravity Simulation Workshop, Denver, Colorado: (November 2, 1989)

“Geometry and Control of Coupled Structures: Recent Developments”

Panelist, AFOSR/AIAA Microgravity Simulation Workshop, Denver, Colorado: (November 2, 1989)

Algebraic and Geometric Integration Workshop, MSI, Cornell University, Ithaca: (November 9, 1989)

“Symplectic and almost Poisson Integration of Rigid Body Systems”

Mathematics Colloquium, Cornell University, Ithaca: (November 14, 1989)

“Mechanics, Control and Holonomy”

Theoretical & Applied Mechanics Colloquium, Cornell University, Ithaca: (December 22, 1989)

“Geometry and Control of Coupled Structures”

Applied Dynamics Seminar, University of Maryland, College Park: (March 8, 1990)

“Geometric Phases and Optimal Reconfiguration Maneuvers”

Systems Science Seminar, Arizona State University, Tempe: (May 22, 1990)

“Geometric Phases, Holonomy, and Optimal Control in Mechanical Systems”

Mathematics Seminar, Ohio State University, Columbus, Ohio: (October 25, 1990)

“Geometric Phases, Holonomy, and Optimal Control in Mechanical Systems”

NSF-EPRI Workshop on Intelligent Control, EPRI, Palo Alto: (October 15, 1990)

“The Intelligent Servomechanisms Project”

Annual Meeting of the American Association for the Advancement of Science, Washington, D.C.: (February 19, 1991)

“Geometric Phases, Optimal Control and Space Robotics”

Mathematics Colloquium, Georgetown University, Washington, D.C.: (March 1, 1991)

“Geometric Phases, Holonomy and Optimal Control in Mechanical Systems”

Workshop on Mathematical Problems in Robotics, Oberwolfach, Germany: (June 16 - June 22, 1991)

“Geometric Phases & Anholonomy in Space Robotics”

Workshop on Nonlinear Control, Los Alamos National Laboratory: (July 24 - August 1, 1991)

“Control Problems on Principal Bundles and Nonholonomic Mechanics”

Applied Mechanics and Mechanical Engineering Seminar, Caltech: (May 26, 1992)

“Constrained Variational Problem in Mechanics and Optimal Control”

Workshop on Microrobotics, Jet Propulsion Laboratory, Pasadena: (May 28, 1992)

“Coordination of Legged Locomotion via Coupled Nonlinear Oscillators”

Workshop on Geometric Variational Problems and Optimal Control, Fields Institute for Mathematical Research, Waterloo, Canada: (June 6-9, 1992)

“Constrained Variational Problems in Mechanics and Optimal Control”

AMS-SIAM Summer Seminar, Colorado State University, Ft. Collins: (July 26-August 1, 1992)

“Geometric Mechanics, Symmetry and Paradigms for Control Theory”

Dynamics Seminar, University of Houston, Mathematics Department: (November 12, 1992)

“Intelligent Control of Movement: A Role for Coupled Oscillators”

Robotics Workshop, IMA, University of Minnesota, Minneapolis-St. Paul: (January 24-29, 1993)

“Intelligent Control of Movement: A Role for coupled Oscillators”

Instrumentation & Controls Division Seminar, Oak Ridge, TN: (March 29, 1993)

“Rational Wavelets and Approximation of Linear Systems”

Eleventh Army Conference on Applied Mathematics and Computing, Carnegie Mellon University, Pittsburgh: (June 8-11, 1993)

“Rational Wavelets in Control”

Conference on Geometric Methods in Theoretical and Computational Mechanics, Oberwolfach, Germany: (July 24-30, 1993)

“Constraints, Controls and Reduction”

Joint meeting of AMS and the Canadian Math Society, Vancouver, B.C.: (August 15 - 1993)

“Hamiltonian Control System on Bundles”

1994 Science and Technology Symposium on *Motion, Control and Geometry*, National Academy of Sciences, Washington, D.C.: (April 12, 1994)

“Coupled Oscillators and Motion Control”

Workshop on Geometric Mechanics and Nonholonomic Systems, University of California, Berkeley: (August 12-13, 1994)

“G-Snakes: Nonholonomic Kinematic Chains on Lie Groups”

Engineering Systems Research Center Colloquium, University of California, Berkeley: (September 28, 1994)

“Oscillations, Constrained Systems and Motion Control”

SEMATECH Seminar (Jan 11, 1995) and Texas Instruments Seminar: (Jan 12, 1995)

“Intelligent Control”

ONR-ARPA Workshop on Bio-locomotion and Control of Flow on Deformable Surfaces, Baltimore: (March 21, 1995)

“Motion Control of Deformable Bodies”

University of Arkansas Spring Lecture Series, Fayetteville: (April 8, 1995)

“Geometry of Nonholonomic Systems on Lie Groups”

Dynamics and Control Special Seminar, Department of Mechanical and Aerospace Engineering, Princeton University: (May 25, 1995)

“Oscillations, Constrained Systems and Motion Control”

Workshop on Monitoring and Control of Intelligent Epitaxy, Banff Conference Center: (June 12, 1995)

“Wavelets and Neural Networks in Identification and Control”

Industry Workshop on Semiconductor Manufacturing, Institute for Systems Research, University of Maryland at College Park: (May 16, 1996)

“Modeling and Sensor Based Control for Semiconductor Processing”

Varian Ion Implant Systems, Gloucester, Mass: (May 31, 1996)

“Modeling and Sensor Based Control for Semiconductor Processing”

Symposium on the Mathematical Theory of Networks and Systems, Washington University, St. Louis: (June 24-28, 1996)

“Nonholonomic Mechanical Systems on Lie Groups”

Symposium on the Mathematical Theory of Networks and Systems, Washington University, St. Louis: (June 24-28, 1996)

“Geometric Methods for Motion Control of Deformable Bodies”

College of Engineering Control Colloquium, University of Michigan, Ann Arbor: (October 25, 1996)

“Models and Motion Control for Deformable Bodies in Fluids”

ECSE Seminar, Harvard University, Cambridge: (February 20, 1997)

“Learning from Repeated Trials: A Dynamical System”

Department of Mathematics Colloquium, Boston University: (February 21, 1997)

“Models and Motion Control for Deformable Bodies in Fluids”

University of Kaiserslautern, Germany, Workshop on Three Decades of Algebraic Systems Theory in Honor of the 60th Birthday of Paul A. Fuhrmann: (September 24, 1997)

“Modeling and Reduction: Spectra, Wavelets and PCA”

Allerton Workshop on Future Directions in Systems and Control, University of Illinois, Urbana-Champaign: (September 28, 1997)

“On Controlling the Formation of Spatio-Temporal Patterns”

Workshop on Geometric Mechanics and Control, Caltech, Pasadena: (Dec 13, 1997)

“Magnetostrictive Actuation”

Department of Mathematics Colloquium, Virginia Polytechnic Institute and State University, Blacksburg: (April 10, 1998)

“Control and Mechanics: A Geometric Perspective”

IMA Workshop on Nonlinear Systems and Identification, Minneapolis-St. Paul: (April 30, 1998)

“From Smart Devices to Smart Systems”

IMA Workshop on Animal Locomotion and Robotics, Minneapolis-St. Paul: (June 1, 1998)

“Oscillations and Motion on Lie Groups”

Workshop on Introduction to Smart Structures, Tampa, FL: (December 1998)

“Piezoelectric and Magnetostrictive Actuation”

Workshop on Perspectives in Control, Harvard University: (October 23-24, 1998)

“Patterns in Control”

NSF Learning and Intelligent Systems Workshop, Georgetown University: (May 3-4, 1999)

“Binaurally Directed Movement”

LIDS Colloquium, Massachusetts Institute of Technology: (May 11, 1999)

“Geometry of Model Reduction”

Workshop on Flow Control, University of California, San Diego: (May 31-June 1, 1999)

“Patterns in Control of Flows”

Workshop on Mechanics, Oberwolfach Math Institute, Germany: (July 25-31, 1999)

“Geometry of Magnetoelasticity”

Workshop on Lie Groups, Wuerzberg, Germany: (August 3-6, 1999)

“Motion Control on Lie Groups”

ARO Workshop on Smart Structures, Pennsylvania State University: (August 16-18, 1999)

“Patterns in Control”

SPIE Conference on Mathematics and Control of Smart Structures, Newport Beach: (March 8, 2000)

“Geometry of Magnetoelasticity”

Workshop on Applied Mathematics and Optimization, University of Notre Dame: (April 8, 2000)

“Control using Auditory Feedback”

College of Engineering Controls Colloquium, University of Michigan: (April 14, 2000)

“Some Recent Progress in Distributed Control”

NSF Workshop on Mathematical Problems in Robotics, Arlington: (May 15, 2000)

“Control using Auditory Feedback”

Workshop on Biological Control Systems, Chicago: (June 27, 2000)

“Learning Binaurally Directed Movement”

IMA Workshop on Mathematical Challenges in GPS, St. Paul, Minnesota: (August 17, 2000)

“Approximate Nonlinear Filtering and GPS”

Workshop on Hysteresis, Metastability and Aftereffect, University of Illinois at Chicago: (August 28, 2000)

“Modeling and Control of Hysteresis”

Colloquium, Mathematics Department, University of Maryland at Baltimore County: (December 1, 2000)

“Relative Equilibria and Rings of Satellites”

Workshop on Cooperative Control and Optimization, University of Florida: (December 4, 2000)

“Role of Symmetries and Nonlinearities in Distributed Cooperative Control”

Distinguished Lecture Series (Mechanical and Industrial Engineering Department), University of Illinois, Urbana-Champaign: (April 24, 2001)

“Synthetic Potentials and Dissipation”

Decision and Control lab Seminar, University of Illinois, Urbana-Champaign: (April 25, 2001)

“Arrays, Patterns and PDE's in Control”

Third International Symposium on Hysteresis and Micromagnetic Modeling HMM-01, George Washington University: (May 21-23, 2001)

“Conserving Algorithms for Micromagnetics”

SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah: (May 23, 2001)

“Model Reduction and Control”

Workshop in Micromagnetics and Applications to MRAMS, Princeton University: (June 7-8, 2001)

“Cayley Transforms in Magnetics”

Fifth SIAM Conference on Control and its Applications, San Diego: (July 11-14, 2001)

“Cayley Transforms in Magnetics”

Fifth SIAM Conference on Control and its Applications, San Diego: (July 11-14, 2001)

“Synthetic Potentials in the Control of Mechanical Systems”

Fifth SIAM Conference on Control and its Applications, San Diego: (July 11-14, 2001)

“Vibratory Gyroscopes, Moving Systems, and Geometric Phase”

Division of Applied Sciences Colloquium, Harvard University: (November 2, 2001)

“Controlling Optical Fields”

Distinguished Lecture at Symposium on Mathematics in the 21st Century, Texas Tech University: (November 8-9, 2001)

“Patterns in Control”

Conference on Cooperative Control and Optimization, University of Florida: (November 12-14, 2001)

“Dynamics and Control of Agile Formations”

Mathematics Department Student-faculty Colloquium, University of Maryland: (March 16, 2002)

“Temporal Patterns in Control”

GN &C Seminar, NASA Goddard Spaceflight Center: (March 25, 2002)

“Coordinated Orbit Transfer for Satellite Clusters”

GRASP Laboratory Lunch Seminar, University of Pennsylvania: (April 12, 2002)

“Control with Auditory Feedback”



Mathematics Department Geometry-Topology Seminar, University of Maryland: (May 6, 2002)

“Momentum Maps, Constrained Dynamics, and Control”

Testbed Workshop, Research Institute for Autonomous Precision Guided Systems, University of Florida: (July 17-18, 2002)

“Geometric Methods for Formation Dynamics and Control”

Workshop on Geometry, Mechanics and Dynamics, in honor of the 60th birthday of J.E. Marsden, Fields Institute, Toronto: (August 7-11, 2002)

“Interactions on Lie Groups”

Workshop on Future Directions in Nonlinear Control of Mechanical Systems, University of Illinois, Urbana-Champaign: (October 5 2002)

“Shapes, Patterns and Controls”

Symposium on New Trends in Nonlinear Dynamics and Control in honor of the 60th birthday of A.J. Krener, Naval Postgraduate School, Monterey: (October 17-18, 2002)

“Interacting Particles on Lie Groups”

Control and Dynamical Systems Seminar, California Institute of Technology: (April 16, 2003)

“Geometry of Gyroscopic Feedback: From Rigid Bodies to Swarms”

Vision Lunch Seminar, Yale University: (May 16, 2003)

“Geometry of Gyroscopic Feedback: From Rigid Bodies to Swarms”

Minisymposium on Swarming, SIAM Conference on Applications of Dynamical Systems 2003, Snowbird: (May 27, 2003)

“Geometry of Steering Laws in Cooperative Control”

Minisymposium on Geometric Dynamics, SIAM Conference on Applications of Dynamical Systems 2003, Snowbird: (May 28, 2003)

“Dynamics on  $SU(n)$  and adaptive optics”

Workshop on Cooperative Control, Block Island: (June 10, 2003)

“Geometry of Gyroscopic Feedback: From Rigid Bodies to Swarms”

Workshop on Biological and Artificial Swarms Institute for Pure and Applied Mathematics, UCLA: (October 3-4, 2003)

“Geometry of Steering Laws for Swarms”

Workshop on New Directions in Control Theory and Applications: Texas Tech University, Lubbock: (November 14-15, 2003)

“A System Identification Problem from Lord Rayleigh”

Workshop on Lie Group Methods and Control Theory International Center for  
Mathematical Sciences, Edinburgh: (June 29, 2004)  
“Geometry of Steering Laws in Cooperative Control”

Summer School on Mathematics of Brain Imaging IPAM-UCLA, Los Angeles: (July 15,  
2004)  
“Geometry of Collective Steering”

Program in Geometric Mechanics and its Applications, Centre Bernoulli, EPFL,  
Lausanne: (July 28, 2004)  
“Geometry of Steering Laws in Cooperative Control”

Workshop in honor of John Baillieul, Boston University, Boston: (May 13, 2005)  
“Controllability in Gravity”

Invited Talk at CDS-Caltech, Pasadena: (February 27, 2006)  
“Pursuit, Stealth and Cohesion: Lessons from Nature”

Workshop on Swarming in Nature and by Design, IPAM-UCLA, Los Angeles: (February  
28, 2006)  
“Pursuit, Stealth and Cohesion: Lessons from Nature”

Colloquium at Division of Engineering and Applied Sciences, Harvard University,  
Cambridge: (March 3, 2006)  
“Pursuit, Stealth and Cohesion: Lessons from Nature”

Munich Mathematical Colloquium, Technical University of Munich, Garching-Munich:  
(October 24, 2006)  
“Geometric Control, Cohesion and Pursuit”

NSF-NIH CRCNS Workshop, Washington D.C.: (June 5, 2006)  
“Trajectories, Controls and Feedback Laws”

Plenary Lecture, 3<sup>rd</sup> Northeast Control Workshop, University of Pennsylvania,  
Philadelphia: (May 16, 2007)  
“Geometry of Collective Steering”

Department of Mathematics Colloquium, Howard University, Washington, D.C.:  
(November 16, 2007)  
“Pursuit and Cohesion: in Nature and by Design”

Invited speaker, 2<sup>nd</sup> Workshop on Swarming in Natural and Engineered Systems,  
University of Pennsylvania, Philadelphia: (May 16, 2007)  
“Pursuit Laws: theory and data”

Hendrik W. Bode Prize Lecture (plenary), 46<sup>th</sup> IEEE Conference on Decision and Control, New Orleans: (December 14, 2007)  
“Pursuit and Cohesion: in Nature and by Design”

Inaugural Cymer Distinguished Lecture, Cymer Center for Control Systems and Dynamics, University of California, San Diego: (May 30, 2008)  
“Pursuit and Cohesion: from Biology to Autonomous Vehicles”

Electrical Engineering Colloquium, University of California Los Angeles: (October 20, 2008)  
“Pursuit and Cohesion”

Invited speaker, Mathematisches Forschungsinstitut Oberwolfach, Germany: (July 26, 2008)  
“Pursuit and Cohesion”

Third Workshop on Swarming in Natural and Engineered Systems, Block Island: (June 4, 2009)  
“Games and Dynamics”

GRASP Laboratory Colloquium, University of Pennsylvania: (March 26, 2010)  
“Geometry of Cyclic Pursuit”

ECE-GSA Seminar and TA Workshop, University of Maryland (April 2, 2010)  
“Geometric Phase: An Introduction”

CSCAMM Workshop on Nonlinear Dynamics of Networks 2010, University of Maryland, College Park: (April 6, 2010)  
“Pursuit and Collective Behavior”

Maryland Robotics Center, University of Maryland, College Park: (April 23, 2010)  
“Pursuit and Cohesion: Bio-inspiration for Collective Robotics”

ONR & AFOSR Bio-inspired Autonomous Systems Review, Arlington, VA: (May 21, 2010)  
“Control Strategies for Autonomy and Cohesion”

Workshop on Insect Self-organization and Swarming, Mathematical Biosciences Institute, Ohio State University: (March 18, 2011)  
“Variational Principles in Control of Collective Behavior”

University of Notre Dame, South Bend: (April 14, 2011)  
“Control Strategies for Autonomy and Cohesion”

Army Research Laboratory, Aberdeen: (August 4, 2011)  
“Strategies for Autonomy and Cohesion”

Applied Dynamics and Geometric Mechanics Meeting, Oberwolfach: (August 15, 2011)  
“Control of Collectives”

Intelligent Automation Inc. – ISR Colloquium, Maryland: (December 7, 2011)  
“Reconstructing Collectives”

Baetjer Colloquium, Princeton University: (April 20, 2012)  
“Structure and Dynamics in Collectives”

Workshop on Dynamics of Prey Capture and Escape, Janelia Farm Research Campus of HHMI: (March 7, 2013)  
“Latency and Stochasticity”

Summer School on Geometry, Mechanics and Control ICMAT VII, Madrid, Spain: (July 1- July 5, 2013) – 6.5 hours lecture series  
“Geometry of Collectives: Control, Dynamics and Reconstruction”

AFOSR Sensory Information Systems Program Review, REEF Center, Shalimar, Florida: (Oct 21-25, 2013) “Geometry of Collectives: Control, Dynamics and Reconstruction”

Workshop - Perspectives in Dynamical Systems & Control (VJTI and IIT Bombay, TEQIP-II)

Indian Institute of Technology, Bombay, INDIA (March 17-22, 2014) – two talks delivered over the web, each lasting about 1.5 hours.

Lecture 1 “Geometry of Collectives: Control, Dynamics and Reconstruction”

Lecture 2 “Optimality in Collectives”

George Washington University, MAE Seminar, Washington D.C. : (May 22, 2014)  
“Geometry of Collectives: Control, Dynamics, and Reconstruction”

AFOSR Sensory Information Systems Program Review, Doolittle Institute, Shalimar, Florida: (Oct 6 - 8, 2014) “Optimality in Collectives: Seeking Hamilton(ian)”

Workshop - Swarms with a Purpose: Collective Motion, Dynamics and Control: From Bacteria to Ballet, Radcliffe Institute for Advanced Study, Harvard University, Cambridge, MA (December 11-12, 2014) “Optimality in Collectives: seeking Hamiltonian”

Workshop (all-day) at 53<sup>rd</sup> IEEE Conference on Decision and Control, Los Angeles, CA: (December 14, 2014) “Geometry of Collectives: Control, Dynamics, and Reconstruction” – *Dyadic Building-block Interactions: Pursuit, Escape and Other*. There were in addition five other 1 hour talks as part of the workshop, all connected to research outcomes supported by the AFOSR grant on Collective Behavior.

Workshop – Information Engines, Santa Fe Institute, Santa Fe, New Mexico: (June 24, 2015) “Optimal Control and Information Engines”

NSF Workshop – Learning, Perception & Control, Arlington, VA: (August 25, 2015)  
“Inverse Optimality”

International Conference on Geometric Science of Information 2015, Palaiseau, France:  
(October 28 – 30, 2015): “Enlargement, Geodesics, and Collectives”

Celebration of the 65<sup>th</sup> Birthday of Professor-Dr. Juergen Scheurle, TUM Munich,  
Germany: (June 12, 2017):  
“Subriemannian Geometry and Nonequilibrium Thermodynamics”

Workshop on Information Engines at the Frontiers of Nanoscale Thermodynamics,  
Telluride, CO: (August 10, 2017)  
“Subriemannian Geometry and Nonequilibrium Thermodynamics”

Celebration of the 70<sup>th</sup> Birthday of Professor Darryl D. Holm, Madrid, Spain: (July 5,  
2017) – talk given over skype due to travel difficulties (aircraft trouble and cancellation  
of two flights)  
“Flocks and Form”