

## Melvin Leok: Curriculum Vitae

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### Education

CALIFORNIA INSTITUTE OF TECHNOLOGY

Ph.D.	Control and Dynamical Systems Applied and Computational Mathematics ( <i>minor</i> ) <i>Thesis:</i> <i>Foundations of Computational Geometric Mechanics</i> <i>Committee:</i> <i>Jerrold E. Marsden (advisor), Thomas Y. Hou, Richard M. Murray, Michael Ortiz, and Alan D. Weinstein (Mathematics, UC Berkeley).</i>	<i>GPA: 4.0/4.0</i>	Oct 2000–Jun 2004
M.S.	Mathematics	<i>GPA: 4.0/4.0</i>	Oct 1999–Jun 2000
B.S.	Mathematics ( <i>with honor</i> )	<i>GPA: 4.0/4.0</i>	Oct 1996–Jun 2000

### Professional Experience

T.H. Hildebrandt Research Assistant Professor, Mathematics, University of Michigan.	Sep 2004–Aug 2007
Postdoctoral Scholar, Control and Dynamical Systems, California Institute of Technology.	Jul 2004–Aug 2004

### Research Interests

My current research is focused on the emerging field of computational geometric mechanics, which aims to develop computational schemes that draw upon insights from geometric mechanics, through the use of symmetry and differential geometric techniques. Towards this end, I have developed a reduction theory for discrete variational mechanics, as well as discrete geometry in the form of discrete analogues of exterior calculus and connections on principal bundles. More recently, I have developed generalized Galerkin variational integrators that incorporate adaptivity and multiscale computation through an appropriate choice of finite-dimensional function spaces.

### Publications

*Generalized Galerkin Variational Integrators*, in preparation, 2004.  
*A Discrete Theory of Connections on Principal Bundles* (with J.E. Marsden, A.D. Weinstein),  
in preparation, 2003.  
*Discrete Exterior Calculus* (with M. Desbrun, A. Hirani, J.E. Marsden), in preparation, 2003.  
*Discrete Poincaré Lemma* (with M. Desbrun, A. Hirani, J.E. Marsden), submitted, Appl. Numer. Math., 2003.  
*Discrete Routh Reduction* (with S.M. Jalnapurkar, J.E. Marsden, M. West), submitted, J.FoCM, 2003.  
*Symplectic Integrators for Mechanical Systems with Symmetry*, Caltech SURF Report, 1999.  
*A Mathematical Model of True Polar Wander*, Caltech SURF Report, 1998.  
*Estimating the Attractor Dimension of the Equatorial Weather System*, Acta Phys. Pol. A **85**, 1994.

### Research Prizes

*SIAM Student Paper Prize*, Society for Industrial and Applied Mathematics. 2003  
*Leslie Fox Prize in Numerical Analysis* (second prize), Institute of Mathematics and its Applications, UK. 2003

### Graduate Fellowships

*Josephine de Kármán Fellowship* (established by Theodore von Kármán). 2003–2004  
*International Fellowship*, Agency for Science, Technology and Research, Singapore. 2002–2004  
*Poincaré Fellowship* (Betty and Gordon Moore Fellowship), Caltech. 2000–2004  
*Tau Beta Pi Fellowship*, Tau Beta Pi, National Engineering Honor Society. 2000–2001  
*Tan Kah Kee Foundation Postgraduate Scholarship*, Singapore. 2000

### Research Grants and Travel Awards

*ICIAM Travel Grant*, NSF DMS-0218051, Society for Industrial and Applied Mathematics. 2003  
*London Mathematical Society Bursary*, Short Course on Computational Differential Equations. 2002  
*Grant-in-Aid of Research*, Sigma Xi, The Scientific Research Society. 2001  
*SIAM Student Travel Award*, SIAM Conference on Applications of Dynamical Systems. 2001  
*Summer Undergraduate Research Fellowship*, Caltech. 1998, 1999

## Melvin Leok: Curriculum Vitae

### Additional Honors and Awards

<i>Chinese-American Engineers and Scientists Association of Southern California Scholarship.</i>	2000
<i>Club Singapura Scholarship</i> , Club Singapura, Southern California.	2000
<i>Herbert J. Ryser Scholarship</i> , Caltech Mathematics Department.	1999
<i>E. T. Bell Undergraduate Mathematics Research Prize</i> , Caltech Mathematics Department.	1999
<i>Jack E. Froehlich Memorial Award</i> , Caltech.	1999
<i>Sigma Xi</i> , The Scientific Research Society (Associate Member).	1999
<i>Tau Beta Pi</i> , National Engineering Honor Society.	1999
<i>Upperclass Merit Award (Carnation Scholarship)</i> , Caltech.	1998, 1999
<i>Loke Cheng-Kim Foundation Scholarship</i> , Singapore.	1996–2000
<i>Lee Kuan Yew Award for Mathematics and Science</i> , Ministry of Education, Singapore.	1994
<i>Top Prize, First Step to Nobel Prize in Physics</i> , Polish Academy of Sciences.	1993
<i>Student of the Year</i> , Computer Science Faculty, Raffles Junior College, Singapore.	1993
<i>Bronze medal, 4th International Olympiad in Informatics</i> , Bonn, Germany.	1992

### Invited Conference Talks

Turbulence Working Group Workshop, T-7, LANL, Santa Fe, NM.	Dec 2003
Full Body Problem Workshop, Caltech, Pasadena, CA.	Nov 2003
Leslie Fox Prize Meeting, University of Cambridge, UK.	Jun 2003
Student Paper Prize Presentation, SIAM Annual Meeting, Montréal, Canada.	Jun 2003
Geometrical Mechanics and Turbulence Modeling, CNLS, LANL, Santa Fe, NM.	Nov 2002
Geometry, Symmetry and Mechanics II, University of Warwick, UK.	Jul 2002
Invariant and Symmetry-Preserving Integrators for $N$ -Body Simulation, University of Leicester, UK.	Apr 2002
Reduced Dimensional Modeling Workshop, CNLS, LANL, Los Alamos, NM.	Nov 2001

### Invited Minisymposium Talks

Geometric Dynamics and Applications, AIMS Fifth International Conference on Dynamical Systems and Differential Equations, Pomona, CA.	Jun 2004
Geometric Methods for PDEs, NUMDIFF, University of Halle, Germany.	Sep 2003
Non-Grid based Methods for Geophysical and Astrophysical Flows, ICIAM, Sydney, Australia.	Jul 2003
Structure-Preserving Algorithms, SciCADE 2003, Trondheim, Norway.	Jul 2003
Discrete Geometry and Geometric Integration, SIAM Dynamical Systems, Snowbird, UT.	May 2003
Geometric Integration and Computational Dynamics, Foundations of Computational Mathematics, Minneapolis, MN.	Aug 2002
Geometric Integration, SIAM Dynamical Systems, Snowbird, UT. <i>SIAM Student Travel Award.</i>	May 2001

### Invited Seminar Talks

Temasek Laboratories, National University of Singapore.	Jul 2004
SIAM Student Chapter, Caltech, Pasadena, CA.	Jan 2004
School of Mathematics, University of Minnesota, Twin Cities, MN.	Jan 2004
School of Engineering and Science, International University of Bremen, Germany.	Sep 2003
Paderborn Institute for Scientific Computation, University of Paderborn, Germany.	Sep 2003
Caltech/JPL Nonlinear Astrodynamics Group, Pasadena, CA.	Aug 2003
Institute for High Performance Computing, National University of Singapore.	Feb 2003, Jul 2004
Center for Integrative Multiscale Modeling and Simulation, Caltech, Pasadena, CA.	May 2002
Culham Electromagnetics and Lightning Ltd, Abingdon, Oxfordshire, UK.	Apr 2002
Department of Informatics, University of Bergen, Bergen, Norway.	Oct 2001
Department of Mathematical Sciences, NTNU, Trondheim, Norway.	Oct 2001
Mathematics Department, National University of Singapore.	Aug 2000, Jul 2004
Center for Remote Imaging, Sensing and Processing, National University of Singapore.	Sep 1999

## Melvin Leok: Curriculum Vitae

### Contributed Talks

Southern California Applied Mathematics Symposium, Claremont, CA.	Apr 2004
Auckland Numerical Ordinary Differential Equations, Auckland, New Zealand.	Jul 2003
International Congress on Industrial and Applied Mathematics, Sydney, Australia.	Jul 2003
Biennial Conference on Numerical Analysis, Dundee, Scotland.	Jun 2003
Mechanics and Symmetry European Summer School, Peyresq, France.	Sep 2001
Southwest Regional Workshop on New Directions in Dynamical Systems, USC, Los Angeles, CA.	Nov 2000
Caltech SURF Seminar Day, Pasadena, CA.	Oct 1999
Caltech SURF Seminar Day, Pasadena, CA. <i>Semi-finalist, Perpall Speaking Competition.</i>	Oct 1998

### Contributed Posters

Compatible Spatial Discretizations for Partial Differential Equations, Institute for Mathematics and its Applications “Hot Topics” Workshop, MN.	May 2004
ARO-Institute for Collaborative Biotechnologies Review, UCSB, Santa Barbara, CA.	Jul 2003, Feb 2004
International Congress on Industrial and Applied Mathematics, Sydney, Australia.	Jul 2003
CIMMS-IPAM Workshop on Molecular Modeling and Computation, Pasadena, CA.	Nov 2002
DARPA/NSF OPAAL Workshop, Seattle, WA.	May 2001
Southern California Applied Mathematics Symposium, Caltech, Pasadena, CA.	May 2001
Dynamics Days 2000, Santa Fe, NM.	Jan 2000
SIAM Conference on Applications of Dynamical Systems, Snowbird, UT.	May 1999, 2003
NSF-KDI/IGPP Workshop on accurate simulation and modeling of physical systems, San Diego, CA. <i>Student Poster Silver Medal Award in 1998.</i>	Nov 1998, 1999, 2000

### Teaching and Work Experience

#### CALIFORNIA INSTITUTE OF TECHNOLOGY

<i>Teaching Assistant</i> , Control and Dynamical Systems	Apr 2003–Jun 2003
Conducted office hours, recitations, and graded problem sets for CDS 205, Geometric Mechanics.	
Instructor: Prof. Jerrold Marsden.	
Text: <i>Mechanics and Symmetry</i> , Marsden and Ratiu, TAM 17.	
<i>Teaching Assistant</i> , Control and Dynamical Systems	Oct 2002–Dec 2002
Conducted office hours, recitations, and graded problem sets for CDS 201, Applied Operator Theory.	
Instructor: Prof. James Beck.	
Text: <i>Linear Operator Theory in Engineering and Science</i> , Naylor and Sell, AMS 140.	
<i>Lecturer</i> , Control and Dynamical Systems	Sep 2002
Gave a lecture in the CDS Precourse on Modeling and Dynamics, for first year graduate students.	
<i>Teaching Assistant</i> , Mathematics	Oct 1999–Jun 2000
Conducted office hours, and graded problem sets for Mathematics 120, the graduate abstract algebra course taken by graduate students in preparation for their doctoral qualifying examinations.	
Instructor: Prof. David B. Wales (Ma 120ab), Prof. Matthias Flach (Ma 120c).	
Text: <i>Algebra</i> , Hungerford, GTM 73 (Ma 120ab); <i>Algebra</i> , Lang (Ma 120c).	
<i>Research Assistant</i> , Physics	Oct 1997–May 1998
Supervised by Prof. Brad T. Werner, Institute of Geophysics and Planetary Physics, UCSD.	
Mathematical and computational models of aeolian processes in the formation of superimposed sand dunes.	

#### NATIONAL UNIVERSITY OF SINGAPORE

<i>Laboratory Tutor</i> , Mathematics	Jul 2000–Sep 2000
Conducted computer laboratory tutorial sessions for freshman calculus using <b>Derive</b> . Responsible for 360 students, divided into 12 weekly sections of 30 students each. Supervised graduate laboratory assistants.	

#### SINGAPORE ARMED FORCES

<i>Project Specialist</i> , School of Military Medicine	Mar 1994–Sep 1996
Mandatory military service, attained the rank of 3rd Sergeant. Developed instructional software for military medical personnel, system administrator for CAI Center Local Area Network.	

## Melvin Leok: Curriculum Vitae

### Research Visits, Conferences and Summer Schools

2004 CNA Summer School, Advances in Nonlinear Analysis, Center for Nonlinear Analysis, Carnegie Mellon University, Pittsburgh, PA. <sup>†</sup>	May–Jun 2004
DARPA Workshop on Design of Robust Dynamical Systems, UTRC, East Hartford, CT. <sup>†</sup>	Jan 2004
Southern California Applied Mathematics Symposium, Irvine, CA.	May 2003
Advances and Mathematical Issues in Large Scale Simulation, Institute for Mathematical Sciences, National University of Singapore. <sup>‡</sup>	Feb 2003
Mathematical Challenges in Scientific and Engineering Computation, Newton Institute, University of Cambridge. <sup>‡</sup>	Jan 2003
Workshop on Geometry, Dynamics, and Mechanics, Fields Institute, Toronto, Canada. <sup>†</sup>	Aug 2002
Workshop on Astrodynamics, University of Surrey. <sup>†</sup>	Apr 2002
Workshop on Classical N-Body Systems and Applications, University of Warwick. <sup>†</sup>	Apr 2002
LMS/EPSRC Short Course on Computational Differential Equations. <sup>†</sup>	Mar 2002
Groupoidfest, University of California, Berkeley, CA. <sup>‡</sup>	Nov 2001
Geometric Integration Group of Prof. Hans Munthe-Kaas, Department of Informatics, University of Bergen, Bergen, Norway. <sup>‡</sup>	Oct 2001
Numerics Group of Prof. Brynjulf Owren, Department of Mathematical Sciences, Norwegian University of Science and Technology, Trondheim, Norway. <sup>‡</sup>	Oct 2001
Mechanics and Symmetry European Summer School, Peyresq, France. <sup>‡</sup>	Sep 2001
Numerical Analysis Group of Prof. Arieh Iserles, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, United Kingdom. <sup>‡</sup>	Aug–Sep 2001
Surface Water Waves, Newton Institute EuroConference, University of Cambridge. <sup>†</sup>	Aug 2001
5th PIMS Industrial Problem Solving Workshop, University of Washington, Seattle, WA. <sup>†</sup>	Jun 2001
4th PIMS Graduate Mathematics Modelling Camp, University of Victoria, BC, Canada. <sup>†</sup>	Jun 2001
2001 CNA Summer School, Multiscale Problems in Nonlinear Analysis, Center for Nonlinear Analysis, Carnegie Mellon University, Pittsburgh, PA. <sup>†</sup>	Jun 2001

<sup>†</sup>Funded by conference organizers. <sup>‡</sup>Funded by research grants. <sup>‡</sup>Funded by host institution.

### Professional Service

Judge, Semifinals, Doris S. Perpall Speaking Competition, Caltech.	Nov 2003
Co-organizer, CIMMS Workshop on Discrete Geometry for Mechanics, Pasadena, CA.	Oct 2003
Co-organizer, discrete geometry and geometric integration minisymposium (MS 38, 62), SIAM DS03.	May 2003
Judge, Mathematics/Applied Mathematics Session, Caltech SURF Seminar Day	Oct 2002, 2003
Co-organizer, CIMMS Workshop on Networks, Optimization and Duality, Pasadena, CA.	July 2002
Coordinator, Geometric Mechanics Seminar, Control and Dynamical Systems, Caltech.	2002
Co-organizer, geometric integration minisymposium (MS 51, 69), SIAM DS01.	May 2001
Referee, <i>Applied Numerical Mathematics</i> , <i>Celestial Mechanics and Dynamical Astronomy</i> , <i>Communications in Contemporary Mathematics</i> , <i>Physica D</i> , <i>SIAM Applied Dynamical Systems</i> .	

### University Service

Officer, SIAM Student Chapter, Caltech.	2004
Member, Caltech Project for Effective Teaching, Caltech.	2002–2004
Member, Academics Committee, Graduate Student Council, Caltech.	2002
Graduate Student Representative, Committee on Institute Programs, Caltech.	2001–2003
Director, CDS Option Representative, Graduate Student Council, Caltech.	2001–2002
Member, Committee on Teaching Assistant Training, Graduate Dean's Office, Caltech.	2001–2002
Student Representative, Feynman Teaching Prize Selection Committee, Caltech.	2000
Director for Academic Affairs, Associated Students of Caltech (ASCIT).	1999–2000
Chairman, Academics and Research Committee, Caltech.	1999–2000
Student Representative, Core Curriculum Steering Committee, Caltech.	1999–2000
House Representative, Academics and Research Committee, Caltech.	1998–1999
Student Representative, Academic Policies and Curriculum Committee, Caltech.	1997–1999

## Melvin Leok: Curriculum Vitae

### Professional Memberships

American Mathematical Society  
Foundations of Computational Mathematics (Geometric Integration Interest Group)  
London Mathematical Society  
Singapore Mathematical Society  
Society for Industrial and Applied Mathematics (Dynamical Systems Activity Group)

### Biographical Sketch

Melvin Leok will join the mathematics department of the University of Michigan, Ann Arbor, in September 2004, as a T.H. Hildebrandt Research Assistant Professor. He received his B.S. *with honors* and M.S. in Mathematics in 2000, and his Ph.D. in Control and Dynamical Systems with a minor in Applied and Computational Mathematics under the direction of Jerrold Marsden in 2004, all from the California Institute of Technology. His primary research interests are in computational geometric mechanics, discrete geometry, and structure-preserving numerical schemes, and particularly how these subjects relate to systems with symmetry and multiscale systems. He was the recipient of the SIAM Student Paper Prize, and the Leslie Fox Prize (second prize) in Numerical Analysis, both in 2003, for his work on *Foundations of Computational Geometric Mechanics*. While a doctoral student at Caltech, he held a Poincaré Fellowship (2000–2004), a Josephine de Kármán Fellowship (2003–2004), an International Fellowship from the Agency for Science, Technology, and Research (2002–2004), a Tau Beta Pi Fellowship (2000–2001), and a Tan Kah Kee Foundation Postgraduate Scholarship (2000). As a Caltech undergraduate, he received the Loke Cheng-Kim Foundation Scholarship (1996–2000), the Carnation Scholarship (1998–2000), the Herbert J. Ryser Scholarship (1999), the E.T. Bell Undergraduate Mathematics Research Prize (1999), and the Jack E. Froehlich Memorial Award (1999).

### References

Available upon request.