CURRICULUM VITAE

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Formal Education:

Ph.D.	Physics, University of Michigan, 1976
M.S.	Physics & Mathematics, University of Michigan, 1971
B.S.	Physics, University of Minnesota, 1967

Darryl D Holm is currently a Professor of Mathematics at Imperial College London. There, he performs research and teaches courses in Geometric Mechanics. His work involves formulating and analysing model continuum partial differential equations that are derived using geometry and symmetry in variational principles for dynamical systems and control problems. These continuum models have been applied, for example, to investigate nonlinear waves such as solitons, turbulence, geophysical fluid dynamics (GFD) in climate change and weather variability, and, more recently, to derive and analyse stochastic PDE models of (i) multiscale fluid interactions and (ii) shape analysis for image registration.

Recently, Holm has been developing the field of Stochastic Geometric Mechanics (SGM), as summarised in his list below of publications with links to the journals where they have appeared.

Holm is also a mentor in Imperial College London's Mathematics Department for the EPSRC awarded Centre for Doctoral Training entitled "Mathematics of Planet Earth" (http://mpecdt.org/). Recently, his work on stochastic GFD has led to collaboration with other leaders of the EPSRC MPE CDT to investigate Stochastic Dynamical Data Assimilation (SDDA) for quantifying and reducing uncertainty in numerical simulations of weather, climate and ocean circulation. Remarkably, the SDDA approach for GFD also been found to work well for quantifying and reducing uncertainty in applications of stochastic shape analysis for image registration.

Thus, Holm's foundational development of the new science of Stochastic Geometric Mechanics (SGM) for spatial smooth invertible maps with stochastic time dependence has produced fruitful applications to uncertainty quantification and reduction of uncertainty via data assimilation in fields ranging from fluid dynamics to image analysis.

Holm's interest in SDDA has recently led to a European Research Council Synergy Grant (ERC SyG) to use stochastic geometric mechanics for the derivation, analysis, numerical simulation and assimilation of computational data and satellite observations for upper ocean dynamics. The ERG SyG, entitled "Stochastic Transport in Upper Ocean Dynamics" (STUOD), comprises a joint effort among three institutions: Imperial College London; INRIA (Rennes, FR); and IFREMER (Brest, FR).

Service:

Holm's career began in 1972 at Los Alamos National Laboratory (LANL) where for thirty four years he found many rewarding scientific and organisational opportunities. Holm began as a technical staff member in the Theoretical Design division at LANL. In 1976 he earned a PhD in theoretical physics at the University of Michigan, and in 1980 he moved to the Theoretical Division, where he helped found the Center for Nonlinear Studies and served as its Acting Director. Holm also served as Deputy Group Leader of the Applied Mathematics Group in the Theoretical Division of LANL. In 1988 he was appointed to the position of LANL Fellow. LANL Fellows comprise about 1% of the LANL staff and are tasked by the Director to provide research leadership, relieved of administrative burden.

For the past 15 years, Holm has been a Professor of Mathematics at Imperial College London. Holm first arrived at Imperial College London in 2005 as a Royal Society Wolfson Fellow. Besides furthering his scientific career, coming to London has provided Holm many opportunities to follow diverse cultural interests, as well. For example, in 2007, he was selected as one of four public members of the Society of London Theatre's Olivier Nomination and Award Committee.

At the beginning of 2010 Holm became Director of the Imperial College London Institute of Mathematical Sciences (IMS). In this position, he continued developing a joint project with London hospitals which he called "CardioMaths". In the CardioMaths project, Holm led several mathematics PhD students and postdocs to develop mathematical and computational models of the cardiology and electrophysiology underlying the hospital procedure called "ablation" of the atrium, which is used for curing atrial fibrillation (AF).

After its germination at IMS, the CardioMaths project has grown into the current Electro-CardioMaths Centre of Excellence at the Imperial College National Heart and Lung Institute.

In 2011 Holm began pursuing a new biomedical direction when he was awarded the European Research Council's Advanced Grant for another health-related research program, entitled "Five Challenges in Computational Anatomy" (FCCA). Simply put, the five challenges were: (1) to register images of different data structures and (2) combine them, even at (3) different resolutions; then do the same things with (4) splines and (5) image metamorphosis, including a stochastic element.

In 2013 Holm helped found the EPSRC Centre for Doctoral Training entitled "Mathematics of Planet Earth" (http://MPECDT.org/) in a partnership between Imperial College London's Mathematics Department and Reading University's School of Mathematical and Physical Sciences.

Recently, Holm's work has focused on using geometric mechanics in developing stochastic analysis methods for estimating uncertainties in the predictions obtained the from the flows of smooth invertible maps (diffeomorphisms, or diffeos). Remarkably, evolution by diffeomorphic maps governs both Computational Anatomy in the comparison and analysis of shapes, as well as ideal continuum dynamics which govern weather and climate. Thus, the applications of stochastic diffeomorphic maps for quantifying uncertainties in image analysis also can be used for uncertainty quantification in the fundamental data-driven equations of weather variability and climate change. This work involves a wide range of expertise. Its application focused in weather and climate is conducted under the auspices of an EPSRC Standard Grant, in collaboration with other members of the Imperial College Mathematics Department and the MPECDT staff, especially Dr Colin Cotter and Professor Dan Crisan.

Thus, Holm's foundational development of the new science of Stochastic Geometric Mechanics for spatial smooth invertible maps with stochastic time dependence has led to fruitful applications to the mathematics of uncertainty quantification and data assimilation in fields ranging from fluid dynamics to image analysis.

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Publication summaries:
http://arxiv.org/find/all/1/au:+Holm_D/0/1/0/all/0/1
http://scholar.google.co.uk/citations?user=to0hReIAAAAJ

Research Interests and Citations:

Before coming to Imperial College London in 2005 as Professor of Mathematics, Holm spent thirty four years at Los Alamos National Laboratory. During his scientific career, Holm has developed a wide range of interests, many of which were informed by his geometric approach to dynamical systems.

Reviews of more than 250 of his publications in mathematics have appeared in *Mathematical Reviews*, available on MathSciNet. About 200 of Holm's papers have also been indexed in the Zentralblatt MATH Database, including 12 books.

Holm's main activities have been based on his use of geometric mechanics to derive and analyse new nonlinear evolution equations for multiscale phenomena. Applications of these equations range from climate modeling and ocean circulation, to template matching in imaging science, to telecommunications. The solution behavior of these equations includes solitons (governed by the Camassa-Holm equation), turbulence (modelled by Holm's LANS-alpha equation), template marching for biomedical images (modelled by the EPDiff equation) and the method of stochastic advection by Lie transport (SALT) for uncertainty quantification and reduction of uncertainty via data assimilation for upper ocean dynamics.

Patents: In telecommunications, Holm holds the patent on the Iterated Mapping Approach for controlling the pulse propagation and re-amplication process in optical fibers.[1]

[1] UNITED STATES PATENT # 6157762 was issued December 5, 2000. It grants the intellectual property rights for using nonlinear amplifying loop mirrors (NALMs) to stabilize, shape and regenerate optical pulses in fibers at high bit rates. The patent is based on treating the pulse propagation and re-amplication process as an iterated mapping. For a technical summary, see I. Gabitov, D. D. Holm, B. Luce and A. Mattheus, *Optics Lett.* **20** (1995) 2490-2492. http://wikipatents.com/US-Patent-6157762/nonlinear-pulse-reshaping-for-optical-fiber-transmission-systems

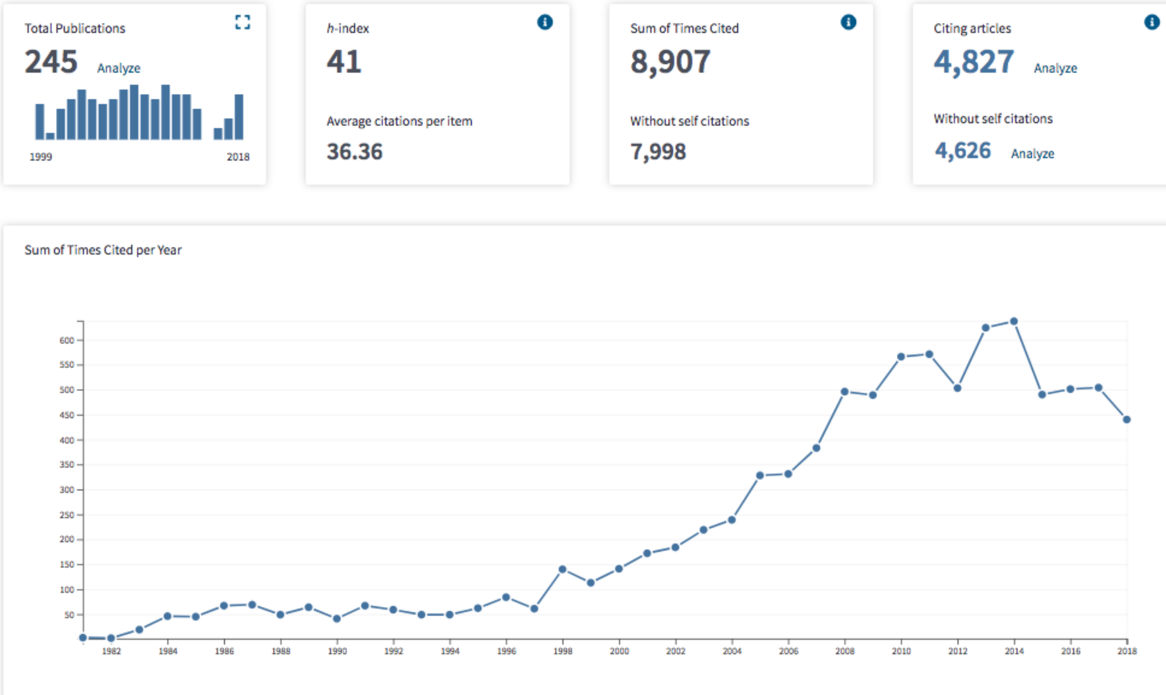

Figure 1: Holm's citation rate has more than doubled during the past ten years, according to the Web of Science (WoS). Holm's WoS h-index is 41 and his most cited paper has about 1950 citations on WoS.

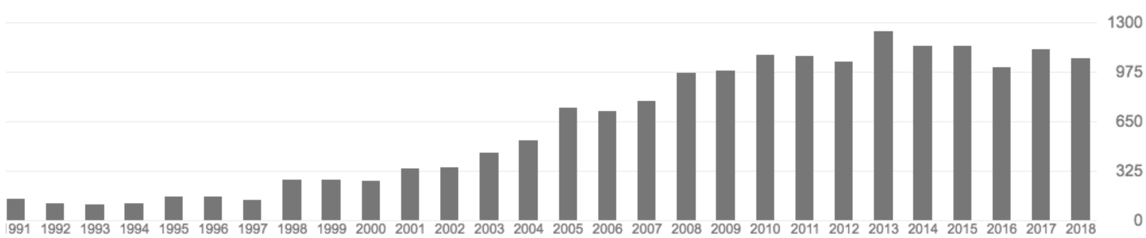

Figure 2: Citations on Google Scholar (GS) arises from computer searches which incorporate more journals than WoS and include arXiv citations. Holm has about 18,500 GS citations, his GS h-index is 61 and his most cited paper has about 2,800 citations on GS. *Holm's top 4 cited papers on GS have a total of more than 5000 citations.*

In fluid dynamics Holm has developed new methods of derivation and analysis of approximate fluid equations by using averaging, asymptotics and geometrical dynamics in Hamilton's principle. These methods include the Euler-Poincaré theory to derive and analyse Lagrangian averaged closure equations for large eddy simulation (LES) of turbulence. The resulting mathematical regularization approach to deriving closure models for computing turbulence in fluids and plasmas has now become a standard approach.

These regularization closures include the Lagrangian-averaged Navier-Stokes-alpha (LANS-alpha) models of turbulence. These turbulence closures are still a very active area of study. For example, the LANS-alpha model is in now in use in the Parallel Ocean Program at

Los Alamos for computing high resolution global ocean circulation, including the effects of subgrid scales and turbulence on Lagrangian mean motions of a rotating stratified fluid.

During 2005–2010, when he first arrived at Imperial College London as a Royal Society Wolfson Fellow, Holm worked to demonstrate the power of geometric mechanics in a variety of applications ranging from nonlinear water waves to plasma physics, and from numerical methods to the discovery of new classes of equations showing emergent singularities with coherent dynamics.

During 2009–2013 at Imperial College London, Holm was developing the CardioMaths project. The CardioMaths project team addressed the mathematics of the interactions of electrocardial waves with each other and with the shape and heterogeneity of the heart. In partnership with medical clinicians, engineers and computer scientists, the team developed the capability to model a certain medical surgical procedure known as "ablation" for curing the cause of the irregular heartbeat syndrome called atrial fibrillation. This project has now transformed into the ElectroCardioMaths Programme at the Imperial College National Heart and Lung Institute, see `http://www.imperial.ac.uk/nhli/research/centres-and-initiatives/electrocardiomaths-programme/` for more details and recent progress.

Since 2009 and in parallel with these medical procedures, Holm has been developing mathematical methods for comparing, denoising and interpreting magnetic resonance images (MRI), and fusing the results with other types of medical images. For this purpose, Holm developed the EPDiff equation, which controls the evolution of the momentum map for each data structure as it transforms along geodesics from one shape to another with respect to the norms chosen for comparison. of the images

In 2014 Holm helped found the EPSRC MPE CDT `mpecdt.org`. In support of the CDT Holm has developed a course in PDEs for geophysical fluid dynamics (GFD). In addition, Holm has established a research program in stochastic geometric mechanics for aimed at estimating model error in numerical weather forecasting and climate simulations.

Holm's work on stochastic geometric mechanics for GFD has recently had a sequence of further developments, which we now briefly sketch, with recent references below.

1. In [Hol15], the extension of geometric mechanics to include stochasticity in nonlinear fluid theories was accomplished by using Hamilton's variational principle, constrained to enforce stochastic Lagrangian fluid trajectories arising from the stochastic Eulerian vector field
$$v(x,t,dW) := u(x,t)\,dt + \sum_{i=1}^{N} \xi_i(x) \circ dW^i(t)\,, \tag{1}$$
regarded as a decomposition into the sum of a drift velocity $u(x,t)$ and a sum over stochastic terms. Imposing this decomposition as a constraint on the variations in Hamilton's principle for fluid dynamics [HMR98], led in [Hol15] to new stochastic partial differential equation (SPDE) models of the effects of unknown, rapidly fluctuating, scales of motion on slower resolvable times scales in a variety of fluid theories, particularly for geophysical fluid dynamics (GFD).

2. The same decomposition of the fluid flow velocity into a sum of drift and stochastic parts derived in [Hol15] was also discovered in [CGH17] to arise in a multi-scale decomposition of the deterministic Lagrange-to-Euler flow map into a slow large-scale mean and a rapidly fluctuating small scale map. Homogenisation theory was used to derive effective slow stochastic particle dynamics for the resolved mean part, thereby justifying the stochastic fluid partial equations in the Eulerian formulation. The application of rigorous homogenisation theory required assumptions of mildly chaotic fast small-scale dynamics, as well as a centering condition, according to which the mean of the fluctuating deviations was small, when pulled back to the mean flow.

   The results of [CGH17] justified regarding the Eulerian vector field in (1) as a genuine decomposition of the fluid velocity into a sum of drift and stochastic parts, rather than simply a perturbation of the dynamics meant to model unknown effects in uncertainty quantification. As a genuine decomposition of the solution, one should expect that the properties of the fluid equations with stochastic transport noise should closely track the properties of the unapproximated solutions of the fluid equations. For example, if the unapproximated model equations are Hamiltonian, then the model equations with stochastic transport noise should also be Hamiltonian, as shown in [Hol15].

3. Paper [DOC18] showed that the same stochastic fluid dynamics derived in [Hol15] naturally arises from an application of a stochastic Lagrange-to-Euler map to Newton's second law for a Lagrangian domain of fluid, acted on by an external force. In addition, local well posedness in regular spaces and a Beale-Kato-Majda blow-up criterion are proved in [DOC18] for the stochastic model of the 3D Euler fluid equation for incompressible flow derived in [Hol15]. Thus, the analytical properties of the 3D Euler fluid equations with stochastic transport noise derived in [Hol15] closely mimic the corresponding analytical properties of the original deterministic 3D Euler fluid equations.

4. Inspired by spatiotemporal satellite observations of the trajectories of objects drifting near the surface of the ocean in the National Oceanic and Atmospheric Administration's "Global Drifter Program", paper [FGB18] developed data-driven stochastic models of geophysical fluid dynamics (GFD) with non-stationary spatial correlations representing the dynamical behaviour of oceanic currents. These models were derived using reduction by symmetry of stochastic variational principles, leading to stochastic Hamiltonian systems, whose momentum maps, conservation laws and Lie-Poisson bracket structures were used in developing the new stochastic Hamiltonian models of GFD with nonlinearly evolving stochastic properties.

5. The stochastic fluid velocity decomposition results of [Hol15] and [CGH17] show that the principles of transformation theory and multi-time homogenisation can be used to lay the foundations for a physically meaningful, data-driven and mathematically-based approach for decomposing the fluid transport velocity into its drift and stochastic parts. This approach can be applied immediately to the class of continuum flows whose deterministic motion is based on fundamental variational principles.

   Two related papers [CCH$^+$18a, CCH$^+$18b] have recently used this approach to develop a new methodology to implement the velocity decomposition of [Hol15] and [CGH17] for uncertainty quantification in computational simulations of fluid dynamics. The new methodology was tested numerically and found to be suitable for coarse graining in two separate types of problems based on discretisations using either finite elements, or finite differences. Specifically, uncertainty quantification tests using this velocity decomposition were performed by comparing ensembles of coarse-grid realisations of solutions of the resulting stochastic partial differential equation with the "true solutions" of the deterministic fluid partial differential equation, computed on a refined grid. The time discretisation used for approximating the solution of the stochastic partial differential equation was shown to be consistent. Comprehensive numerical tests confirmed the non-Gaussianity and quantified the uncertainty of the stream function, velocity and vorticity fields for incompressible 2D Euler fluid flows in a bounded domain using finite elements [CCH+18a] and for 2-layer quasi-geostrophic flows in a 2D periodic channel using finite differences [CCH+18b].

References

[CCH+18a] Colin J. Cotter, Dan Crisan, Darryl D. Holm, Wei Pan, and Igor Shevchenko. Modelling uncertainty using circulation-preserving stochastic transport noise in a 2-layer quasi-geostrophic mode. *arXiv:1802.05711*, 2018.

[CCH+18b] Colin J. Cotter, Dan Crisan, Darryl D. Holm, Wei Pan, and Igor Shevchenko. Numerically modelling stochastic lie transport in fluid dynamics. *arXiv:1801.09729*, 2018.

[CGH17] C. J. Cotter, G. A. Gottwald, and D. D. Holm. Stochastic partial differential fluid equations as a diffusive limit of deterministic Lagrangian multi-time dynamics. *Proc. Roy. Soc. A*, 473:20170388, 2017.

[DOC18] Darryl D. Holm Dan O. Crisan, Franco Flandoli. Solution properties of a 3d stochastic euler fluid equation. *J Nonlinear Sci (to appear)*, 2018.

[FGB18] Darryl D. Holm François Gay-Balmaz. Stochastic geometric models with non-stationary spatial correlations in lagrangian fluid flows. *J Nonlinear Sci*, 28(3):873–904, 2018.

[HMR98] Darryl D Holm, Jerrold E Marsden, and Tudor S Ratiu. The Euler–Poincaré equations and semidirect products with applications to continuum theories. *Advances in Mathematics*, 137(1):1 – 81, 1998.

[Hol15] D. D. Holm. Variational principles for stochastic fluid dynamics. *Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences*, 471(2176), 2015.

Holm's most recent papers have been placed on the arXiv when submitted for publication and may be found online at `https://arxiv.org/find/all/1/au:+Holm_D/0/1/0/all/0/1`

For a nearly complete list of Holm's publications, see
`https://scholar.google.co.uk/citations?user=rTwSwLsAAAAJ&hl=en&oi=ao`

Summary of Experience in Two Main Parts:

(1) Thirty-four years experience with Los Alamos National Laboratory (LANL) performing R & D coordination in issues of national and international scientific interest in applied nonlinear dynamics research, theoretical physics and experimental design. 1984 National Award of

Excellence for Significant Contribution to the Nuclear Weapons Program. Theoretical Design Team participant in 1991 Joint Verification Experiment for US/Soviet Threshhold Testban Treaty. Founding Nonlinear Science Editor for Physics Letters A, in 1986. Founding member and past Director of the LANL Center for Nonlinear Studies (CNLS). Member and past co-leader of the Mathematical Modeling and Analysis Group (T-7) at LANL. Primary supervisor of twenty eight postdoctoral fellows at LANL. Organizer of more than twenty scientific conferences and workshops there. Came to Imperial College London in 2005 as Professor of Applied Mathematics. Remains a Fellow of the Los Alamos National Laboratory, which is a lifetime appointment.

(2) Fifteen years experience in teaching and research at Imperial College London:

In 2005 Holm received the Royal Society of London's Wolfson Award for Meritorious Research.

In 2007, Holm was selected as one of four public members of the Society of London Theatre's Olivier Nomination and Award Committee. (Now that's London life!)

During 2010-2011, Holm was Director of the Imperial College London Institute of Mathematical Sciences.

Holm is interested in formulating and developing the new science of stochastic geometric mechanics, with applications in a variety of areas, ranging from quantifying errors in image registration for Computational Anatomy using the Large Deformation Diffeomorphic Metric (LDDMM) approach, to uncertainty quantification and data assimilation for climate science and meteorology.

In 2011 Holm began a new responsibility when he was awarded the European Research Council's Advanced Grant for his research program in shape analysis, entitled "Five Challenges in Computational Anatomy (FCCA)". This grant lasted until 1 May 2017.

In 2014 began nine years of teaching, mentoring and administration in EPSRC Centre for Doctoral Training entitled "Mathematics of Planet Earth" http://MPECDT.org/

In 2016–2019 Holm worked with colleagues in the Imperial College Maths Department on stochastic variational principles for geophysical fluid dynamics and its applications in uncertaity quantifiation and reduction of uncertainty using the particle filtering method for data assimilation. This work led to an EPSRC Standard Grant 2017-2019 and an ERC Synergy Grant for 2020-2026.

Ongoing Grants in Stochastic Geometric Mechanics (SGM)

Holm's interest in Stochastic Geometric Mechanics (SGM) was galvanised through his involvement in a successful bid for an EPSRC Centre for Doctoral Training (CDT) in "Mathematics of Planet Earth" (MPE) in a partnership between Imperial College London Mathematics Department and the University of Reading School for Physical Sciences, which includes the Departments of Mathematics and Statistics, as well as Meteorology. This EPSRC CDT partnership will accept a cohort of about 15 new PhD students in MPE each year for 5 years. It began in September 2014 when the first cohort arrived and it will finish in June 2022 when the last cohort graduates.

As in the deterministic case, Stochastic Geometric Mechanics has a wide range of applications, including geophysical fluid dynamics (GFD) for estimating model error in numerical weather forecasting and climate simulations.

An EPSRC standard grant "Variational principles for stochastic parameterisations in geophysical fluid dynamics"(starting 01/04/2016 for 36 months), for which Holm is the PI arose directly from discussions of the needs of the PhD students within MPE CDT.

This interest has now developed into a successful Synergy Grant proposal to the European Research Council, entitled "Stochastic Transport in Upper Ocean Dynamics" (STUOD).

Employment History:

Imperial College London
2005–present: Professor of Applied Mathematics
2010–2011: Director, Institute of Mathematical Sciences

Los Alamos National Laboratory

1988–present: Los Alamos National Laboratory Fellow

2003–2005: Scientific Advisor and Laboratory Fellow, Computer and Computational Science Division, Continuum Dynamics Group

1988–Present: Laboratory Fellow
Mathematical Modeling and Analysis Group

1985–1988: Deputy Group Leader, Theoretical Division,
Mathematical Modeling and Analysis Group

1983–1985: Staff Member, Mathematical Modeling and Analysis Group

1982–1983: Acting Director, Center for Nonlinear Studies

1972–1983: Staff Member, Theoretical Design Group

Present and Recent Research Funding as PI:

- Royal Society Wolfson Research Merit Award (2005-2010) £220K
- United States Office of Naval Research Grant (2006-2010) £320K
  Non-Linear Internal Wave Initiative (NLIWI)
- Imperial College London, Institute for Mathematical Sciences (2009-2013) £840K
  CardioMathematics Programme
- European Research Council Advanced Grant (2011-2016) £1.4M
  Five Challenges in Computational Anatomy, Grant # 267382 FCCA
- UK EPSRC Standard Grant (2016-2019) £940K
  Variational principles for stochastic parameterisations (VPSP)
  in geophysical fluid dynamics (GFD), Grant # EP/N023781/1

- EPSRC Platform Grant (co-I) (2017-2023) £600K
  Chemistry in Phase Space (CHAMPS), Steve Wiggins (Bristol) PI, EPSRC Network in Mathematics with Universities of Bristol, Leeds, Cardiff and Imperial College London.
- United States Office of Naval Research Grant (2019-2021) £200K
  Fluid Dynamics of Geometric Rough Paths (FDGRP)
- European Research Council Synergy Grant (2020-2026) €10M
  "Stochastic Transport in Upper Ocean Dynamics" (STUOD)

Ongoing Grants:

On-going Grants

Project Title	*Funding source*	*Amount (Euros)*	*Period*	*Role*	*Research Topic*
Stochastic Variational Principles for Geophysical Fluid Dynamics (SVP)	EPSRC Standard Grant	1.13M Euro	2016-2019	PI	Stochastic geometric mechanics methods for the derivation, analysis, numerical simulation and data assimilation in geophysical fluid dynamics.
Chemistry and Mathematics in Phase Space (CHAMPS)	EPSRC Programme Grant	7.02M Euro	2017-2023	Co-PI	Classical-Quantum interactions in molecular chemistry
Stochastic Transport in Upper Ocean Dynamics (STUOD)	European Research Council Synergy Grant	10M Euro	2020-2026	PI	Stochastic geometric mechanics modelling for the derivation, analysis, numerical simulation and assimilation of satellite data for upper ocean dynamics.

Selected Fellowships, Awards, Honors and External Committees:

The D2H Fest in honor of the 70th birthday of Darryl D Holm
Imperial College London 2–6 October, 2017
http://mpecdt.org/

The D2H Fest in honor of the 70th birthday of Darryl D Holm
ICMAT, Madrid 3–7 July, 2017
https://www.icmat.es/congresos/2017/darryl70/

Plenary Speaker, SIAM conference on nonlinear waves and coherent structures, Cambridge, UK, 11-14 August 2014.

Fellow of The Institute of Mathematics and its Applications (IMA), 2013 – present.

Synergy Awards Committee member
European Research Council (2012–2014)
http://erc.europa.eu/funding-schemes/synergy-grants

Recipient of European Research Council Advanced Grant 267382,
Five Challenges in Computational Anatomy
(Five Year Research Award, begun 1 May 2011)

Plenary speaker: IMA Lighthill Lecture
British Applied Mathematics Colloquium, Birmingham, 11-13 April 2011.

Primary speaker, UK-Japan Winter School
Integrable Systems & Symmetries, Univ of Manchester, 7-10 January 2010
http://www.mth.kcl.ac.uk/~berndt/conferences/UK-Japan10/ws2010home.html

Plenary speaker, Royal Society of Medicine, Training Meeting on
Clinical Electrophysiology and Atrial Fibrillation, London, 9 November 2009

Elected member of the Imperial College London British Heart Foundation Centre of Research Excellence, September 2009 – Present, http://www.imperial.ac.uk/bhfcre

Special Volume in honor of the 60th birthday of Darryl D Holm
J. Phys. A: Math. Theor. **41** (34) 29 August 2008

The D2H Fest in honor of the 60th birthday of Darryl D Holm
Centre Interfacultaire Bernoulli (CIB)
EPFL in Lausanne, Switzerland, 22–28 July, 2007
http://cib.epfl.ch/PublicEvent.php?event=565

July 2007, Plenary Speaker, Dynamics Days Europe, Loughborough, UK

Member, COST Action MP0806: Particles in Turbulence,
September 2009 – Present http://mp0806.cineca.it/

Jan-Dec 2007, Society of London Theatre's Olivier Nomination and Award Committee

September 2006, Rockefeller Foundation Resident Scholar, Bellagio, Italy

July 2005 Invited Lecturer, ICTP Summer School and Conference on Poisson Geometry, held in Trieste, Italy

May 2005, Inaugural Lecture, Imperial College London

January 2005, Royal Society of London Wolfson Fellowship
for Meritorious Research, Five Year Research Award

September 2004, Keynote Speaker,
International Workshop on Camassa-Holm Equations, Bologna, Italy

August 2003, Plenary Speaker, International Meeting in Direct and Large Eddy Simulations, Münich, Germany

Jan 2003, Plenary Speaker, Dynamics Days, held at Scottsdale, AZ

July-August 2002, Visiting Fellow, Warwick University, Coventry, UK

March 2001, Plenary Speaker, Fred Howes Memorial Workshop, held at MSRI, UC Berkeley

2000 Visiting Fellow, Isaac Newton Institute for Mathematical Sciences, Cambridge University, Cambridge, UK, October-December 2000

2000 Lecturer, MASIE Summer School, Course on *Hamiltonian Fluid Mechanics*, Peyresq, France, September 3 - 16

1998 Lecturer, DANISH CENTER FOR APPLIED MATHEMATICS AND MECHANICS, TECHNICAL UNIVERSITY OF DENMARK, Ph.D.-course / Advanced school, Variational Methods in Applied Mechanics, Lyngby, January 12 - 21

1997 Senior Assessment Panel, National Science Foundation, Division of Mathematical Sciences, International Assessment of the US Mathematical Sciences, January-July, 1997, http://www.nsf.gov/pubs/1998/nsf9895/

1997 UC Visiting Scholar, UCSC Mathematics Department, Santa Cruz, CA, January-May

1997 Los Alamos National Laboratory Achievement Award

1996 Scientific Advisory Board, Isaac Newton Institute for Mathematical Sciences, research programme in THE MATHEMATICS OF ATMOSPHERE AND OCEAN DYNAMICS, Cambridge University, Cambridge, UK

1996 Plenary Speaker, SIAM Annual Meeting, Kansas City, MO

1995 Participant, Isaac Newton Institute for Mathematical Sciences, research programme in LOW DIMENSIONAL BEHAVIOR OF PDEs, Cambridge University, Cambridge, UK

1991 Theoretical Design Team Participant, Joint Verification Experiment for US/Soviet Threshhold Testban Treaty

1988–present, Laboratory Fellow, Los Alamos National Laboratory

1988 Plenary Lecturer, Enrico Fermi Summer School, Varenna, Italy. Course CIX, "Nonlinear Topics in Ocean Physics", organized by A. R. Osborne.

1986–1994 Founding Editor, *Physics Letters A*, Nonlinear Science Section

1984 National Award of Excellence for Significant Contribution to the Nuclear Weapons Program

1984 Los Alamos National Laboratory, Distinguished Performance Award

1981–2000, Executive Committee for Los Alamos Center for Nonlinear Studies

1967–1971 Danforth Fellow, University of Michigan

Conferences, Workshops and Minisymposia Organized:

Co-Organizer,
D'Arcy Thompson Shape Analysis Program

Isaac Newton Institute, Cambridge, UK
22 August – 20 December, 2017
https://www.newton.ac.uk/event/gfs

Co-Organizer,
CliMathNet Conference 2017
The 5th Annual CliMathNet Conference
Henley Business School, Whiteknights Campus
University of Reading, from 29 August – 1 September 2017
http://www.climathnet.org/2017conferencereading/

Co-Organizer,
International Workshop on Mathematics of Climate Change and Natural Disasters,
Date: 24-28 March 2017
Venue (Local): LIT-INPE, Sao José dos Campos (SP), Brazil

Co-Organizer,
London Mathematical Society Scheme 2 grant for a lecture tour and UK visit by
Professor Yvette Kosmann-Schwarzbach in March 2016

Co-Organizer, UK-Japan Winter School, *Classic and Stochastic Geometric Mechanics.* http://www.brunel.ac.uk/~mastmmb/ukjapan16/
Held January 4-7, 2016, Mathematics, Imperial College London.
London Mathematical Society Scheme 1 Grant ref. 11521

Co-Organizer, Four Workshops on Analysis, Geometry and Stochastics for Planet Earth, 2015-2016, London Mathematical Society Grant ref. 31416 LMS Scheme-3 Grant

Co-Organizer, Four Workshops on Geometric Mechanics, 2014-2015, London Mathematical Society Grant ref. 31320 LMS Scheme-3 Grant

Program Committee, MFCA2015, Mathematical Foundations of Computational Anatomy, 9 October 2015, in Munich, Germany, as a Satellite Meeting of MICCAI 2015, devoted to statistical and geometrical methods for modelling the variability of biological shapes. http://www-sop.inria.fr/asclepios/events/MFCA15/.

Co-Organizer, Geometric Mechanics, Variational & Stochastic Methods Program
EPFL, Lausanne, Switzerland
1 Jan - 30 June, 2015
http://gmvsm2015.epfl.ch/

Co-Organizer, Special Session on *Geometric Mechanics*, comprising 47 speakers in 5 days at the 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, held 7-11 July 2014 in Madrid, Spain.

Co-Organizer, Workshop *Mathematical Foundations of Computational Anatomy.*
Held June 10-13, 2014, Mathematics, Imperial College London.

Co-Organizer, Complex Fluids Program
Isaac Newton Institute, Cambridge, UK

1 May - 23 August, 2013
http://www.newton.ac.uk/programmes/CFM/ws.html

Co-Organizer, Focus Program on Geometry, Mechanics and Dynamics:
the Legacy of Jerry Marsden
Fields Institute, Toronto, July 2012
http://www.fields.utoronto.ca/programs/scientific/12-13/Marsden/

Organizer, Minisymposium *EPDiff @ EquaDiff.*
Held at Loughborough University, August 1-5, 2011
http://atlas-conferences.com/cgi-bin/abstract/cbbz-01

Organizer, Workshop *Mathematical Foundations of Computational Anatomy.*
Held May 16-20, 2011, Mathematics, Imperial College London.

Organizer, Workshop *Optimal Control and Shape Matching in Biomedical Imaging.*
Held April 19-22, 2010, Institute for Mathematical Sciences, Imperial College London.

Co-Organizer, Workshop *Optimal Control and Shape Matching in Biomedical Imaging.*
Held April 20-22, 2009, Annapolis, MD, USA.

Organizer of Workshop, *Optimal Control and Shape Matching in Biomedical Imaging.*
Held July 24-28, 2006, Santa Fe, NM, USA.
https//:wiki.cis.jhu.edu/projects/shapefrg

Co-Organizer, *Warwick Turbulence Symposium:*
Workshop, Environmental Turbulence from Clouds through the Ocean.
Held at Warwick University, March 13-17, 2006
http://www.eng.warwick.ac.uk/staff/rmk/rmk_files/environmental.htmlheld

Co-Organizer, Workshop *Probability, Geometry & Integrable Systems* (In honor of Henry McKean) Held at UC Berkeley, MSRI, December 5-9, 2005

Co-Organizer, CNLS Workshop, *Turbulence.*
Held July 2005, at La Fonda, Santa Fe, NM.

Co-Organizer, CNLS Workshop, *Turbulence*
Held August 2004, at Bishop's Lodge Resort, Santa Fe, NM.

Co-Organizer, Bernoulli Centre Workshop,
Geometric Mechanics and Its Applications,
Held 12-16 July 2004, at EPFL, Lausanne, Switzerland.
http://cib.epfl.ch/PublicEvent.php?event=721

Co-Organizer, CNLS Workshop, *Statistical Hydrodynamics.*
Held March 2002, at Santa Fe, NM.

Co-Organizer, NSF Workshop, *Frontiers of Mathematics in Geosciences.*
Held March 5-7, 2001, at IMA, U Minnesota.[2]

[2]For details about this program, including description, schedule, titles and abstracts, online copies of

Co-organizer, CNLS/ONR 1998 Conference, *Singularities in Nonlinear Physics, Mathematics and Engineering*, held January 4-6, 1998, in Santa Fe, NM.

1997 Co-chair, SIAM Workshop on *Bioremediation and Porous/Fracture Flow*.
Held Summer 1997 at Los Alamos, NM.
http://www.siam.org/meetings/archives/br97/br97home.htm

Co-chair, CNLS 1995 Conference on *Nonlinear Phenomena in Ocean Dynamics*

Co-chair, NEEDS '94 Conference on *Nonlinear Evolution Equations and Dynamical Systems*

Co-chair, CNLS 1993 Conference on *Forces of Nature*

Co-chair, CNLS 1988 Conference on *Advances in Fluid Turbulence*
Physica D: Nonlinear Phenomena, Volume 37, Issues 13, Pages 1-564 (July 1989)

Co-chair, University of California *1986 Summer School in Nonlinear Science*

Co-chair, AMS-SIAM 1984 Summer Seminar on *Systems of Nonlinear PDEs*, held at College of Santa Fe

Chair, CNLS 1983 Conference on *Fronts, Interfaces and Patterns*

Co-chair, *Joint Los Alamos/Limeil Conference on Hydrodynamics and Instabilities*, June 28-July 2,1982

Books Authored:

Geometric Mechanics and Symmetry: From Finite to Infinite Dimensions,
DD Holm,T Schmah and C Stoica.
Oxford University Press, (2009).
ISBN 978-0-19-921290-3

Geometric Mechanics I: Dynamics and Symmetry,
DD Holm.
World Scientific: Imperial College Press, Singapore, (2008).
ISBN 978-1-84816-195-5, 2nd edition (2011).

Geometric Mechanics II: Rotating, Translating and Rolling
DD Holm
World Scientific: Imperial College Press, Singapore, (2008).
ISBN 978-1-84816-155-9, 2nd edition (2011).

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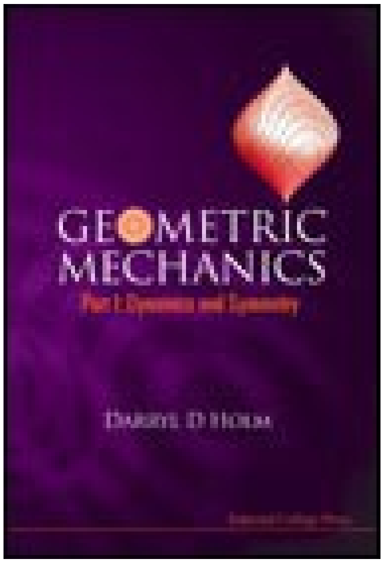
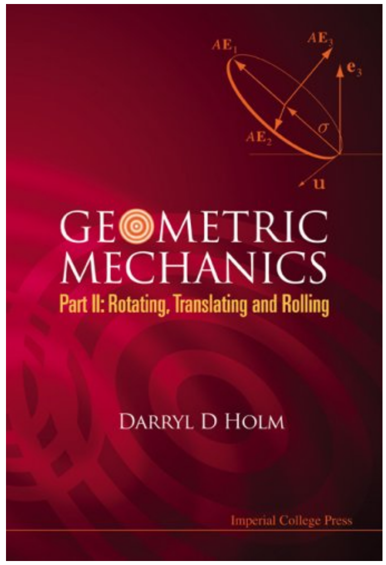
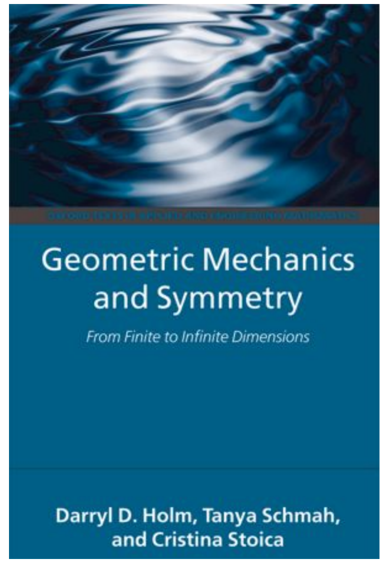
presentations, and participant lists, see: http://www.ima.umn.edu/multimedia/winter/frontier.html







Recent *Reviews* of Holm's Books:

G Derks (2009) Geometric Mechanics, by Darryl D Holm.
BOOK REVIEW, *J Geom Mech* **1**, 267-270.

P Lynch (2009) Featured Review: Geometric Mechanics, Part I: Dynamics and Symmetry, by Darryl D Holm.
SIAM REVIEW **51**, 639-640.

P Hydon (2008) Geometric Mechanics, Part II: Rotating, Translating and Rolling, by Darryl D Holm.
UK Nonlinear News Review Issue 55, Jun 2009.
http://www.maths.leeds.ac.uk/applied/news.dir/issue55/geom.html

W Freiberger (2009) NEW BOOKS: Geometric Mechanics, Part I: Dynamics and Symmetry, by Darryl D Holm.
Quart. of Appl. Math. **67** (2009) 793-793.

W Freiberger (2009) NEW BOOKS: Geometric Mechanics, Part II: Rotating, Translating and Rolling, by Darryl D Holm.
Quart. of Appl. Math. **67** (2009) 795-795.

M. Dixon (2008) Geometric Mechanics, Part I and Part II, Reviews on Amazon Book Pages Online

M. Rodrígues-Olmos, Geometric Mechanics and Symmetry: From finite to infinite dimensions, by Darryl D. Holm, Tanya Schmah and Cristina Stoica
BOOK REVIEW, *J. Geom. Mech.* **1**, (4) 483-488 (2009)

G. Gaeta, Geometric Mechanics and Symmetry: From finite to infinite dimensions, by Darryl D. Holm, Tanya Schmah and Cristina Stoica.

BOOK REVIEW Zentralblatt MATH Database,
European Mathematical Society, Zbl 1175.70001

R. J. Gray, Geometric Mechanics and Symmetry: From finite to infinite dimensions, by Darryl D. Holm, Tanya Schmah and Cristina Stoica.
BOOK REVIEW *UK Nonlinear News Review* Issue 61, Dec 2010.
http://www.maths.leeds.ac.uk/applied/news.dir/issue61/symm.html

W. J. Satzer, Geometric Mechanics and Symmetry: From finite to infinite dimensions, by Darryl D. Holm, Tanya Schmah and Cristina Stoica.
BOOK REVIEW 12/03/2009, Mathematical Association of America,
http://wwwdev.maa.org/maa{%}20reviews/1215095.html

American Mathematical Society MathSciNet Reviews

(a) **MR2419209 (2011d:37162)** Holm, Darryl D.
Geometric mechanics. Part I. Dynamics and symmetry.
Imperial College Press, London; distributed by World Scientific Publishing Co. Pte. Ltd., Hackensack, NJ, 2008. xx+354 pp. ISBN: 978-1-84816-195-5; 1-84816-195-6
(Reviewer: Tudor S. Ratiu, 2011)

(b) **MR2419210 (2011d:37163)** Holm, Darryl D.
Geometric mechanics. Part II. Rotating, translating and rolling.
Imperial College Press, London; distributed by World Scientific Publishing Co. Pte. Ltd., Hackensack, NJ, 2008. xvi+294 pp. ISBN: 978-1-84816-155-9; 1-84816-155-7
(Reviewer: Tudor S. Ratiu, 2011)

(c) **MR2548736 (2011d:37001) 37-01 (37Jxx 37K05 37K65 70G45 70G65 70H05 70Hxx) Holm, Darryl D. (4-LNDIC); Schmah, Tanya [Schmah, T. I.] (5-MCQR); Stoica, Cristina (3-WLR)**
Geometric mechanics and symmetry. From finite to infinite dimensions. With solutions to selected exercises by David C. P. Ellis.
Oxford Texts in Applied and Engineering Mathematics, 12. Oxford University Press, Oxford, 2009. xvi+515 pp. ISBN 978-0-19-921291-0
(Reviewer: Frans Cantrijn, 2011)

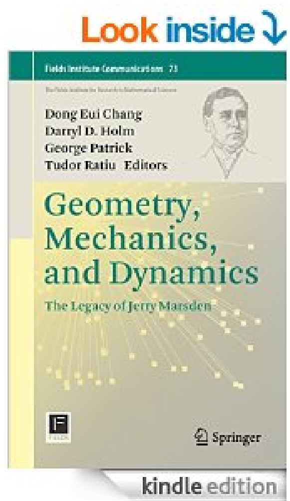
Books authored (cont)

Crossover-Time in Quantum Boson and Spin Systems
G.P. Berman, E.N. Bulgakov and D.D. Holm,
Lecture Notes in Physics, Vol. **m21**, Springer-Verlag
ISBN 3-540-58011-5 (1994).

Hamiltonian Structure and Lyapunov Stability for Ideal Continuum Dynamics
D.D. Holm, J.E. Marsden and T.S. Ratiu, University of Montreal Press,
ISBN 2-7606-0771-2 (1986).

Symmetry breaking in fluid dynamics: Lie group reducible motions for real fluids.
PhD Thesis (Physics) The University of Michigan (1976).
http://www.osti.gov/energycitations/servlets/purl/7348957-Ic54kH/7348957.pdf

Books and Journal Volumes Edited:



Geometry, Mechanics and Dynamics: The Legacy of Jerry Marsden,
D. E. Chang, D. D. Holm, G. W. Patrick and T. S. Ratiu, Springer-Verlag, New York (2015).

Nonlinear Phenomena in Ocean Dynamics, D. D. Holm, R. C. Malone, L. G. Margolin and R. Smith, *Physica D*, **98** (1996) 229 – 600.

Nonlinear Evolution Equations & Dynamical Systems, NEEDS '94, International Workshop Proceedings, A. R. Bishop, D. D. Holm and V. G. Makhankov, World Scientific, Singapore (1995).

Advances in Fluid Turbulence, with G. Doolen, R. Ecke, D. D. Holm and V. Steinberg, *Physica D*, **37** (1989) 1 – 564.

Proceedings of the Conference on Numerical Methods in High Temperature Physics, R.E. Alcouffe, D. D. Holm and P.J. O'Rourke, LA-11342-C, Los Alamos National Laboratory (1988).

Nonlinear Systems of Partial Differential Equations in Applied Mathematics, D. D. Holm, J.M. Hyman and B. Nicolaenko, Lectures in Applied Mathematics, Volume 23–Parts 1 and 2, AMS, Providence (1986).

Proceedings of the Joint Los Alamos/Limeil Conference on Hydrodynamics and Instabilities, June 28-July 2,1982, Los Alamos National Laboratory LAUR (1983).

SCIENTIFIC JOURNAL EDITORSHIP:

Physics Letters A, Nonlinear Science section, March 1986 – February 1994
(Founding Editor)

SIAM Journal of Applied Dynamical Systems
Associate Editor, March 2001 – 2005
http://epubs.siam.org/sam-bin/dbq/toclist/SIADS

Dynamics of PDE
Associate Editor, October 2004 – May 2005
http://www.intlpress.com/PDE

Theoretical and Computational Fluid Dynamics
Associate Editor Dec 2005 to present.
http://www.springer.com/materials/mechanics/journal/162

Journal of Physics A: Mathematical and Theoretical
Associate Editor Dec 2005 to Dec 2015.

Journal of Geometric Mechanics
Associate Editor May 2009 to present.

Journal of Nonlinear Science
Associate Editor Fall 2012 to present.
Senior Editor Fall 2016 to present.

International Journal of Geometric Methods in Modern Physics (IJGMMP)
Associate Editor Fall 2012 to present.

SIGMA (Symmetry, Integrability and Geometry: Methods and Applications)
Associate Editor June 2013 to present.

Dynamics and Statistics of the Climate System: An Interdisciplinary Journal,
Advisory Board, Mar 2016 to present.

Managing editor of the annual book series *Springer Briefs in Mathematics of Planet Earth - Weather Climate Oceans*, Mar 2016 to present..

UNITED STATES PATENT # 6157762:
Nonlinear pulse reshaping for fiber transmission systems.

Granted December 5, 2000.

USP# 6157762 patents the idea of using nonlinear amplifying loop mirrors (NALMs) to stabilize, shape and regenerate optical pulses in fibers at high bit rates. The idea treats the pulse propagation and re-amplication process as an **iterated mapping**. See I. Gabitov, D. D. Holm, B. Luce and A. Mattheus, *Optics Lett.* **20** (1995) 2490-2492.

Our invention uses certain nonlinear optical devices (NALMs) to reshape and recover optical pulses which have suffered distortions during propagation in an optical fiber due to chromatic dispersion, energy losses, and other effects. Our device, which we name a Nonlinear Pulse Reshaping Device (NPRD), is specifically designed to minimize the differences between the amplitude and phase of input and output pulses. This causes the reshaping or recovery of optical pulses which have suffered distortion during propagation in an optical fiber that restores them into a form which is very similiar in terms of amplitude and phase profiles to the pulses initially launched into the fiber.

To show that such a device can be built and is practical to operate, we wrote the scientific article entitled *Recovery of solitons with nonlinear amplifying loop mirrors*, published in 1995 by Ildar Gabitov, Darryl Holm, Benjamin Luce, and Arnold Mattheus. This article is a theoretical analysis of the use of Nonlinear Amplifying Loop Mirrors (NALM's) to recover optical pulses.

International Committees

- European Research Council, ERC Synergy Evaluation Committee (2014)

Imperial College London

Mathematics Outreach: MathMatters, 2005 – 2012

The MathMatters Outreach Presentation Program was founded by Holm in 2005 as a co-operative venture between the Mathematics Department and ExciTech, the College's external contractor for outreach. During 2005-2009 MathMatters trained about two dozen third-year students annually. In academic year 2009-2010, MathMatters opened admissions to both second-year and third-year mathematics students. This was a successful move and the programme has become an exciting and vital means for students in both years to develop transferable life skills and confidence in public presentation. In addition, hundreds of secondary school students in the London area have been exposed to the potential enjoyment and career opportunities afforded by choosing further education in mathematics.

These volunteer mathematics students in the MathMatters Program were first given intensive coaching and practice in their oral presentation skills during four Saturday group sessions. Then they participated in three to four individual team coaching sessions depending on group needs. The student presentations were designed, rehearsed, coached and developed to emphasise interesting applications of mathematics that fit into the Secondary School curriculum. The presentations were then scheduled with the secondary schools through ExciTech, who also funded the CRB (Criminal Record Bureau) checks. After each presentation, the university students were debriefed and given further encouragement, recognition and coaching, as needed.

One of the rewarding features of this program so far has been that about 25% of the MathMatters participants have gone into teaching high school mathematics. Another rewarding feature was that MathMatters students reported feeling increased confidence and success in their job and postgraduate interviews.

Service at Imperial College

Faculty of Natural Sciences

- Grantham Institute College Management Board, 2015
- Director, Institute for Mathematical Sciences, 2011
- Natural Sciences Lecture Committee, 2009
- Natural Sciences Strategic Research Committee, 2011, 2007-2009
- Natural Sciences Organisational Research Committee, 2006
- Advisory Committee Grantham Institute for Climate Change
  – Co-Organiser: First Grantham Workshop, 2007

Mathematics Department

- Executive Committee, Mathematics of Planet Earth,
  Centre for Doctoral Training, 2014 – Present
- Management Committee, 2011
- Research Assessment Exercise Committee, 2008
- Dynamical Systems Hiring Committee, 2007

Graduate Teaching at Imperial College

2014 – Present

- Autumn term: PDEs for Geophysical Fluid Dynamics (MPE CDT students)

Undergraduate Teaching at Imperial College

2008 – Present

- Spring term: Geometric Mechanics 2 (M4A34) (Fourth Year)
- Fall term: Geometric Mechanics 1 (M3A16) (Third/Fourth Year)

2007

- Dynamics II (M3A16) (Third/Fourth Year)
- Geometry Symmetry and Mechanics (M4A34) (Fourth Year)
- Information Science Engineering (ISE2.11) (Second Year)

2006

- Dynamics II (M3A16) (Third Year)
- Information Science Engineering (ISE2.11) (Second Year)
- Geometry Symmetry and Mechanics (M4A34) (Fourth Year)
- Mathematics for Civil Engineering (M1Ci) (First Year)

2005

- Dynamics II (M3A16) (Third Year)
- Mathematics for Chemical Engineering (M1Eng) (First Year)
- Geometry Symmetry and Mechanics (M4A34) (Fourth Year)

16 Masters Thesis Students (4th-year MSci) at Imperial College

2016

Joaniquet Tukiainen, (Angel) (MSc)
Nonlinear Wave Dynamics on a Strand of Poincaré Disks

Erwin Luesink (MSc, Twente University, The Nederlands)
Stochastic GFD Models

2015

So Takao (MSc)
Stability of Quasigeostrophic Point Vortices

2014

Gavin Ball (4th year)
Knots in Reeb flows

Nadir Ganaba (MSc)
Stochastic processes in optimal control

2013

Alex Lucas (4th year)
Toda lattice G-strands

Jérémy Adric Firozaly (MSc)
Nonlocal, nonlinear waves in fluids: a study of the b-equation

2012

Eric Lai (3rd year)
Geometric Mechanics of String Theory

2011

Elias Malik
Magnetic Tornadoes

Jan Jachnik
Spinning and Rolling of an Unbalanced Disk

Rowan Lonsdale
Geometric Phase of Euler's Disk

2010

Anthony Young,
Geometric Quantisation

2009

Eugene T. Y. Chang,
Eikonal equations for electrical waves in the heart

2006

Kin Tang, *Rolling of a Sphere with Off-Center Mass*

Matthew Rihan, *Quaternionic Rigid Body Dynamics*

David Ellis, *Hopf Fibration and the 1:1 Resonance*

2004 - 2005

Sam Stechmann, *Soliton Models for Internal Waves*
http://www.krellinst.org/doecsgf/deixis/2005/practicum.php?id=201

13 PhD Students at Imperial College

Matthew Dixon, *Geometric Integrators for Continuum Dynamics, 2007*
(1st postdoc with A Lew at Stanford, 2nd postdoc with my previous postdoc S Shkoller at UC Davis, then Assistant Professor at UC San Francisco, now Dixon is an Associate Professor at UI Chicago.)

Cesare Tronci, *Kinetic Theory of Aggregation*, 2008
(After a postdoc with TS Ratiu at EPFL, Tronci is now a Reader at Surrey University)

David Ellis, *Geometric Mechanics and Field Theory*, 2011
(Now working at Geneva, CH at < *David.Ellis@brevanhoward.com* >)
http://en.wikipedia.org/wiki/Brevan_Howard

Martins Bruveris, *Geometry of Diffeomorphism Groups and Shape Matching*, 2012
(After a postdoc with TS Ratiu at EPFL and 4 years as Lecturer at Brunel College London, Bruveris is now working in London.)

David Meier, *Higher Order Variational Principles for Imaging*, 2013 (After 5 years as Lecturer at Brunel College London, now works in Zurich, CH.)

Alexis Arnaudon (Started Sept 2013, viva 3 Mar 2017, PhD June 2017), Finished a postdoc with Mauricio Baharona, in the EPSRC Precision Medicine project, Mathematics Department, Imperial College London. Now at EPFL.

Nader Ganaba (Started March 2015, now on Interruption of Studies)

Athami Bettencourt de Leon (Started Sept 2016)

So Takao (Started Sept 2016)

Erwin Luesink (Started Sept 2017)

Stuart Patching (Started Sept 2018)

Oliver Street (Started Sept 2019)

Ruiao Hu (Started Sept 2019)

18 Postdoctoral Fellows at Imperial College

Colin J Cotter, 2005-2006 (Now Reader at Imperial College, Mathematics)

Jonathan Munn, 2006-2007 (Now Schoolmaster, Mathematics teacher, and Priest at Our Lady of Walsingham and St Francis Anglican Catholic Church)

James R Percival, 2007-2011 (Now at Imperial College, Earth Sciences)

Christopher Cantwell, 2009-2010 (Now at Imperial College, Aeronautics)

Sehun Chun, 2009-2011 (Now at University of Johannisberg)

Laurent Risser, 2009-2011 (Now at University of Toulouse)

Francois-Xavier Vialard, 2009-2011 (Now at Dauphine University, Paris)

Rossen Ivanov (Marie-Curie Fellow) 2009-2011 (Now at Dublin Inst of Tech)

Martins Bruveris, 2011-2012 (Now a Lecturer at Brunel College London)

Joris Vankerschaver, 2012-2014 (Now at Enthought, Cambridge UK)

Henry Ochi Jacobs, 2012-2015 (Now working on Big Data in NYC)

Jacob Eldering, 2013-2015 (Now at IMPA in Rio de Janeiro)

Dmitry Pavlov, 2013-2015 (Now working in San Diego)

Alex Castro, 2014-2015 (Now at Imperial College London)

François Demoures, 2014-2016 (Now at ENS, Paris)

Tomasz Tyranowski, 2014-2017 (Now at MPI Garching

Wei Pan, 2016-2019, EPSRC Standard Grant

Igor Shevchenko, 2016-2019, EPSRC Standard Grant

2019

Published 2019

1. Stochastic Closures for Wave-Current Interaction Dynamics,
Holm, D. D. 2019, Journal of Nonlinear Science,
https://doi.org/10.1007/s00332-019-09565-0
arXiv:1905.01930v5

2. Predicting uncertainty in geometric fluid mechanics
François Gay-Balmaz and Darryl D. Holm
Discrete & Continuous Dynamical Systems - S
https://doi.org/10.3934/dcdss.2020071

3. Solution properties of a 3D stochastic Euler fluid equation,
Dan O. Crisan, Franco Flandoli, Darryl D. Holm [2019],
J Nonlinear Sci 29(3): 9.
https://doi.org/10.1007/s00332-018-9506-6
Spiral identifier: http://hdl.handle.net/10044/1/63498

4. A Geometric Framework for Stochastic Shape Analysis,
Alexis Arnaudon, Darryl D. Holm, Stefan Sommer (2019)
Foundations of Computational Mathematics (FoCM) 19: 653.
https://doi.org/10.1007/s10208-018-9394-z

5. Geometry of Nonadiabatic Quantum Hydrodynamics,
   Foskett, M.S., Holm, D.D. & Tronci, C.
   Acta Appl Math (2019).
   https://doi.org/10.1007/s10440-019-00257-1
   arXiv:1807.01031

6. Circulation and Energy Theorem Preserving Stochastic Fluids
   Theodore D. Drivas and Darryl D. Holm.
   Proceedings of the Royal Society of Edinburgh Section A: Mathematics
   https://doi.org/10.1017/prm.2019.43
   Published online by Cambridge University Press: 23 July 2019
   arXiv:1808.05308

Submitted or in preparation 2018 – 2019

1. arXiv:1910.03574
   Data assimilation for a quasi-geostrophic model with circulation-preserving stochastic transport noise
   Colin Cotter, Dan Crisan, Darryl Holm, Wei Pan and Igor Shevchenko.
   Submitted to *J Stat Phys*, Special volume on Mathematics of Planet Earth

2. arXiv:1910.03018
   Perspectives on the Formation of Peakons in the Stochastic Camassa-Holm Equation
   Thomas Bendall, Colin Cotter and Darryl Holm, Submitted to *?????*

3. arXiv:1909.00388
   Modelling the climate and weather of a 2D Lagrangian-averaged Euler-Boussinesq equation with transport noise
   Diego Alonso-Oran, Aythami Bethencourt de Leon, Darryl Holm, So Takao
   Submitted to *J Stat Phys*, Special volume on Mathematics of Planet Earth

4. arXiv:1908.11481
   Lagrangian averaged stochastic advection by Lie transport for fluids
   Theodore D. Drivas, Darryl D. Holm, James-Michael Leahy
   Submitted to *J Stat Phys*, Special volume on Mathematics of Planet Earth

5. arXiv:1905.01930
   Stochastic Closures for Wave–Current Interaction Dynamics
   Darryl D. Holm
   J NonLin Sci, to appear

6. arXiv:1904.05783
   A Geometric Diffuse-Interface Method for Droplet Spreading
   Darryl D. Holm, Lennon Nraigh, Cesare Tronci
   Submitted to PRSA

7. arXiv:1903.07201
   Implications of Kunita-Itô-Wentzell formula for k-forms in stochastic fluid dynamics
   Aythami Bethencourt de Léon, Darryl Holm, Erwin Luesink, So Takao.
   Submitted to JNLS 10 May 2019

8. arXiv:1802.05711
   Modelling uncertainty using circulation-preserving stochastic transport noise in a 2-layer quasi-geostrophic model,
   Colin Cotter, Dan Crisan, Darryl D. Holm, Wei Pan, Igor Shevchenko.
   Accepted and resubmitted to SIAM MMS 28 Sept 2018

9. arXiv:1801.09729
   Numerically Modelling Stochastic Lie Transport in Fluid Dynamics,
   Colin J. Cotter, Dan Crisan, Darryl D. Holm, Wei Pan, Igor Shevchenko
   Accepted and resubmitted to JCP 25 Sept 2018

10. arXiv:1706.05882
    Stochastic Transport v Fluctuation-Dissipation Noise in Lorenz 63
    Bernard J. Geurts, Darryl D. Holm, Erwin Luesink.
    Submitted to Phys Lett A, 15 March 2019
    Rejected July 2019, resubmitted J Stat Phys, Lucarini special volume.

Eligible and chosen REF entries

1. Variational principles for stochastic fluid dynamics.
   Darryl D. Holm [2015]
   Proc Roy Soc A, 471: 20140963.
   http://dx.doi.org/10.1098/rspa.2014.0963
   Spiral identifier: http://hdl.handle.net/10044/1/64380

2. Stochastic parametrization of the Richardson triple.
   Darryl D. Holm [2018] *J Nonlinear Sci*
   https://doi.org/10.1007/s00332-018-9478-6
   Spiral identifier: http://hdl.handle.net/10044/1/66547

3. Stochastic evolution of augmented Born–Infeld equations.
   Darryl D. Holm [2018] J Nonlinear Science
   https://doi.org/10.1007/s00332-018-9479-5
   Spiral identifier: http://hdl.handle.net/10044/1/66546

4. Stochastic partial differential fluid equations as a diffusive limit of deterministic Lagrangian multi-time dynamics
   Colin J Cotter, Georg A Gottwald, Darryl D Holm, [2017].
   Proc Roy Soc A, Vol 473 page 20170388
   http://dx.doi.org/10.1098/rspa.2017.0388
   Spiral identifier: http://hdl.handle.net/10044/1/50622

5. Stochastic geometric models with non-stationary spatial correlations in Lagrangian fluid flows
   François Gay-Balmaz, Darryl D. Holm
   J Nonlinear Sci 28: 873–904 (2018).
   https://doi.org/10.1007/s00332-017-9431-0
   Spiral identifier: http://hdl.handle.net/10044/1/57039

6. Variational Principles for Stochastic Soliton Dynamics.
   Darryl D Holm and Tomasz M. Tyranowski [2016]
   Proc Roy Soc A (2016) 472 20150827.
   http://dx.doi.org/10.1098/rspa.2015.0827
   Spiral identifier: http://hdl.handle.net/10044/1/29824

7. Noise and Dissipation on Coadjoint Orbits,
   Alexis Arnaudon, Alex L de Castro, Darryl D Holm
   J Nonlin Sci 28:91–145 (2018)
   https://doi.org/10.1007/s00332-017-9404-3
   Spiral identifier: http://hdl.handle.net/10044/1/33415

8. Multipole Vortex Blobs (MVB): Symplectic Geometry and Dynamics. Darryl D Holm and Henry O Jacobs [2017] Multipole Vortex Blobs (MVB): Symplectic Geometry and Dynamics, J Nonlinear Sci (2017) 27 (3): 973-1006.
   https://doi.org/10.1007/s00332-017-9367-4
   Spiral identifier: http://hdl.handle.net/10044/1/63163

9. Solution properties of a 3D stochastic Euler fluid equation,
   Dan O. Crisan, Franco Flandoli, Darryl D. Holm [2019],
   J Nonlinear Sci 29(3): 813-870 (2019).
   https://doi.org/10.1007/s00332-018-9506-6
   Spiral identifier: http://hdl.handle.net/10044/1/63498

10. Wave breaking for the Stochastic Camassa-Holm equation Dan Crisan and Darryl D. Holm [2018] Physica D 376–377 (2018) 138–143. https://doi.org/10.1016/j.physd.2018.02.004
    Spiral identifier: http://hdl.handle.net/10044/1/57328

2018

Published 2018

1. arXiv:1704.06989.
   Dan O. Crisan, Franco Flandoli, Darryl D. Holm [2018],
   Solution properties of a 3D stochastic Euler fluid equation,
   J Nonlinear Sci (2018).

https://doi.org/10.1007/s00332-018-9506-6
https://arxiv.org/pdf/1704.06989.pdf

2. arXiv:1801.07139.
New variational and multisymplectic formulations of the Euler-Poincaré equation on the Virasoro-Bott group using the inverse map
Darryl D. Holm, Tomasz M. Tyranowski [2018]
Proc. R. Soc. A 474: 20180052.
http://dx.doi.org/10.1098/rspa.2018.0052
https://arxiv.org/pdf/1801.07139.pdf

3. arXiv:1609.00463
Stochastic discrete Hamiltonian variational integrators
Darryl D Holm and Tomasz M. Tyranowski, [2018]
BIT Numerical Mathematics, 1-40.
https://doi.org/10.1007/s10543-018-0720-2
https://arxiv.org/pdf/1609.00463.pdf

4. arXiv:1509.06919
Un-reduction in field theory,
Alexis Arnaudon, Marco Castrillón López, Darryl D Holm,
Lett Math Phys 108: 225–247 (2018)
https://doi.org/10.1007/s11005-017-1000-9
https://arxiv.org/pdf/1509.06919.pdf

5. arXiv:1601.02249
Noise and Dissipation on Coadjoint Orbits,
Alexis Arnaudon, Alex L de Castro, Darryl D Holm
J Nonlin Sci 28:91–145 (2018)
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PhD Thesis (1976):
Symmetry Breaking in Fluid Dynamics: Lie Group Reducible Motions for Real Fluids

Primary thesis advisor: Roy A. Axford, University of Illinois

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Holm's PhD thesis in 1976 contains a classification of the inequivalent subalgebras of the Lie point group of symmetries of the equations of motion for compressible ideal fluids. The inequivalent subalgebras were obtained very concisely by using dynamical systems methods in integrating their characteristic equations as vector fields, instead of applying linear algebra to their commutation relations. This vector field calculus approach revealed the functional behavior of the material equations of state for which additional Lie point symmetries are allowed. The latter were important, for example, in widening the applicability of group invariant solutions for radially exploding and imploding shocks to include materials with strength such as (spatially uniform) solids, instead of being limited to ideal gases.

Geopolitical implications of Holm's 1976 PhD thesis. During 1987-1990, the greater applicability of the Lie group reducible motions for real fluids found in Holm's thesis was used by Holm in collaboration with other LANL scientists to substantiate the accuracy of the Los Alamos on-site yield verification method. A reliable verification method was required before the US-USSR threshold test ban treaty (TTBT) could be ratified by the USA.

In the TTBT negotiations at Geneva during the late 1980's, the Soviets had insisted on remote verification of yields of underground tests by seismic methods from outside the USSR. However, the USA scientists were worried that remote verification methods could easily be spoofed. In support of remote verification, the Soviets had vigorously attacked the on-site yield verification method proposed by LANL, by claiming that it would not transfer from the

USA Nevada Test Site to the different geology of their underground test site at Semipalatinsk-21. Holm was able to use the results of his thesis work to show that the difference in geology could be easily accommodated and that, in fact, the difference was unimportant to the accuracy of the LANL proposed method. Consequently, the LANL method (CORRTEX[3]) was verified successfully at the two test sites, and finally was chosen as the on-site yield verification method that led to the ratification of the TTBT. The TTBT was thought to be an important step in eventually banning thermonuclear weapons tests altogether, which happened a few years later.

[3] For a description of the CORRTEX method, see https://inis.iaea.org/search/search.aspx?orig_q=RN:12608540