

## **Dale Ian Pullin**

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## **UNIVERSITY EDUCATION**

B.Sc. (Mathematics and Physics), University of Melbourne (1966)  
B.E. (Aeronautical Engineering), University of Sydney, H1, University Medal (1969)  
PhD (Aeronautics) Imperial College of Science and Technology (1975)

## **ACADEMIC/PROFESSIONAL POSTS**

Scientific Officer, Low Speed Aerodynamics Division, Aeronautical Research Laboratories, Melbourne Australia (1969-70)  
Postdoctoral Fellow, Department of Aeronautics, Imperial College (1975-76)  
Lecturer, Department of Mechanical Engineering, University of Melbourne. (1976-81)  
Senior Lecturer and Reader, Department of Mechanical Engineering, University of Queensland (1982-90)  
Professor, California Institute of Technology (1991 – 2005), von Kármán Professor, (2005- )

## **RESEARCH INTERESTS**

Theoretical and computational fluid mechanics; rarefied gas dynamics, vortex dynamics, nonlinear waves, compressible flow, shock-wave dynamics, hydrodynamic stability, turbulence and turbulent mixing, combustion, magnetohydrodynamics, numerical algorithms for computational fluid dynamics.

## **PROFESSIONAL MEMBERSHIPS**

Fellow of the American Physical Society

## **INVITED TALKS AND SEMINARS (Past five years)**

### **Meetings:**

*Cargese Turbulence Summer School, Cargese Corsica, August 2007*  
*Tenth International Symposium on Physics of Compressible Turbulent Mixing, Paris, 2006*  
*Symposium on modeling of variable-density and compressible turbulence mixing, LANL, 2005.*  
*Elementary Vortices and Coherent Structures; significance in turbulence dynamics, (Kyoto, Japan), 2004*  
*Frontiers in Applied and Computational Mathematics, (Newark), (2004)*  
*US National Symposium on Computational Mechanics (Albuquerque)(2003)*  
*AIAA 33-rd Fluids Conference (Orlando), 2003*  
*Frontiers of Simulation, CLNS 22-nd Annual International Conf. LANL, 2002.*  
*Tubes, sheets and singularities in fluid mechanics, IUTAM (Zakopane, Poland), 2001*  
*54-th American Physical Society, Division of Fluid Dynamics Meeting (La Jolla), 2001*

*Michigan Interdisciplinary Mathematics Meeting*, (Ann Arbor), 2000)

**Universities:**

UC Irvine, UCSD, USC, Harvard, Johns Hopkins, UIUC, University of Western Australia, University of Melbourne, Monash University, University College, Cork (Ireland), ETH (Switzerland)

**GRADUATE STUDENTS (Ph.D)**

**Past:**

Peter Jacobs, Nigel Lott, Robert Krek, Robert Mallett, Kavan Ardalán, Ashish Misra, Keri Aivaziz, James Buntine, Shaun Shariff, Aurelius Prochazka, Mark Brady, Tobias Voelkl, Paul O'Gorman, Gerard O' Reilly, Vincent Wheatley, James Faddy

**Present:**

Ivan Bermejo, Daniel Chung, Manuel Lombardini, Richard Kramer, Geoff Ward, Jack Ziegler

**POSTDOCTORAL FELLOWS**

Ravi Samtaney, Branko Kosovic, David Hill, Carlos Pantano

**PUBLICATIONS**

**Institutional Reports with international distribution**

1. Pullin, D.I., A method for calculating inviscid separated flows about conical slenderbodies, *Aeronautical Research Laboratories, Aerodynamics Report (Australia)*, (1973) 38 pages.
2. Pullin, D.I., Calculations of the steady conical flow about a yawed delta wing with leading edge separation, *Aeronautical Research Council Research and Memoranda 3767*, (1975), London : Her Majesty's Stationary Office. 47 pages.

**Chapters of Books**

3. Pullin, D.I., Harvey, J.K., and Bienkowski, G.K., Hypersonic leading edge flow of diatomic gas by the direct simulation method, in *Rarefied Gas Dynamics 2*, (Ed Becker & Fiebig), Dfvlr-Press, Porz-Wahn, Germany, (1974) Chapter 5.
4. Pullin, D.I., Davis, J., and Harvey, J.K. Monte Carlo calculations of the rarefied transition flow past a bluff faced cylinder, in *Progress in Astronautics and Aeronautics*, (Ed. Potter) **51** (1), 379-391, Am. Inst. Aeronautics and Astronautics, N.Y., (1977)
5. Pullin, D.I., and Grimshaw, R.H.J., Large amplitude interfacial solitary waves, in *Nonlinear Waves*, (Ed. Hokikawa, Mauro), Springer-Verlag, 221-231, (1988)
6. Moore, D.W., and Pullin, D.I., The vortex pair in a compressible ideal gas, in *Vortex Motion*, (Ed. Hasimoto, Kambe), North-Holland, Amsterdam, 337-341 (1988)
7. Pullin, D.I., On similarity flows containing two-branched vortex sheets, in *Mathematical Aspects of Vortex Dynamics* (Ed. Caflisch), SIAM, 97-106 (1989)

8. Pullin, D.I., Saffman, P.G., Some developments of the Lundgren-Townsend model of turbulent fine scales, in *Unstable and turbulent motion of fluids*, (Ed. S. Kida) World-Scientific, 256-265 (1992)
9. Pullin, D.I., Saffman, P.G., Vortex models of the fine scales of turbulence, in *Small scale structure of turbulence in hydrodynamics and magnetohydrodynamics* (Ed. M. Meneguzzi, A. Pouquet, A. Sulem) Springer-Verlag (New York), 61-74 (1995)
10. Pullin, D.I., Vortex tubes, spirals and the large-eddy simulation of turbulence. *Tubes, sheets and singularities in fluid mechanics*, (Ed. K. Bajer, H.K. Moffatt) Kluwer, 171-180 (2003)
11. Faddy, J., and Pullin, D.I., Evolution of vortex structures in a model of aircraft trailing vortices. in *Elementary Vortices and Coherent Structures; Significance in Turbulence Dynamics*, 242-248, (Ed Kida), Kluwer, 2006.
12. Hill, D.J., Pantano, C. and Pullin, D.I., Large-eddy simulation of Richtmyer-Meshkov instability with reshock. To appear in *Complex effects in large-eddy simulation*, (Ed. S. Kassinos, P. Moin), Springer, 2007

### **Papers in Journals**

13. Pullin D.I. and Harvey, J.K., A numerical simulation of the rarefied flat plate problem, *J. Fluid Mech* **78**, 689-707 (1976)
14. Pullin D.I. and Harvey, J.K., Direct simulation calculations of the rarefied flow past a forward facing step, *AIAA J.* **15**, 124-126, (1977)
15. Pullin, D.I., Kinetic models for polyatomic molecules with phenomenological energy exchange, *Phys. Fluids* **21**, 209-216, (1977)
16. Pullin, D.I., The large scale structure of self-similar rolled up vortex sheets, *J. Fluid Mech.* **88**, 401-430, (1978)
17. Pullin, D.I., Vortex ring formation at tube and orifice openings, *Phys. Fluids* **22**, 401-403, (1979)
18. Pullin, D.I., Particle simulation methods for equilibrium fluid flow, *J. Comp. Phys.* **34**, 231-244, (1980)
19. Pullin, D.I., Generation of normal variates with given mean and standard deviation, *J. Statist. Comput. Simult.* **9**, 303-310, (1979)
20. Pullin, D.I., and Perry, A.E., Some flow visualization experiments on the starting vortex, *J. Fluid Mech.* **97** 239-255 (1980)
21. Pullin, D.I., and Phillips, W.R.C., On a generalization of Kaden's problem, *J. Fluid Mech.* **104**, 45-53, (1981)
22. Pullin, D.I., The nonlinear behaviour of a vortical layer at a wall, *J. Fluid Mech* **108**, 401-421, (1981)
23. Pullin, D.I., Numerical studies of surface-tension effects in non-linear Kelvin-Helmholtz and Rayleigh-Taylor instability, *J. Fluid Mech.* **119**, 507-532, (1982)
24. Pullin, D.I., and Grimshaw, R.H.J., Nonlinear interfacial progressive waves near a boundary in a Boussinesq fluid, *Phys. Fluids* **26**, 897-905, (1983)

25. Pullin, D.I., and Grimshaw, R.H.J., Interfacial progressive waves in a two-layer shear flow, *Phys. Fluids* **26**, 1731-1739, (1983)
26. Pullin, D.I., and Joubert, P.N., Behaviour of a converging channel breakwater, theory and experiment, *J. Fluid Mech.* **141**, 139-157, (1984)
27. Pullin, D.I., A constant vorticity Riabouchinsky free-streamline flow, *Q. Jour. Appl. Math.*, **37**, 619-631, (1984)
28. Pullin, D.I., and Simmons, J.M., Stability of the thin-jet model of the unsteady jet flap, *AIAA J.* **23**, 1118-1121, (1985)
29. Grimshaw, R.H.J., and Pullin, D.I., Stability of finite amplitude waves, part 1 : modulational instability for small amplitude waves, *J. Fluid Mech.* **160**, 297-315, (1985)
30. Pullin, D.I. and Grimshaw, R.H.J., Stability of finite amplitude interfacial waves, part 2 : numerical results, *J. Fluid Mech* **160**, 317-336, (1985)
31. Jacobs, P.A., and Pullin, D.I., Coalescence of stretching vortices, *Phys. Fluids* 1619-1625 (1986)
32. Pullin, D.I., and Jacobs, P.A., Nonlinear waves in a shear flow with a vorticity discontinuity, *Stud. Appl. Math.* **75**.
33. Pullin, D.I., and Jacobs, P.A., Evolution of stretching vortex arrays, *J. Fluid Mech.* **171**, 377-406, (1986)
34. Pullin, D.I., and Grimshaw, R.H.J., Stability of finite amplitude interfacial waves: part 3, effect of shear, *J. Fluid Mech.* **172**, 277-306, (1986)
35. Grimshaw, R.H.J., and Pullin, D.I., Extreme interfacial waves, *Phys. Fluids* **29**, 2802-2807, (1986)
36. Moore, D.W., and Pullin, D.I., The compressible vortex pair, *J. Fluid Mech.* **185**, 171-204, (1987)
37. Lott, N.J., and Pullin, D.I., Methods for fairing B-spline surfaces, *Comp. Aided Des.* **20**, 597-604 (1988)
38. Pullin, D.I. and Grimshaw R.H.J., Finite amplitude solitary waves at the interface between two homogeneous fluids, *Phys. Fluids*, **31**, 3350-3360, (1988)
39. Jacobs, P.A., and Pullin, D.I., Multiple-contour-dynamic simulation of eddy scales in the plane shear layer, *J. Fluid Mech.* **199**, 89-124, (1989)
40. Buntine and Pullin, D.I., Merger and cancellation of strained vortices, *J. Fluid Mech.* **205**, 263-295, (1989)
41. Pullin, D.I. Jacobs, P.A., Grimshaw, R.H.J., and Saffman, P.G., Instability and filamentation of finite amplitude waves on vortex layers of finite thickness, *J. Fluid Mech.* **209**, 359-384, (1989)
42. Pullin, D.I., and Moore, D.W., Remark on a result of D. Dritschel, *Phys. Fluids A* **2**, 1039-1041 (1990)

43. Moore, D.W., and Pullin, D.I., The effect of heat addition on slightly compressible flow; the example of vortex pair motion. *Phys. Fluids A* **3**, 1907-1914 (1991)
44. Pullin, D.I., and Saffman, P.G., Symplectic integration of Hamiltonian systems; the case of four-vortex motion., *Proc. R. Soc. Lond. A* **432**, 481-494 (1991)
45. Mann, A.P., Pullin, D.I., Macrossan, M.N. and Page, N.W. Numerical modelling of dynamic powder compaction using the Kawakita equation of state. *J. Appl. Phys* **70**, 3281-3296, (1991)
46. Pullin, D.I. Contour dynamics methods, *Ann. Rev. Fluid Mech.* **24**, 89-115 (1992)
47. Pullin, D.I., and Saffman, P.G., On the Lundgren-Townsend model of turbulent fine scales., *Phys Fluids A* **5**, 126-145 (1993)
48. Saffman, P.G. and Pullin, D.I., Anisotropy of the Lundgren-Townsend model of turbulent fine scales, *Phys. Fluids* **6**, 802-807 (1994).
49. Pullin, D.I., and Saffman, P.G. Reynolds stresses and one-dimensional spectra for a vortex model of homogeneous anisotropic turbulence, *Phys. Fluids* **6**, 1787-1796 (1994)
50. Macrossan, M.N. and Pullin D.I. A computational investigation of inviscid hypervelocity flow of a dissociating gas past a cone at incidence, *J. Fluid Mech.* **266**, 69-92 (1994)
51. Nadiga, B.T. and Pullin D.I. A numerical method for near-equilibrium discrete-velocity gas flows, *J. Comp. Phys.* **9**, 162-172 (1994)
52. Pullin, D.I., Buntine, J.D. and Saffman, P.G., On the spectrum of a stretched spiral vortex, *Phys. Fluids.* **6**, 3010-3027, (1994)
53. Pullin, D.I. Pressure spectra for vortex models of fine-scale turbulence, *Phys. Fluids* **7**, 849-856 (1995)
54. Prochazka, A., and Pullin, On the two-dimensional stability of the axisymmetric Burgers vortex, *Phys. Fluids*, **7**, 1788-1790 (1995)
55. Mallett, E.R. Pullin, D.I., and Macrossan, M.N. Numerical study of hypersonic leeward flow over a blunt-nosed delta wing. *AIAA J.* **33**, 1626-1633 (1995)
56. Ardalan, K. Meiron D.I. and Pullin, D.I. Steady compressible flows- the hollow-core vortex array, *J. Fluid Mech.*, **301**, 1-17 (1995)
57. Moore, D.W., and Pullin, D.I., Inviscid separated flow over a non-slender delta wing, *J. Fluid Mech.*, **305**, 307-345 (1995)
58. Samtaney, R. and Pullin, D.I., Initial-value and self-similar solutions of the compressible Euler equations, *Phys. Fluids* **10**, 2650-2655 (1996)
59. Saffman, P.G. and Pullin, D.I., Calculation of velocity structure functions for vortex models of turbulence, *Phys. Fluids* **11**, 3072-3084 (1996).
60. Moschetta, J.M. and Pullin, D.I., A robust nondiffusive scheme for the Navier-Stokes/Euler equations, *J. Comp. Phys.* **133**, 193-204 (1997)
61. Misra, A. and Pullin D.I. A vortex-based model for large-eddy simulation, *Phys. Fluids* **11**, 2443-2454 (1997)

62. Pullin, D.I., and Saffman, P.G, Vortex dynamics in turbulence, *Ann. Rev. Fl. Mech.* **30** , 31-51, (1998)
63. Prochazka, A., and Pullin D.I., Structure and stability of nonsymmetric Burgers vortices, *J. Fluid Mech.* **363**, .199-228 (1998)
64. Moore, D.W., and Pullin, D.I., On steady compressible flows with compact vorticity; the compressible Hill's spherical vortex, *J. Fluid Mech.* **374**, .285-303 (1998)
65. Brady. M., Leonard, A., and Pullin, D.I., Regularized vortex sheet motion in three dimensions, *J. Comp. Phys.* **146**, (1998)
66. Samtaney, R and Pullin D.I., Self-similar hypervelocity shock interactions with oblique contact discontinuities, *Shock Waves* **8**, 299-310 (1998)
67. Brady M. and Pullin D.I. On singularity formation in three-dimensional vortex sheet evolution, *Phys. Fluids.* **11**, 3198-3200 (1999)
68. Meiron D.I., Moore D.W. and Pullin D.I. On steady compressible flows with compact vorticity; the compressible Stuart vortex., *J. Fluid Mech.* **409**, 29-49 (2000)
69. Voelkl T., Pullin D.I. and Chan D.C. A physical-space version of the stretched-vortex subgrid-stress model for large-eddy simulation, *Phys. Fluids* **12**, 1810-1825 (2000)
70. Pullin D.I. A vortex-based model for the subgrid flux of a passive scalar, *Phys. Fluids* **12**, 2311-2319 (2000)
71. Samtaney R., Pullin, D.I. and Kosovic, B., Direct numerical simulation of decaying compressible turbulence and shocklet statistics, *Phys. Fluids.* **13**, 1415-1430 (2001)
72. Aivazis K.A. and Pullin D.I. On velocity structure functions and the spherical vortex model for isotropic turbulence, *Phys. Fluids* **13**, 2019-2029 (2001)
73. Pullin, D.I. and Lundgren T.S. Axial motion and scalar transport in stretched spiral vortices, *Phys. Fluids* **13**, 2553-2563 (2001)
74. Kosovic, B., Pullin, D.I and Samtaney, R., Subgrid-scale modeling for large-eddy simulations of compressible turbulence, *Phys. Fluids* **14**, 1511-1522 (2002)
75. O’Gorman, P. and Pullin, D.I., The velocity-scalar cross spectrum of a stretched vortex, *Phys. Fluids*, **15**, 280-291 (2003)
76. Pantano, C. and Pullin, D.I., On the dynamics of collapse of a diffusion-flame hole, *J. Fluid Mech*, **480**, 311-322, (2003)
77. O’Reilly, G. and Pullin, D.I., Structure and stability of the compressible Stuart vortex, *J. Fluid Mech.*, 493, 231-254 (2003)
78. Hill, D.J. and Pullin, D.I., Hybrid tuned center difference – WENO method for large-eddy simulations in the presence of strong shocks. *J. Comp. Phys.* **194**, 435-450 (2004)
79. Gleeson, J.P. and Pullin, D.I., Flatness of tracer density profile produced by a point source in turbulence. *Physics of Fluids*, **15** , 3546-3557 (2003)

80. Pantano C. and Pullin, D.I., A statistical description of turbulent diffusion flame holes, *Combustion and Flame*, **137**, 295-305 (2004)
81. Pullin, D.I. and Wang ZJ, Unsteady forces on an accelerating plate and application to insect hovering flight, *J. Fluid Mech*, **509**, 1-21, (2004)
82. O'Gorman PA, and Pullin, D.I., On modal time correlations of turbulent velocity and scalar fields., *Journal of Turbulence*, **5**, Art. No. 035, (2004)
83. Wheatley, V., Pullin, D.I., and Samtaney, R., Regular shock refraction at an oblique planar density interface in magnetohydrodynamics, *J. Fluid Mech*, **522**, 179-214, (2005)
84. O' Reilly, G. K. and Pullin, D.I., Smooth transonic flow in an array of counter-rotating vortices, *J. Fluid Mech*, **524**, 1197-2006, (2005)
85. O'Gorman, P.A. and Pullin, D.I., Effect of Schmidt number on the velocity-scalar cospectrum in isotropic turbulence with a mean scalar field, *J. Fluid Mech*, **532**, 111-140, (2005)
86. Faddy, J.M. and Pullin, D.I., Flow structure in a model of aircraft trailing vortices. *J. Phys. Fluids*, **17**, Art. No. 085106 (2005)
87. Wheatley, V. and Pullin, D.I., Stability of an impulsively accelerated interface in magnetohydrodynamics, *Phys. Rev. Lett.*, **95**, Art. No. 125002, (2005)
88. Hill, D.J., Pantano., C. and Pullin, D.I., Large-eddy simulation and multi-scale modeling of Richtmyer-Meshkov instability with reshock. *J. Fluid Mech.* **555**, 29-61, (2006)
89. Ponchaut N, Hornung, H.G., Pullin, D.I. and Mouton, C. A., On imploding cylindrical and spherical shock waves in a perfect gas. *J. Fluid Mech.* **560**, 103-122, (2006)
90. Pantano, C., Deiterding, R., Hill, D.J. and Pullin, D.I., A low-numerical dissipation patch-based adaptive mesh refinement method for large-eddy simulation of compressible flows. *J. Comp. Phys.* **221**, 63-87 (2007).
91. Pantano, C., Pullin, D.I. and Dimotakis, P.E. A Wall-function closure for large-eddy simulation of wall-bounded flows. Under review, *Physics of Fluids*.
92. Kramer, R., Pantano, C. and Pullin, DI. A class of energy stable, high-order finite difference interface schemes for adaptive mesh refinement of hyperbolic problems. Under review, *J Comp. Phys*.