

Curriculum Vitae

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Birth: April 3, 1941, Chicago, Illinois

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Department of Computer Science, Bath University, Bath BA2 7AY

Start Date at Bath University: September, 1988

Posts prior to joining the University of Bath

University of Bristol (Lecturing in Mathematics, 1965, 1969-71, 1973-75); University of Illinois at Urbana (Instructor Mathematics, 1965-66); U.S. Navy Postgraduate School (Assistant Professor, Mathematics, 1966-67); University of Iowa (Assistant Professor Mathematics, 1968-69); U.C. Medical Center, San Francisco (Research, automata theory and morphogenesis, 1967-68); Max Planck Institute Göttingen (Research, mathematical models of molecular movement and replication, 1975-76); University of Bristol (Architecture 1977-81, Mechanical Engineering 1983-87, Research, Computer aided architectural design, parallel simulation of thermal behaviour of buildings). I also have worked a number of years in industry, mostly for *Design Computing*, which was concerned with computer aided architectural design.

**Qualifications: San Francisco University, B.Sc in
Mathematics 1962
Bristol University, Ph.D. in Mathematics (Logic)
1965**

Research Programme:

I have been working on the boundary between applications, mathematics and computer science.

My early work was concerned with problems, which are important in scientific computing, of exact computation with expressions which represent functions and numbers. I wish to help narrow the gap between the beautiful and usefully complex mathematical semantics of the real numbers and the way in which they are usually represented in scientific computing.

I am also very interested in spiking neural nets. It is known that these systems have potentially very strong computational capabilities, but we are only beginning to understand how they work in reality, or how artificial ones might be used. It does not seem unreasonable to represent many of the activities in our own brains or in the brains and nervous systems of animals by such systems. We would like to understand basic questions such as how memory works, and how external patterns can become internalised.

Recent Grants

EPSRC Dynamics of Spiking Neural Nets (GR/S69306). Two studentships. Started Jan 1, 2004. Value 124,566 sterling. Finished June 1, 2007

Publications

Books

Logic, Language, Formalism, Informalism, ITP Computer Science, (textbook ISBN 1-850-32127-2), June 1995, pp 246.

Chapters in Books

1. Finding roots of equations involving functions defined by first order algebraic differential equations, pp 427-441 in *Effective Methods in Algebraic Geometry*, edited by Teo Mora and Carlo Traverso, Birkhauser, Boston Basel Berlin 1991, ISBN 0-8176-3546-7, ISBN 3-7643-3546-7

2. Does a trigonometric curve cross an algebraic surface?, in *Computer Graphics and Mathematics*, pp121-129, Springer Verlag, Falcidieno, B., I. Herman, C. Pienovi eds, 1992, ISBN 3-540-55582-X, ISBN 0-387-55582-X
3. Finding roots of sparse polynomials of the form $p(x, x^n)$, in *Computational Algebraic Geometry*, pp 225-235 Birkhauser, 1993, ISBN 0-8176-3678-1, ISBN 3-7643-3678-1
4. Lazy Analysis and elementary numbers, in *The Mathematics of Numerical Analysis*, Lectures in Applied Mathematics, AMS, edited by James Renegar, Michael Shub and Stephen Smale, pp 665-675, Volume 32, 1996, ISBN 0-8218-0530-4.
5. Local theories and cylindrical decomposition, chapter 19 in *Quantifier Elimination and Cylindrical Algebraic Decomposition*, edited by Bob Caviness, and J. Johnson, Texts and Monographs in Symbolic Computation, Springer-Verlag, Wien, New York, 1998, pp 351-364, ISBN 3-211-82794-3, ISSN 0943-853X
6. The Uniformity Conjecture, presented at CCA 2000 in Swansea, Sept 17-19, 2000, also in *Springer lecture notes in Computer Science, Volume 2064*, ISBN 3-540-42197-1, pp 253-272.

Articles in Journals

1. Some undecidable problems involving elementary functions of a real variable, *J. Symb Logic*, v 33, no 4, pp 514-520, 1968
2. Solution of the identity problem for integral exponential functions, *Zeitschr Mat Logik und Grund. d. Math.*, bd 15, pp 333-340, 1969
3. The simple exponential constant problem, *Zeitschr Mat Logik und Grund. d. Mat.*, bd 17, pp 133-136, 1971
4. Tessellations with local transformations, *J. Computer and system sciences*, vol 6, no 5, 373-388, 1972
5. Random growth in a tessellation, *Proc. Camb. Phil. Soc.* 74, pp 515-528, 1973
6. Sets of theorems with short proofs, *J. Symb Logic*, vol 39, no 2, pp 235-242
7. Self reproduction by template, *Mathematical Biosciences*, 28, pp 1-24, 1975
8. Continuous self reproduction, *J. Computer and system sciences*, vol 12, no 1, pp 6-12, 1976

9. AESOP, an architectural relational data base,(with R.J.Phillips and M.J. Beaumont), CAD, vol 11, no 4, 1979, pp 217-226.
10. Geometry for CAAD, (with R.J.Phillips and M.J.Beaumont and J. Bartley), CAD, 1981, v 13, no 2, pp 89-97.
11. Roots of real exponential functions, Bull London Math Soc, (2), 28, pp 46-56, 1983
12. A mathematical framework for modular simulation (with B. Day, P. Fitt and P. Kimber), Mathematics and Computers in simulation 29, pp 373-383, 1987.
13. Non standard models of the theory of elementary functions of a real variable, Zeitschr. f. Math. Logik und Grund d. Math, Bd 34, pp 355-372, 1989
14. (With Brian Day and Nigel Cole), Parallel running of a modular simulation scheme, Appl. Math Modelling, vol 13, pp 225-233, April, 1989.
15. (With Brian Day and Ken Ip), Fluid flow and heat transfer in pipework systems: I Mathematical model for dynamic modular simulation, BSER&T, 10(4), pp 143-149, 1989.
16. (With Brian Day and Ken Ip), Fluid flow and heat transfer in pipework systems: II Design Example, BSER&T, vol 11, number 3, 1990, pp 109-115.
17. Wu's method and the Khovanskii finiteness theorem, Journal of Symbolic Computation, 12, pp 127-141, 1991
18. Computing the topology of a bounded non algebraic curve in the plane, J. Symbolic Computation, 1992, 14, pp 619-643
19. How to Recognise Zero, Journal of Symbolic Computation, (1997) vol 24, number 6, pp 627-645, ISSN 0747-7171
20. A relatively quick way to simulate local random processes on a lattice, (with Wayne Burton), Journal of Applied Probability, ISSN 0021 9002, vol 35 no 3, pp 770-777, Sept 1998.
21. Elimination of Infinitesimal Quantifiers, Journal of Pure and Applied Algebra, vol 139, nos 1-3, 1999, pp 235-253, ISSN 0022-4049, also presented at MEGA 98
22. Weak Wu stratification in R^n , the Journal of Symbolic Computation, ISSN 0747-7171, (1999) 28, pp 213-223.

23. Multiplicative Independence of Algebraic Numbers and Expressions, presented at Mega 2000, also in *Journal of Pure and Applied Algebra* 164, issue 1-2, October, 2001, pp 231-245, ISSN 0022-4049
24. Use of algebraically independent numbers for zero recognition of polynomial terms (with Ahmed Elsonbaty), *Journal of Complexity* 19, issue 5, ISSN 0885-064X, October 2003, pp 631-637
25. Counterexamples to the Uniformity Conjecture (with Ahmed Elsonbaty), *Computational Geometry, Theory and Applications* 33, issue 1-2, January 2006, pp 58-64, Elsevier ISSN 0925-7721
26. Spiking Neural Nets with Symbolic Internal State, (with Carl O'Dwyer), *Information Processing Letters*, Vol 95, issue 6, 30 Sept 2005, pp 529-536 Elsevier ISSN 0020-0190
27. Parallel Computation in Spiking Neural Nets, (with Andrew Carnell), *Theoretical Computer Science*, 2007, vol 386, issue 1-2, pp 57-72, ISSN 0304-3975
28. Zero Tests for Constants in Simple Scientific Computation, December 2007, *Mathematics in Computer Science* (Birkhauser/Springer), vol 1, 1, pp 21-37 ISSN 1661-8270
29. Detecting Mutual Information between Spike Trains Using the Nearest Neighbour Method, with Carl O'Dwyer, submitted for publication

Conference Proceedings

1. Replication and stochastic processes in space, Transactions of the seventh Prague conference and 1974 EMS
2. Fuzzy relations and inexact design requirements, (with R.J. Phillips and M.J. Beaumont), Proceedings of the 1979 International conference on the application of computers in architecture, building design and urban planning, Berlin 1979.
3. (With Brian Day), Using parallel processing for simulation, 3rd European simulation conference, Edinburgh, September 5-8, 1989.
4. (With Nigel Cole), Geometric parallel implementation of the Bristol modular system, IMPEL 89.
5. Towards non algebraic cylindrical decomposition, Proceedings ISSAC 1991, Bonn, pp 247-255, ISBN 0-89791-437-6
6. The Elementary Constant Problem, ISSAC 92 proceedings, pp 108-116, ISBN 0-89791-489-9, 0-89791-490-2.

7. A Zero Structure Theorem for Exponential Polynomials, ISSAC 93 proceedings, pp 144-151, ISBN 0-89791-604-2
8. The Identity Problem for Elementary Functions and Constants, (with J. P. Fitch), ISSAC 1994 proceedings, pp 285-291, ISBN 0-89791-638-7.
9. A simplified method of recognising zero among the elementary constants, ISSAC 1995 proceedings, pp 104-109, ISBN 0-89791-699-9
10. Solution of elementary systems of equations in a box in R^n , pp 120-126 ISSAC 96, ISBN 0-89791-796-0
11. Asymptotic expansions of exp-log functions, (with B Salvy, J Shackell, J van der Hoeven), ISSAC 96, pp 309-314, ISBN 0-89791-796-0.
12. Exact computations with real algebraic numbers, (with Simon Langley), Third conference on Real Numbers and Computers, Pierre et Marie Curie University, April, 1998.)
13. (With N. Tongsiri), Constructive Solid Geometry with Projection, proceedings of ISACA 2000 (Applications of Computer Algebra), Kolhapur, India, Oct 3-5. (1/2. Uses ideas from Natee Tongsiri's thesis.)
14. (With N. Tongsiri), The Semialgebraic approach to the piano mover's problem, pp 75-78, in Computer Mathematics, Proceedings of the Fourth Asian Symposium (ASCM 2000), Chiang Mai, Thailand, 17-21 December 2000, World Scientific, Lecture Notes Series on Computing Vol 8, ISBN 981-02-4498-3, edited by Xiao-Shan Gao and Dongming Wang
15. Recognizing zero among polynomials represented as unwound straight line programs, with Ahmed Elsonbaty. Presented at the Vienna Logic Colloquium, summer 2001.
16. Some observations on familiar numbers, (with Simon Langley), Proc. ISSAC 2002 (ed. T. Mora), ACM press New York, July 2002, ISSN 1-58113-484-3, pp 214-220
17. What can we do with a Solution, (With Simon Langley), CCA 2002. Electronic Notes in Theoretical Computer Science, vol 66, Issue 1, 2002: www.elsevier.nl/locate/entcs/volume66.html
18. Linear Algebra for Time Series of Spikes, (With Andrew Carnell), European Symposium on Artificial Neural Networks (ESANN) 2005, pp 363-369, ISBN 2-930307-05-6

External Activities

I review for the Journal of Symbolic Computation. I was the UK coordinator for the EC funded network, Real Analytic and Algebraic Geometry, which finished in February 2006 (HPRN-CT-2001-00271). I have just been asked to be on the assessment committee of the Irish Research Council for Science Engineering and Technology, to evaluate Fellowship applications in the mathematics/computer science area.

Teaching and Ph.D. students

I have taught Computability, Algorithms, Computer Algebra, Logic, Programming, Analysis, and Linear Algebra courses at the undergraduate level.

Three of my students have completed doctorates: Natee Tongsiri (2001), Ahmed Elsonbaty (2004), Simon Langley (2005). I currently have two Ph.D. students Andrew Carnell and Carl O'Dwyer.