Curriculum Vitae

Carole Janet Twining
Imaging Science and Biomedical Engineering
Stopford Building

Personal Details

Name: Carole Janet Twining
Date of Birth: 15th June, 1964

University Education

1982–1985	St. Hugh's College, Oxford	B.A. In Physics (First)
1985–1986	Newnham College, Cambridge	Certificate of Advanced Study in Mathematics (Part III of the Mathematics Tripos)

Doctoral Thesis

Title	A Study of Lattice Quantum Electrodynamics in 2+1 Dimensions.
Department	The Department of Applied Maths and Theoretical Physics University of Liverpool,1990.

Previous Relevant Employment

1990–1992   SERC Postdoctoral Fellowship in the Department of Theoretical Physics, Oxford.

Current Employment

1999–   Research Associate, Imaging Science and Biomedical Engineering, University of Manchester.

Projects

1999–2002   "Characterising Behavioural Phenotypes Using Automated Image Analysis" Part of the BBSRC/EPSRC Bioinformatics Initiative.

2002–   Part of the MIAS (Medical Images and Signals) IRC Collaboration.

Research and Professional Standing

Publications: Peer-Reviewed Academic Journal Papers

[1] S. Marsland and C. J. Twining,
Constructing diffeomorphic representations for the groupwise analysis of non-rigid registrations of medical images,
IEEE Transactions on Medical Imaging, Volume 23, Number 8, August 2004, Pages 1006–1020.

[2] Rh H. Davies, C. J. Twining, P. Daniel Allen, T. F. Cootes, and C. J. Taylor.
Building Optimal 2D Statistical Shape Models,
Image and Vision Computing, Volume 21, Issues 13-14, 1st December 2003, Pages 1171-1182.

[3] Carole J. Twining and Chris J. Taylor,
The Use of Kernel Principal Component Analysis to Model Data Distributions,
Pattern Recognition, Volume 36, Issue 1, January 2003, Pages 217-227.

[4] Rh. H. Davies, C. J. Twining, T. F. Cootes, J. C. Waterton, C. J. Taylor,
A Minimium Description Length approach to Statistical Shape Modelling,
IEEE Transactions on Medical Imaging, Volume 21 Issue 5 , May 2002, 525-537.

[5] C. J. Twining, C. J. Taylor and P. Courtney,
Robust Tracking and Posture Description for Laboratory Rodents using Active Shape Models,
Behavior Research Methods, Instruments & Computers, Volume: 33, Number: 3 Page: 381 - 391, August 2001.

[6] P-M. Binder, D. Y. K. Ko, A. L. Owczarek and C. J. Twining,
Ordered Cellular Automata in One Dimension
Journal de Physique I, 3 (1993) p21-28.

[7] C. J. Twining and P-M. Binder,
Enumeration of Limit Cycles in Non-Cylindrical Cellular Automata,
Journal of Statistical Physics 66 (1992) p 385-401.

[8] C. J. Twining,
The Limiting Behaviour of Non-Cylindrical Elementary Cellular Automata,
Complex Systems 6 No. 5 (1992) p 417-432.

[9] P-M. Binder, C. J. Twining and D. Sherrington,
Phase-Space Study of Bistable Cellular Automata,
Complex Systems 5 No. 2 (1991) p 127-137.

[10] C. J. Twining,
Low-Temperature Expansion of the Planar Spin Model,
Journal of Physics A Math. & Gen., 21 (1988) p 1735-1738.

Publications: Peer-Reviewed Conference Contributions

2004

[11] C. J. Twining, S. Marsland, and C. J. Taylor,
Groupwise Non-Rigid Registration of Medical Images: The Minimum Description Length Approach,
Medical Image Understanding and Analysis (MIUA), Imperial College London, $23^{rd} - 24^{th}$ September 2004.

[12] C. J. Twining, S. Marsland, and C. J. Taylor,
Groupwise Non-Rigid Registration: The Minimum Description Length Approach,
British Machine Vision Conference (BMVC), Kingston University, London, $7^{th} - 9^{th}$ September 2004.

[13] T. F. Cootes, C. J. Twining, and C. J. Taylor,
Diffeomorphic Statistical Shape Models,
British Machine Vision Conference (BMVC), Kingston University, London, $7^{th} - 9^{th}$ September 2004.

[14] C. J. Twining, S. Marsland, and C. J. Taylor,
A Unified Information-Theoretic Approach to the Correspondence Problem in Image Registration,
The 17th International Conference on Pattern Recognition (ICPR), Cambridge, UK, $23^{rd} - 26^{th}$ August 2004.

[15] T. F. Cootes, S. Marsland, C. J. Twining, K. Smith, and C. J. Taylor,
Groupwise Diffeomorphic Non-rigid Registration for Automatic Model Building, The 8th European Conference
on Computer Vision (ECCV) 2004, Prague, May $11^{th} - 14^{th}$, 2004.
Proceedings of ECCV 2004, Part IV, Lecture Notes in Computer Science (LNCS), volume 3024, pages 316–327,
Springer, 2004.

[16] S. Marsland and C. J. Twining,
Spline Interpolants and the Registration and Analysis of Medical Images,
SIAM Conference on Imaging Science (ISO4), Marriott City Center, Salt Lake City, Utah, $3^{rd} - 5^{th}$ May 2004.

2003

[17] S. Marsland, C. J. Twining, and C. J. Taylor,
Groupwise Non-Rigid Registration using Polyharmonic Clamped-Plate Splines,
MICCAI 2003, Montreal, Canada, $15^{th} - 18^{th}$ November 2003.
Proceedings of MICCAI 2003, Part II, Lecture Notes in Computer Science (LNCS), volume 2879, pages 771-779,
Springer, 2003.

[18] C. J. Twining and S. Marsland,
Constructing Diffeomorphic Representations of Non-Rigid Registrations of Medical Images,
Proceedings of Information Processing in Medical Imaging (IPMI 2003) ,
Lecture Notes In Computer Science (LNCS) 2732, eds. C. Taylor and J. A. Noble, Springer, pages 413-425,
2003.

[19] Rh. H. Davies, C. J. Twining, P. D. Allen, T. F. Cootes and C. J. Taylor,
Shape Discrimination in the Hippocampus using an MDL model,
Proceedings of Information Processing in Medical Imaging (IPMI 2003),
Lecture Notes In Computer Science (LNCS) 2732, eds. C. Taylor and J. A. Noble, Springer, pages 38-50, 2003.

[20] S. Marsland and C. J. Twining,
Constructing Data-Driven Optimal Representations for Iterative Pairwise Non-Rigid Registration,
Proceedings of the Second International Workshop on Biomedical Image Registration (WBIR 2003),
Lecture Notes in Computer Science (LNCS) 2717, eds. J. C. Gee, J. B. Antoine Maintz and M. W. Vannier,
pages 50-60, Springer, 2003.

[21] C. J. Twining and S. Marsland
Groupwise and Local Analysis of Image Warps
Proceedings of the 22nd Leeds Annual Statistics Workshop, $8^{th} - 10^{th}$ July, Leeds 2003.

[22] C. J. Twining and S. Marsland
A Non-Euclidean Metric for the Classification of Variations in Medical Images,
Proceedings of Medical Image Understanding and Analysis (MIUA), Sheffield, $10^{th} - 11^{th}$ July, 2003.

2002

[23] C. J. Twining, S. Marsland and C. J. Taylor.
Measuring Geodesic Distances on the Space of Bounded Diffeomorphisms,
Proceedings of the British Machine Vision Conference (BMVC), Cardiff, $2^{nd} - 5^{th}$ September 2002.

[24] S. Marsland and C. J. Twining.
Clamped-Plate Splines and the Optimal Flow of Bounded Diffeomorphisms,
Proceedings of LASR2002 , the Leeds Annual Statistics Research Workshop, Leeds, $3^{rd} - 5^{th}$ July 2002.

[25] Rh. H. Davies, C. J. Twining, T. F. Cootes, J. C. Waterton and C. J. Taylor.
Constructing Optimal 3D Statistical Shape Models,
Medical Image Analysis and Understanding (MIUA). 2002.

[26] Rh. H. Davies, C. J. Twining, T. F. Cootes, J. C. Waterton and C. J. Taylor.
3D Statistical Shape Models Using Direct Optimisation of Description Length,
in Proceedings of the 7th European Conference on Computer Vision (ECCV),
Lecture Notes in Computer Science (LNCS) 2352 , p3-21, 2002.

[27] Rh. H. Davies, T. F. Cootes, C. J. Twining, J. C. Waterton and C. J. Taylor.
3D Statistical Shape Models for Automatic Segmentation of MR Images,
10th Scientific Meeting and Exhibition of the International Society for Magnetic Resonance in Medicine
(ISMRM). 2002.

2001

[28] Rh. H. Davies, T. F. Cootes, C. J. Twining and C. J. Taylor
An Information Theoretic Approach to Statistical Shape Modelling,
Proceedings of British Machine Vision Conference (BMVC) 2001, September $10^{th} - 13^{th}$, University of Manchester.

[29] C. J. Twining and C. J. Taylor
Kernel Principal Component Analysis and the construction of non-linear Active Shape Models,
Proceedings of British Machine Vision Conference (BMVC), Manchester, September $10^{th} - 13^{th}$, 2001.

2000

[30] C. J. Twining, C. J. Taylor, P. Courtney and C. Dourish
Characterising Behavioural Phenotypes using Automated Image Analysis,
Proceedings of Measuring Behavior 2000 , Nijmegen.

Publications: Other

[31] Rh. H. Davies, T. F. Cootes, C. J. Twining, and C. J. Taylor.
Constructing Optimal Statistical Shape Models for Automatic Image Segmentation,
in EPSRC PREP 2002.

Presenter at Conference: International Conferences

- C. J. Twining, S. Marsland, and C. J. Taylor,
A Unified Information-Theoretic Approach to the Correspondence Problem in Image Registration,
The 17th International Conference on Pattern Recognition (ICPR), Cambridge, UK, $23^{rd} - 26^{th}$ August 2004.

- C. J. Twining and S. Marsland,
Constructing Diffeomorphic Representations of Non-Rigid Registrations of Medical Images,
Information Processing in Medical Imaging (IPMI 2003),Ambleside, UK, 20th-25th July, 2003.

- C. J. Twining and S. Marsland
Groupwise and Local Analysis of Image Warps
The 22nd Leeds Annual Statistics Workshop, Leeds, UK, 8th-10th July, 2003.

- C. J. Twining, C. J. Taylor, P. Courtney and C. Dourish
Characterising Behavioural Phenotypes using Automated Image Analysis,
Measuring Behavior 2000, Nijmegen, The Netherlands, 15th-18th August, 2000.

Presenter at Conference: National Conferences

- C. J. Twining, S. Marsland, and C. J. Taylor,
Groupwise Non-Rigid Registration of Medical Images: The Minimum Description Length Approach,
Medical Image Understanding and Analysis (MIUA), Imperial College London, $23^{rd} - 24^{th}$ September 2004.

- C. J. Twining, S. Marsland, and C. J. Taylor,
Groupwise Non-Rigid Registration: The Minimum Description Length Approach,
British Machine Vision Conference (BMVC), Kingston University, London, $7^{th} - 9^{th}$ September 2004.

- C. J. Twining and S. Marsland
A Non-Euclidean Metric for the Classification of Variations in Medical Images,
Medical Image Understanding and Analysis (MIUA), Sheffield, 10th-11th July, 2003.

- C. J. Twining and C. J. Taylor
Kernel Principal Component Analysis and the construction of non-linear Active Shape Models,
The British Machine Vision Conference (BMVC) 2001, September 10th-13th, University of Manchester.

Conferences/Workshops Attended: International

- The 17th International Conference on Pattern Recognition (ICPR), Cambridge, UK, $23^{rd} - 26^{th}$ August 2004.

- The 8th European Conference on Computer Vision (ECCV), Prague, Czech Republic, 11th-14th May, 2004.

- SIAM Conference on Imaging Science (ISO4), Salt Lake City, Utah, $3^{rd} - 5^{th}$ May, 2004.

- Medical Image Computing and Computer-Assisted Intervention (MICCAI), Montreal, Canada, 15th-18th November 2003.

- The 2nd International Workshop on Biomedical Image Registration (WBIR), Pennsylvania, USA, June 23rd-24th, 2003.

- Information Processing in Medical Imaging (IPMI), Ambleside, UK, 20th-25th July, 2003.

- The 22nd L.A.S.R (Leeds Annual Statistics Research) Workshop, University of Leeds, UK, 8th - 10th July 2003.

- Mathematics and Image Analysis (MIA'02), Paris, September 10th-13th, 2002.

- The 21st L.A.S.R (Leeds Annual Statistics Research) Workshop, University of Leeds, UK, 3rd - 5th July 2002.

- The 7th European Conference on Computer Vision (ECCV), Copenhagen, Denmark, 28th-31st May, 2002.

- "Uncertainty in Geometric Computations", Sheffield, England, 5th-6th July, 2001.

- Measuring Behavior, the 3rd International Conference on Methods and Techniques in Behavioral Research, Nijmegen, The Netherlands, 15th-18th August, 2000.

Conferences/Workshops Attended: National

- Medical Image Understanding and Analysis (MIUA), Imperial College London, $23^{rd} - 24^{th}$ September 2004.
- British Machine Vision Conference (BMVC), Kingston University, London, $7^{th} - 9^{th}$ September 2004.
- Medical Image Understanding and Analysis (MIUA), Sheffield, 10th-11th July, 2003.
- The British Machine Vision Conference (BMVC), University of Cardiff, 2nd-5th September 2002.
- The British Machine Vision Conference (BMVC), University of Manchester, 10th-13th September 2001.
- The British Machine Vision Conference (BMVC), University of Bristol, 11th-14th September 2000.

Esteem Indicators

- Runner-Up for the Francois Erbsmann Prize at Information Processing in Medical Imaging (IPMI) 2003 for the paper *"Constructing Diffeomorphic Representations of Non-Rigid Registrations of Medical Image"*

- Awarded the Best Paper prize at the 7th European Conference on Computer Vision (ECCV) 2002 for the paper *"3D Statistical Shape Models Using Direct Optimisation of Description Length"*

- Awarded the Image Metrics Prize for an outstanding contribution to model-based computer vision at the British Machine Vision Conference (BMVC) 2001 for the paper *"An Information Theoretic Approach to Statistical Shape Modelling"*

Research Grants & Collaborations

- Investigator on EPSRC Grant, reference: `EP/C523164/1`, "Mathematics of Image Registration".

- International Collaborator on Marsden Fund grant `MAU0408`[1] (Royal Society of New Zealand), "A principled approach to the non-rigid registration and structural analysis of groups of medical images", awarded to Dr Stephen Marsland, Institute of Information Sciences, Massey University, New Zealand.

Refereeing

Journals:

- IEEE Transactions on Medical Imaging.

- Electronics Letters, IEE Publications.

- Behavior Research Methods, Instruments & Computers, Psychonomic Society Publications.

Conferences/Workshops:

- Reviewer and member of Young Researcher Committee for IPMI (Information Processing in Medical Imaging) 2005.

- 2nd international workshop on Generative Model Based Vision (GMBV), workshop in conjunction with the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR) 2004.

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[1] `http://www.rsnz.govt.nz/funding/marsden_fund/awards_2004.php`

Statement on Research

My initial project (Characterising Behavioural Phenotypes Using Automated Image Analysis) met all of its objectives, and significantly advanced the application of state of the art computer vision techniques to the automated analysis of video data. Preliminary results were presented at the International 'Measuring Behavior' conference [30], which is a conference focusing on the methods and techniques in behavioural research, and generated great interest, demonstrating the desire amongst behavioural scientists for such an automated analysis system. The project also generated journal publications in both theoretical [3, 2] and applied areas [5] of research. The algorithms developed during the course of this project were intended to form the basis for a prototype automated behavioural analysis system, and our industrial collaborators were keen to proceed with a further collaboration to develop and test such a prototype.

Starting during the latter part of this project, I also became involved in collaborative theoretical work [28, 4, 2, 26, 19, 25] which made important advances in the field of shape modelling; the work published in [2] won the best model-based vision prize at the British Machine Vision Conference [28] in 2001, and the work published in [4] won a best paper prize at the biennial (international) ECCV conference.

I am currently working as part of the MIAS (From Medical Images and Signals to Clinical Information) IRC, an inter-disciplinary research consortium funded jointly by EPSRC and MRC. My current principal focus is in the area of biomedical image registration. This work has so far included:

- Groupwise image registration algorithms [17, 20],

- Spline-based and diffeomorphism group techniques for representation and analysis of sets of warps [24, 23, 22, 18, 1, 16],

- Theoretical work on the derivation of information-theoretic objective functions for groupwise image registration [14, 12, 11].

This work has been presented to the international medical image analysis community [e.g., 17, 18], the machine vision community [e.g., 23, 12] as well as to international audiences with a more mathematical focus [e.g., 16]. My colleagues and I have already made important, recognised theoretical advances; the work published in [1] was one of two runners-up for the Francois Erbsmann prize at IPMI 2003, a biennial international conference.

As regards collaborative working, I have contributed to work published by other members of ISBE (e.g., T.F. Cootes (senior lecturer) [13, 15], Rhodri Davies (former ISBE graduate student)), as well as continuing my collaboration with Stephen Marsland. This collaboration began when he joined ISBE, and has continued since his move to Massey University, New Zealand, where he recently obtained a Marsden Fund grant[2], on which I am named as an external collaborator, and which will enable us to continue our collaboration in this area.

Papers Submitted to Journals

- Carole J. Twining and Stephen Marsland
  "Constructing an atlas for the diffeomorphism group of a compact manifold with boundary, with application to image registration"
  Submitted to the SIAM Journal on Applied Mathematics.

Referees

If required, the following persons have agreed to provide references:

- Professor Sir Michael Brady FRS FEng, BP Professor of Information Engineering, Department of Engineering Science, University of Oxford.

- Stephen M. Pizer, Kenan Professor, Department of Computer Science, University of North Carolina at Chapel Hill.

Signed: **Dated: December 16, 2004**