

Academic CV

Simeon Bamford

Work:

Complex Systems Modelling Group,
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Personal:

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Education

- 2005 - 2008 PhD, Neuroinformatics, University of Edinburgh.
- 2004 - 2005 MSc by Research, Neuroinformatics (Distinction), Edinburgh University.
Taught element included: Neuroscience Research Methods, Neural
Computation, Bioinformatics, Neuromorphic VLSI, Neuroinformatics
Research.
- 1995 RSA/CTEFLA, GEOS Language Centre, Hove.
- 1992 - 1995 BA hons, Artificial Intelligence (First Class), Sussex University.

Employment (Academic and Other)

- 2011 Mar - present Research Associate, Complex Systems Modelling group, Istituto Superiore di
Sanità, Rome; working on EU-funded CORONET project. (www.coronet-project.eu)
- 2009 Apr - 2011 Feb Research Associate, Laboratory for Synthetic Perceptive, Emotive and
Cognitive Systems, Pompeu Fabra University, Barcelona; working on EU-
funded ReNaChip project. (www.renachip.org)
- 2009 Jan-Mar Research Associate, University of Edinburgh.
- 2008 (p/t) Tutor for Neuromorphic VLSI MSc module, University of Edinburgh Doctoral
Training Centre for Neuroinformatics.
- 2007 (p/t) Website Developer, University of Edinburgh Doctoral Training Centre for
Neuroinformatics. (www.anc.ed.ac.uk/dtc)
- 2004 Business Mentor for social entrepreneurs; freelance with London
Development Agency.
- 1998 - 2004 Entrepreneur & Director, Cycle Training UK Ltd, London. (www.cycletraining.co.uk)
- 1996-1998 Database Developer and Technical Manager, JHC, London.
- 1995-1996 English Teacher (EFL), (1) Greenwich School of English, Włocławek, Poland;
(2) CESC, Framlingham, Suffolk.

Research

I find both the study of neural systems and the discipline of engineering them fascinating. I see great scope for biomedical applications with the potential to improve health provision and better the human condition, and I ultimately expect this work to shed light on the nature of our minds.

My current work is to develop neuromorphic hardware which implements a network of units, each

representing a populations of neurons; the populations demonstrate bistable attractor dynamics, with stochastic behaviour influenced by inputs. It is my hope that this work will allow a paradigm shift in our understanding of brain dynamics; we will put the hardware into bidirectional coupling with in-vitro neuron cultures.

The ReNaChip project (2009-2011) aimed to create a chip which could be implanted in a brain to replace a neural circuit which performs a learning task (classical conditioning). My role involved developing analysis methods for recorded multi-unit activity signals for detection of stimulus events; converting computational models of cerebellar function into integrated electronic circuitry; and building circuitry for front-end amplification and processing of neural signals. These culminated in the full-custom design of a CMOS chip, which I tested working closely with electrophysiologists working with mammals. The design included a novel field-programmable array of mixed-signal components specialised for neural signal processing and neural modelling applications. My interest in field-programmable circuitry was augmented by my brief work at Edinburgh University on a project to create a related design specialised for neuromorphic applications.

My PhD (2005-2008) was in the area of neuromorphic engineering, where I created a CMOS chip demonstrating new ideas in spike delivery in multi-chip neuromorphic systems and in virtual synaptic rewiring. This was grounded in a computational modelling endeavour which explored the role of synaptic rewiring in the development of topographic maps and receptive fields, for example in the early visual pathway. In my MSc (2004-2005) I gained experience in a silicon clean-room and experience of patch-clamp recording from dissociated cells and in-vitro cultures, using novel integrated patch-clamp devices.

In addition to my technical skills and expert knowledge in science and engineering, I have excellent written and spoken communication skills. My self-starting and hard working nature is demonstrated by the success of my previous entrepreneurial career.

Peer-Reviewed Journal Articles

- 2012 "A VLSI field-programmable mixed-signal array to perform neural signal processing and neural modelling in a prosthetic system", Bamford SA, Hogri R, Giovannucci A, Taub AH, Herreros I, Verschure PFMJ, Mintz M, Del Giudice P. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, in press (<http://www.sim.me.uk/neural/JournalArticles/BamfordEtAl2012TNSRE.pdf>).
- 2012 "Silicon synapses self-correct for both mismatch and design inhomogeneities", Bamford SA, Murray AF, Willshaw DJ. *Electronics Letters*, vol. 48, no. 7, pp. 360-361.
- 2012 "Spike-timing-dependent plasticity with weight dependence evoked from physical constraints", Bamford SA, Murray AF, Willshaw DJ. *IEEE Transactions on Biomedical Circuits and Systems*, in press (<http://www.sim.me.uk/neural/JournalArticles/BamfordEtAl2012TBCAS.pdf>).
- 2012 "A framework for approaches to transfer of a mind's substrate", Bamford S. *International Journal of Machine Consciousness*, in press (<http://www.sim.me.uk/neural/JournalArticles/Bamford2012IJMC.pdf>).
- 2010 "Synaptic rewiring for topographic map formation and receptive field development", Bamford SA, Murray AF, Willshaw DJ. *Neural Networks*, vol. 23, pp. 517-527.
- 2010 "Large developing receptive fields using a distributed and locally reprogrammable address-event receiver", Bamford SA, Murray AF, Willshaw DJ. *IEEE Transactions on Neural Networks*, vol. 21, no. 2, pp. 286-304.

Peer-Reviewed Conference Papers

- 2011 "Behavioral rehabilitation of the eye closure reflex in senescent rats using a real-time biosignal acquisition system", Prückl R, Taub AH, Hogri R, Magal A, Herreros I, Bamford SA, Ofek Almog R, Shacham Y, Verschure PFMJ, Mintz M, Scharinger J, Silmon A, Guger C, *International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp. 4211-4214.
- 2011 "The application of a real-time rapid-prototyping environment for the behavioral rehabilitation of a lost brain function in rats", Prückl R, Grünbacher E, Ortner R, Taub AH, Hogri R, Magal A, Segalis E, Zreik M, Nossenson N, Herreros I, Giovannucci A, Ofek Almog R, Bamford S, Marcus-Kalish M, Shacham Y, Verschure PFMJ, Messer H, Mintz M, Scharinger J, Silmon A, Guger C, *IEEE Symposium Series in Computational Intelligence, Cognitive Algorithms, Mind, and Brain (CCMB)*.
- 2010 "Intimate mixing of analogue and digital signals in a field-programmable mixed-signal array with lopsided logic", Bamford SA, Giulioni M, *IEEE Biomedical Circuits and Systems Conference (BIOCAS)*, pp. 234-237.
- 2008 "Large developing axonal arbors using a distributed and locally-reprogrammable address-event receiver", Bamford SA, Murray AF, Willshaw DJ, *IEEE International Joint Conference on Neural Networks (IJCNN)* pp.1464-1471.
- 2008 "Synaptic rewiring for topographic map formation", Bamford SA, Murray AF, Willshaw DJ, *International Conference on Artificial Neural Networks (ICANN)* pp. 218-227.

Conference Abstracts (not peer-reviewed)

- 2012 "A VLSI chip to implement a neuroprosthesis for substitution of a cerebellar learning function", Bamford SA, Hogri R, Magal A, Taub AH, Giovannucci A, Herreros I, Del Giudice P, Mintz M, *Society for Neuroscience (SFN) Meeting, (pending)*.
- 2012 "Closed-loop interface with the olivocerebellar system", Hogri R, Magal A, Konforty D, Segalis E, Bamford SA, Prueckl R, Guger C, Mintz M, *Society for Neuroscience (SFN) Meeting (pending)*.
- 2010 "Replacing a cerebellar microcircuit with an autonomous neuroprosthetic device", Giovannucci A, Bamford SA, Herreros I, Hogri R, Taub A, Zucca R, Prueckl R, Mintz M, Silmon A, Guger C, Del Giudice P, Verschure PFMJ, *Society for Neuroscience (SFN) Meeting*.
- 2010 "A real-time analysis and control system for the reconstitution of cerebellar functionality", Prueckl R, Taub A, Hogri R, Giovannucci A, Herreros I, Bamford SA, Zreik M, Nossenson N, Guger C, Mintz M, Verschure PFMJ, Messer-Yaron H, Silmon A, *Society for Neuroscience (SFN) Meeting*.
- 2010 "Replacing a cerebellar microcircuit with an autonomous neuroprosthetic device", Giovannucci A, Bamford SA, Hogri R, Taub A, Prueckl R, Guger C, Del Giudice P, Verschure PFMJ, *Federation of European Neuroscience Societies (FENS) Forum*.

Other Publications

- 2009 "Synaptic rewiring in neuromorphic VLSI for topographic map formation", PhD Thesis, University of Edinburgh. (<http://www.sim.me.uk/neural/thesis.pdf>)

Invited Talks

- 17th May 2011 "Modern classical conditioning: towards a CMOS chip for bi-directional in-vivo brain interface for rehabilitation of a learnt eye-blink response", *Istituto di Biorobotica, Scuola Superiore Sant'Anna, Pisa.*
- 15th May 2011 "Modern classical conditioning: towards a CMOS chip for bi-directional in-vivo brain interface for rehabilitation of a learnt eye-blink response", *University Campus Bio-Medico, Rome.*
- 19th Feb 2010 "Modern classical conditioning: towards a VLSI chip for bi-directional in-vivo brain interface for rehabilitation of a learnt eye-blink response", *Institute of Biomedical Engineering, Imperial College.*
- 19th Dec 2008 "Synaptic rewiring in neuromorphic VLSI for topographic map formation", *Istituto Superiore di Sanità, Rome.*
- 10th June 2008 "Synaptic rewiring in neuromorphic VLSI for topographic map formation", *Electronic and Computer Engineering Dept., Hong Kong University of Science and Technology.*
- 9th April 2008 "Synaptic rewiring in neuromorphic VLSI for topographic map formation", *Robotics, Brain and Cognitive Sciences Dept., Italian Institute of Technology.*

Professional Development

I have acted as a reviewer for:

- IEEE Transactions on Neural Networks.
- IEEE Transactions on Biomedical Circuits and Systems.
- Frontiers in Neuromorphic Engineering.
- Frontiers in Neural Engineering.
- International Journal of Machine Consciousness.
- IEEE International Joint Conference on Neural Networks (IJCNN).
- IEEE International Symposium on Circuits and Systems (ISCAS).
- International Conference on Artificial Neural Networks (ICANN).

I have attended the following workshops and conferences:

- 2011 Capo Caccia Cognitive Neuromorphic Engineering Workshop.
- 2011 European Future and Emerging Technologies Exhibition (FET).
- 2010 IEEE Biomedical Circuits and Systems Conference (BIOCAS).
- 2009 Barcelona Cognition, Brain and Technology Summer School.
- 2008 International Joint Conference on Neural Networks (IJCNN).
- 2008 International Conference on Artificial Neural Networks (ICANN).
- 2007 Neuromorphic Engineering Workshop, Telluride, CO; (I was named "Best New Neuromorph").
- 2005 IEEE/EMBS Neural Engineering Conference (NER)

Technical Skills

Electronics design	Cadence, Spice, ORCAD, Target 3001, Xilinx ISE - VHDL
Data capture	Molecular Devices - Axoscope and Clampex, CED - Spike2
Programming	Matlab, Java (Eclipse), C++, Delphi - Object Pascal, Pop-11, Prolog, Visual Basic
Databases	MySQL, MS Access, IBM AS400 - RPG
Web development	PHP, HTML, CSS, Javascript, Joomla, Dreamweaver
OS and apps	Linux, Windows, Latex, Open/MS Office, Photoshop, Corel Draw, GIMP

References

Academic:

Paolo Del Giudice (Current Supervisor)
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Alan Murray (PhD Supervisor)
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