

# Dr. Erwan LE MARTELOT

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## Software Engineer at Google

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Date of birth: 8<sup>th</sup> May 1980

Nationality: French

## RESEARCH INTERESTS

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My research interests evolve around optimisation algorithms, software engineering, network science, complex systems, and nature-inspired computation. I also take a particular interest in graphics generation, geography and nature related fields. As also a software engineer I like my research to be applied and available as efficient algorithm implementations or software, along with publications.

## EDUCATION AND QUALIFICATIONS

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- 2006 – 2010**     **Doctorate (EngD) in Computer Science**  
**University College London, London, U.K.**  
*Subject:* Investigating and Analysing Natural Properties Enabled by Systemic Computation within Nature-inspired Computer Models  
*Academic supervisor:* Dr Peter J. Bentley  
*Synopsis:* Systemic Computation (SC) is a novel computation paradigm and corresponding computer architecture addressing the incompatibilities between electronic and natural computation by incorporating at its core properties found in natural systems. My thesis investigated and developed SC by assessing its potential to enable exploitation and analysis of natural properties within nature-inspired computer models. It presented the first high-level complete systemic computer, also including a visualisation framework, and then models developed to study the properties of self-adaptation, fault-tolerance, crash-proof computing, self-repair, homeostasis, flexibility and self-organisation. Throughout its various case studies, the thesis demonstrates how the rules and native natural properties provided by SC can be exploited to build improved natural properties. (*Full details in attached appendix.*)
- 2004 – 2005**     **Master of Research in Computer Science**  
**University Pierre et Marie Curie – Paris 6, Paris, France**  
Specialised in Artificial Intelligence and Decision; additional focus on Multimedia, Image and Sound Processing
- 2000 – 2003**     **Master of Science in Computer Science (DIIC - Diplôme d'Ingénieur)**  
**IFSIC, University of Rennes 1, Rennes, France**  
specialised in Languages and Computer Systems
- 1998 – 2000**     **DEUG SIR (2 years University Degree) in Computer Science**  
**University of Bretagne Sud, Vannes, France**  
specialised in Languages and Computer Systems

## WORK EXPERIENCE

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- 2012 to date**     **Google, Mountain View, CA, USA**  
*Software engineer:* Design and engineering in Java and C++ on Google TV. Algorithmic for indexing, searching, ranking on very large-scale data sets involving massively parallel and distributed computing. Natural language processing.
- 2010 to 2012**     **Imperial College London, London, U.K.**  
*Post-doctoral Research Associate:* Conception and development of new community detection algorithms enabling efficient multi-resolution analysis of large-scale data sets. Applications to various resolution criteria with both local and global approaches. Applications to crisp and overlapping communities. Design for parallel computing.  
*Tutor in Software Engineering:* Design: object-oriented programming, systems modelling and development, and design patterns. Algorithms: randomized algorithms, string-matching algorithms, dictionary search, advanced graph algorithms, dynamic programming, linear programming and Fourier transforms.
- 2006 – 2010**     **University College London, London, U.K.**  
*Doctorate:* Investigating and Analysing Natural Properties Enabled by Systemic Computation within Nature-inspired Computer Models.  
Work on complex systems, bio-inspired computing, distributed parallel computing, machine learning, computer language and architecture design, 3D visualisations.
- 2005 – 2006**     **University College London, London, U.K.**  
Creation within a scientific and artistic context of an original evolutionary adaptive system to study the relationships between mind, body and environment. This work led to the Fugitive Moments exhibition in Chichester in 2006.
- Summer 2004**     **LIP6 (Laboratory of Computer Science at Paris 6 University), Paris, France**  
Decoupling constraints checking with Prolog in Java programs.
- March – Aug. 2003**     **Unilog, Paris, France**  
Applicative maintenance on a national policyholders management client/server application. Migration GCos-Unix.
- Sept. 2002 – Feb. 2003**     **University of Rennes 1, Rennes, France**  
Java and Scheme tutor for computer science university students.  
**IRISA-INRIA, University of Rennes 1, Rennes, France**  
Development in Java of a C code optimisation tool for better performances in embedded systems. Project directed by INRIA and Texas Instrument.
- Summers 2002 and 2001**     **IRISA-INRIA, Rennes, France – VALORIA, Vannes, France**  
Research in the area of testing for design and reliability in software engineering. Development in Java and XML of the tool JMutator involving the mutation test method in Java classes.

## SKILLS

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### Project Management

Autonomy, Organisation, Self-teaching, Professional Software Quality, Strict Deadlines Ability

### Communication skills

- Teamwork experience involving computer scientists, biologists or artists – academics or engineers.
- Ability to take the lead and control a team.
- Good relational abilities.
- Work presentation to a wide audience at local meetings or international conferences.
- Publication of scientific papers in books, journals and conferences for an international audience of researchers and computer scientists.

## Computing

Operating Systems	Unix based systems (MacOS X, Linux), Windows, Dos
Languages	C++, C, Java, C#, Matlab, XML, Eiffel, Prolog, Unix Shells, ASM, Latex
Data Structures	Lists (dynamic, skip), Trees (random, binary, self-balancing), Graphs representations, Hash tables, Bloom filters
Animation and Rendering	3D (Java3D, Direct3D, OpenGL), 2D Engine (C/C++, SDL, Gtk+, C#, DirectDraw)
Internet/Networks	HTML, PHP, SQL Java, C/C++
Analysis Methods	Algorithms Complexity, UML, Design Patterns

## General Algorithms

Sorting Algorithms, Graph Algorithms, Community Detection in Networks, String-matching Algorithms, Randomised Algorithms

## Nature/Bio-inspired Computation

Modelling of Nature-inspired Systems, Natural Properties Based Models, Emerging Behaviour, Complex Systems, Genetic Algorithms, Artificial Neural Networks, Artificial Immune Systems, Gene Regulatory Networks, Ant Colony Optimisation, Genetic Programming, Swarm Intelligence

## Computer Graphics

Ray Tracing, Radiosity, Abstract Graphics Generation, Fractal Algorithms, Terrain and Landscape Generation, Image Processing, Mathematical Morphology, Face Detection

## Physics-inspired Systems

Physics-based Engines, Force-directed Layout Algorithms, 2D Game Engines

## Decision and Probabilistic Models

Decision trees, Pattern recognition, Markov models, Bayesian networks

## Driving License

Full clean Californian and French licenses

## LANGUAGES

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French	Native speaker
English	Proficient
Spanish	Conversational

## EXTRA-CURRICULAR ACTIVITIES

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Sports	Martial Arts (2 <sup>nd</sup> Dan in Soo Bahk Do, 4 years of Karate), Sailing
Music	Guitar player, Celtic music fan
Travels	Austria, Belgium, Brazil, Canada, Caribbean, Czech republic, Egypt, England, France, Germany, Greece, Hungary, India, Ireland, Italy, Japan, Malaysia, Mexico, Morocco, Nepal, Portugal, Scotland, Singapore, Spain, Thailand, U.A.E., U.S.A., Wales

## REFEREES

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Pr. Chris Hankin	Imperial College, London, U.K.	✉ <a href="mailto:c.hankin@imperial.ac.uk">c.hankin@imperial.ac.uk</a>	☎(+44) 207 594 8266
Dr. Peter J. Bentley	UCL, London, U.K.	✉ <a href="mailto:p.bentley@cs.ucl.ac.uk">p.bentley@cs.ucl.ac.uk</a>	☎(+44) 207 679 1329
Dr. R. Beau Lotto	UCL, London, U.K.	✉ <a href="mailto:lotto@ucl.ac.uk">lotto@ucl.ac.uk</a>	☎(+44) 751 556 3260
Pr. Sarah Rubidge	University of Chichester, U.K.	✉ <a href="mailto:s.rubidge@ucc.ac.uk">s.rubidge@ucc.ac.uk</a>	☎(+44) 798 442 2056

**PhD Abstract** Natural systems provide unique examples of computation in a form very different from contemporary computer architectures. Biology demonstrates capabilities such as adaptation, self-repair and self-organisation that are becoming increasingly desirable for our technology. The apparent dichotomy between systems of “natural computation” such as the brain, and computer systems based on classical designs shows that even though the two systems of computation might be mathematically equivalent at a certain level of abstraction, they are practically so dissimilar that they become incompatible.

Systemic Computation is a novel, unconventional and bio-inspired computation paradigm as well as a corresponding computer architecture introduced by Bentley (2007) and addressing the incompatibilities between electronic and natural computation by incorporating at its core properties found in natural systems. It is Turing complete, designed to support bio-inspired systems and shares the desirable capabilities of biology not found in conventional architectures.

The purpose of the thesis was to investigate and analyse the natural properties enabled by systemic computation within nature-inspired computer models. The first step had been to develop a complete platform implementing such computation. This platform involves virtual machine, dedicated language, compiler, graphical environment and on-line computation visualisation. The natural properties of self-adaptation, fault-tolerance, crash-proof computing, self-repair, homeostasis, flexibility and self-organisation have then been explored and analysed using several nature inspired models implemented on the platform. These models include genetic algorithms, artificial neural networks and artificial immune systems. By incorporating natural properties at the core of the models the work presented novel ways to think and design models inspired from nature. The on-line graphical visualisation of such models then enabled an analysis at a high level of abstraction by “looking” at computation throughout execution.

- Publications**
- Le Martelot, E and Hankin, C. (2012) Fast Multi-Scale Community Detection based on Local Criteria within a Multi-Threaded Algorithm. Arxiv pre-print.
  - Le Martelot, E. and Hankin, C. (2012) Fast Multi-Scale Detection of Relevant Communities in Large Scale Networks. To appear in *The Computer Journal*, Oxford University Press, 2013.
  - Le Martelot, E. and Hankin, C. (2012) Multi-scale Community Detection using Stability Optimisation. To appear in *The International Journal of Web Based Communities (IJWBC) Special Issue on: Community Structure in Complex Networks*, vol 9(3), 2013.
  - Le Martelot, E. and Hankin, C. (2011) Multi-scale Community Detection using Stability as Optimisation Criterion in a Greedy Algorithm. In Proceedings of the 2011 International Conference on Knowledge Discovery and Information Retrieval (KDIR 2011), pp. 216-225, October 26-29, 2011, Paris, France.

- Le Martelot, E. and Hankin, C. (2011) Community Detection using Stability Optimisation, Abstract for the International Conference on Network Science - NetSci 2011, June 8-10, 2011, Budapest, Hungary.
- Le Martelot, E. and Bentley, P. J. (2010) Novel Visualisation and Analysis of Natural and Complex Systems using Systemic Computation, *Information Visualization*, vol 10(1), 1-31, 2011.
- Le Martelot, E. and Bentley, P. J. (2009) On-Line Systemic Computation Visualisation of Dynamic Complex Systems. In Proceedings of the 2009 International Conference on Modeling, Simulation and Visualization Methods (MSV'09), pp. 10-16, July 13-16, 2009, Las Vegas, Nevada, USA.
- Le Martelot, E. and Bentley, P. J. (2008) Metabolic Systemic Computing: Exploiting Innate Immunity within an Artificial Organism for On-line Self-Organisation and Anomaly Detection. In *The Journal of Mathematical Modelling and Algorithms: Special issue on Artificial Immune System*, vol. 8(2), pp. 203-225, Bentley, P.J., Lee, D. (Ed), 2009.
- Le Martelot, E. and Bentley, P. J. (2008) Modelling Biological Processes Naturally using Systemic Computation: Genetic Algorithms, Neural Networks, and Artificial Immune Systems. In *Nature-Inspired Informatics for Intelligent Applications and Knowledge Discovery: Implications in Business, Science and Engineering*, pp. 204-241, Choing, R. (Ed), 2009, IGI Global.
- Le Martelot, E., Bentley, P. J., and Lotto, R. B. (2008) Eating Data is Good for Your Immune System: An Artificial Metabolism for Data Clustering using Systemic Computation. In Proceedings of 7th International Conference on Artificial Immune Systems (ICARIS 2008), pp. 412-423, August 10-13, 2008, Phuket, Thailand.
- Le Martelot, E., Bentley, P. J., and Lotto, R. B. (2008) Crash-Proof Systemic Computing: A Demonstration of Native Fault-Tolerance and Self-Maintenance. In Proceedings of 4th IASTED International Conference on Advances in Computer Science and Technology (ACST 2008), pp. 49-55, April 2-4, 2008, Langkawi, Malaysia.
- Le Martelot, E., Bentley, P. J., and Lotto, R. B. (2007) Exploiting Natural Asynchrony and Local Knowledge within Systemic Computation to Enable Generic Neural Structures. In Proceedings of 2nd International Workshop on Natural Computing (IWNC 2007), pp. 122-133, December 10-13, 2007, Nagoya University, Nagoya, Japan.
- Le Martelot, E., Bentley, P. J., and Lotto, R. B. (2007) A Systemic Computation Platform for the Modelling and Analysis of Processes with Natural Characteristics. In Proceedings of 9th Genetic and Evolutionary Computation Conference (GECCO 2007) Workshop: Evolution of Natural and Artificial Systems - Metaphors and Analogies in Single and Multi-Objective Problems, pp. 2809-2816, July 7-11, 2007, University College London, London, U.K.

**International Talks and Presentations**

- Multi-scale Community Detection using Stability as Optimisation Criterion in a Greedy Algorithm, International Conference on Knowledge Discovery and Information Retrieval (KDIR 2011), October 28, 2011, Paris, France
- Community Detection using Stability Optimisation, International Conference on Network Science (NetSci 2011), June 8, 2011, Budapest, Hungary
- On-Line Systemic Computation Visualisation of Dynamic Complex Systems. The 2009 International Conference on Modeling, Simulation and Visualization Methods (MSV'09), July 13-16, 2009, Las Vegas, Nevada, USA
- Systemic Computation, where natural computation and new technologies come together. UCL Electronic & Electrical Engineering Dpt Presentation day, September 18, 2008, University College London, London, U.K.
- Eating Data is Good for Your Immune System: An Artificial Metabolism for Data Clustering using Systemic Computation. 7th International Conference on Artificial Immune Systems (ICARIS 2008), August 13, 2008, Phuket, Thailand
- Crash-Proof Systemic Computing: A Demonstration of Native Fault-Tolerance and Self-Maintenance. 4th IASTED International Conference on Advances in Computer Science and Technology (ACST 2008), April 4, 2008, Langkawi, Malaysia.
- Exploiting Natural Asynchrony and Local Knowledge within Systemic Computation to Enable Generic Neural Structures. 2nd International Workshop on Natural Computing (IWNC 2007), December 11, 2007, Nagoya University, Nagoya, Japan.
- A Systemic Computation Platform for the Modelling and Analysis of Processes with Natural Characteristics. Genetic and Evolutionary Computation Conference (GECCO 2007), July 7, 2007, University College London, London, U.K.
- Fugitive Moments Exhibition, November 29, 2006, Otter Gallery, University of Chichester, Chichester, U.K.

**Relevant Courses**

- Finance and Value Creation Workshop, September 2007, London Business School, London, U.K.