# Danilo Pianini

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**OBJECTIVE**
Placement in an academic position that allows for advanced research in pervasive computing (i.e., modeling, analysis, design, and verification) with a particular focus on simulation.

**CITIZENSHIP**
Italy

**RESEARCH THEMES**
My current research is focussed on the engineering aspects of pervasive computing, with the goal of providing a robust, easy, and coherent chain of tools and procedures that can lead to robust, adaptive, self-healing, and possibly evolving software ecosystems. I recently got fascinated by aggregate programming, namely all the languages and techniques that enable the programming of groups of devices as a single entity distributed in space and time.

**EDUCATION**

**Dipartimento di Ingegneria Elettronica, Informatica e delle Telecomunicazioni, Università di Bologna**, Bologna (BO), Italy

Ph.D. in Electronics, Computer Science and Telecommunications Engineering,

- Thesis Title: *Engineering Complex Computational Ecosystems*
- Supervisor: Prof. Mirko Viroli
- Tutor: Prof. Antonio Natali
- External reviewer: Prof. Giovanna di Marzo Serugendo
- External reviewer: Prof. Simon Dobson
- Area of Study: Pervasive computing

Self-organising pervasive ecosystems of devices are set to become a major vehicle for delivering infrastructure and end-user services. The inherent complexity of such systems poses new challenges to those who want to dominate it by applying the principles of engineering. The recent growth in number and distribution of devices with decent computational and communicational abilities, that suddenly accelerated with the massive diffusion of smartphones and tablets, is delivering a world with a much higher density of devices in space. Also, communication technologies seem to be focussing on short-range device-to-device (P2P) interactions, with technologies such as Bluetooth and Near-Field Communication gaining greater adoption. Locality and situatedness become key to providing the best possible experience to users, and the classic model of a centralised, enormously powerful server gathering and processing data becomes less and less efficient with device density. Accomplishing complex global tasks without a centralised controller responsible of aggregating data, however, is a challenging task. In particular, there is a local-to-global issue that makes the application of engineering principles challenging at least: designing device-local programs that, through interaction, guarantee a certain global service level. In this thesis, we first analyse the state of the art in coordination systems, then motivate the work by describing the main issues of pre-existing tools and practices and identifying the improvements that would benefit the design of such complex software ecosystems. The contribution can be divided in three main branches. First, we introduce a novel simulation toolchain for pervasive ecosystems, designed for allowing good expressiveness still retaining high performance. Second, we leverage existing coordination models and patterns in order to create new spatial structures.

Third, we introduce a novel language, based on the existing "Field Calculus" and integrated with the aforementioned toolchain, designed to be usable for practical aggregate programming.

### Seconda Facoltà di Ingegneria, Università di Bologna, Cesena (FC), Italy

M.S., Software Engineering, March 2011
- *110L/110 - Magna cum Laude*
- Thesis Topic: *A Framework for Simulation of Pervasive Services Ecosystems*
- Supervisor: Dr. Mirko Viroli
- Area of Study: Computational Models

My master thesis was focused in the definition of a model and the realisation of a framework to simulate pervasive service ecosystems as they are meant in the SAPERE European Project. It analyses the relevance of the simulation both in the scientific method and in the specific context of pervasive computing. It introduces the Monte Carlo method and its realisation in the biochemistry field, through the well-known Stochastic Simulation Algorithms (SSA) described first by Gillespie and then optimized by Gibson and Slepoy. A computational model able to face highly dynamic requirements is then introduced, and an extension to the existing SSA algorithm "Next Reaction" is proposed to support it. The simulation framework Alchemist was then developed, and two case studies featuring high complexity (morphogenesis and crowd steering) were shown.

B.S., Software Engineering, October 2008
- *106 / 110*
- Thesis Topic: *From Swarm Intelligence to Self-Organising Coordination: a Pervasive Scenarios Application*
- Adviser: Prof. Andrea Omicini
- Area of Study: Distributed Systems

My bachelor thesis discusses the motivations which are pressing software engineers to move away from the object oriented towards the multi agent programming paradigm. It introduces the concept of coordination among agents with specific focus on the Linda tuple spaces medium and its extension with programmable behaviour, TuCSoN. Nature-inspired patterns are discussed and a taxonomy is proposed. A proof-of-concept example is then proposed, exploiting TuCSoN to produce a real distributed application which uses an ant-inspired pattern.

### ITCG L. Einaudi, Novafeltria (RN), Italy

Senior high school specializing in science education with focus on biology, July 2005
- 100/100

PUBLICATIONS ORDERED BY TIME

[1] D. Pianini, S. Virruso, R. Menezes, A. Omicini, and M. Viroli, "Self organization in coordination systems using a wordnet-based ontology," in *Fourth IEEE International Conference on Self-Adaptive and Self-Organizing Systems, SASO 2010, Budapest, Hungary, 27 September - 1 October 2010*, 2010, pp. 114–123. [Online]. Available: http://dx.doi.org/10.1109/SASO.2010.35

[2] D. Pianini, M. Viroli, and S. Montagna, "A simulation framework for pervasive services ecosystems," in *Proceedings of the 12th Workshop on Objects and Agents, Rende (CS), Italy, Jul 4-6, 2011*, 2011, pp. 150–157. [Online]. Available: http://ceur-ws.org/Vol-741/ID15_PianiniViroliMontagna.pdf

[3] S. Montagna, M. Viroli, M. Risoldi, D. Pianini, and G. D. M. Serugendo, "Self-organising pervasive ecosystems: A crowd evacuation example," in *Software Engineering for Resilient Systems - Third International Workshop, SERENE 2011, Geneva, Switzerland, September 29-30, 2011. Proceedings*, 2011, pp. 115–129.

[4] D. Pianini, S. Montagna, and M. Viroli, "A chemical inspired simulation framework for pervasive services ecosystems," in *Federated Conference on Computer Science and Information Systems - FedCSIS 2011, Szczecin, Poland, 18-21 September 2011, Proceedings*, 2011, pp. 667–674. [Online]. Available: http://fedcsis.eucip.pl/proceedings/pliks/98.pdf

[5] S. Montagna, D. Pianini, and M. Viroli, "Gradient-based self-organisation patterns of anticipative adaptation," in *Sixth IEEE International Conference on Self-Adaptive and Self-Organizing Systems, SASO 2012, Lyon, France, September 10-14, 2012*, 2012, pp. 169–174. [Online]. Available: http://dx.doi.org/10.1109/SASO.2012.25

[6] ——, "A model for drosophila melanogaster development from a single cell to stripe pattern formation," in *Proceedings of the ACM Symposium on Applied Computing, SAC 2012, Riva, Trento, Italy, March 26-30, 2012*, 2012, pp. 1406–1412. [Online]. Available: http://doi.acm.org/10.1145/2245276.2231999

[7] M. Viroli, D. Pianini, S. Montagna, and G. Stevenson, "Pervasive ecosystems: a coordination model based on semantic chemistry," in *Proceedings of the ACM Symposium on Applied Computing, SAC 2012, Riva, Trento, Italy, March 26-30, 2012*, 2012, pp. 295–302. [Online]. Available: http://doi.acm.org/10.1145/2245276.2245336

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[9] B. Anzengruber, D. Pianini, J. Nieminen, and A. Ferscha, "Predicting social density in mass events to prevent crowd disasters," in *Social Informatics - 5th International Conference, SocInfo 2013, Kyoto, Japan, November 25-27, 2013, Proceedings*, 2013, pp. 206–215. [Online]. Available: http://dx.doi.org/10.1007/978-3-319-03260-3_18

[10] G. Stevenson, J. Ye, S. Dobson, D. Pianini, S. Montagna, and M. Viroli, "Combining self-organisation, context-awareness and semantic reasoning: the case of resource discovery in opportunistic networks," in *Proceedings of the 28th Annual ACM Symposium on Applied Computing, SAC '13, Coimbra, Portugal, March 18-22, 2013*, 2013, pp. 1369–1376. [Online]. Available: http://doi.acm.org/10.1145/2480362.2480619

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[12] D. Pianini, M. Viroli, F. Zambonelli, and A. Ferscha, "HPC from a self-organisation perspective: The case of crowd steering at the urban scale," in *International Conference on High Performance Computing & Simulation, HPCS 2014, Bologna, Italy, 21-25 July, 2014*, 2014, pp. 460–467. [Online]. Available: http://dx.doi.org/10.1109/HPCSim.2014.6903721

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| TEACHING EXPERIENCE | **Alma Mater Studiorum Università di Bologna**, Bologna (BO), Italy |

*Post-doc* **since January 2015**

- Contract Professor for the course "Computer Science Foundations A", 2015.
- Teaching assistant for the course "Complex Adaptive Software System Engineering", 2015.

*PhD Student* **January 2012 to December 2014**

- Teaching assistant for the course "Object Oriented Programming", 2014.
- Teaching assistant for the course "Complex Adaptive Software System Engineering ", 2014.
- Teaching assistant for the course "Object Oriented Programming", 2013.
- Teaching assistant for the course "Computer Science Foundations A", 2013.
- Co-Supervisor Davide Ensini's master thesis, 2014.
- Co-Supervisor Luca Nenni's master thesis, 2014.
- Co-Supervisor Enrico Polverelli's master thesis, 2012.
- Co-Supervisor Andrea Dallatana's master thesis, 2012.
- Co-Supervisor Francesca Cioffi's master thesis, 2012.
- Co-Supervisor Paolo Contessi's master thesis, 2012.
- Co-Supervisor in Giacomo Pronti's master thesis, 2012.
- Co-Supervisor in Francesco Cardi's bachelor thesis, 2012.
- Seminar "From Engineer to Alchemist, There and Back Again: An Alchemist Tale"
- Seminar "The simulation alchemy"

*Contract Researcher* **June 2011 to December 2012**

- Contract professor for the course "Laboratory of Multi Agent Systems", 2011.
- Co-Supervisor in Michele Morgagni's master thesis, 2011.
- Co-Supervisor in Matteo Desanti's master thesis, 2011.

**University of Iowa**, Iowa City, IA USA

*Visiting Researcher* **August 2014 to September 2014**

- Seminar "Programming Networks from the Aggregate Perspective"

**Florida Institute of Technology**, Melbourne, FL USA

*Visiting Researcher* **July 2009 to October 2009**

- Seminar "Self Organization in Coordination Systems using a Wordnet-based Ontology", along with Sascia Virruso, under the supervision of Dr. Ronaldo Menezes

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| PERIODS ABROAD | **University of Iowa**, Iowa City, IA USA |

*Visiting Researcher* **August 2014, to September 2014**

- Research on aggregate programming and high order functions for field calculus. Refinement of Protelis.
- UIowa supervisor: Dr. Jacob Beal
- UniBo supervisor: Prof. Mirko Viroli

**Raytheon BBN Technologies**, Cambridge, MA USA

*Visiting Researcher* **June 2014, to August 2014**

- Research on aggregate programming and high order functions for field calculus. Realisation of Protelis.
- BBN supervisor: Dr. Jacob Beal
- UniBo supervisor: Prof. Mirko Viroli

**Johannes Kepler Universität**, Linz, Austria

*Visiting Researcher*                     **July 2013, to October 2013**

- Research on crowd density estimation and prediction, crowd steering, crowd simulation, pervasive ecosystems.
- JKU supervisor: Univ.-Prof. Mag. Dr. Alois Ferscha
- UniBo supervisor: Prof. Mirko Viroli

**Florida Institute of Technology**, Melbourne, FL USA

*Visiting Researcher*                     **July 2009 to October 2009**

- Research on distributed systems, complex networks and self organisation
- FIT supervisor: Dr. Ronaldo Menezes
- UniBo supervisor: Prof. Andrea Omicini

PROFESSIONAL
EXPERIENCE

**Valpharma International S.p.A.**, Pennabilli (RN), Italy

*Stage: raw material quality control*             **July 2004 to August 2004**

SERVICE

Contribution to open-source software projects:
- SmarTrRR
- Protelis
- Alchemist
- Angela the Mandelbrot Set Explorer
- Sabayon Linux

Frequent contributor to Wikipedia. and OpenStreetMap.

Designer and main developer of SmarTrRR, 2015–today
- SmarTrRR is a transitive dependency range resolver plugin for Gradle. It replaces the default Protelis resolver, implementing a progressive range restriction, and a conflict resolution algorithm. Also, it allows the user to configure specific artifact substitutions.

Designer and main developer of Protelis, 2014–today
- Protelis is a programming language aiming at making networked systems just as easy to build for complex and heterogeneous networks as for single machines and cloud systems. This accomplished by separating the different tasks and making some of the hard and subtle parts automatic and implicit.

Designer and leader developer of Alchemist, 2010–today
- Alchemist is an innovative simulator meant to join the expressiveness of the agent based modelling and the power and speed of the stochastic simulation algorithms used in chemistry. It is tailored to scenarios in which many nodes interact exchanging informations. Its flexibility allows for a wide range of applications, spacing from the classical chemistry to the biology (e.g. complex morphogenesis processes) to pervasive computing.

Creator and maintainer of Nirvana overlay for Gentoo Linux, 2014–2015
- Nirvana is an overlay for Gentoo Linux, namely a container of ebuild files, which are scripts describing how to install and maintain packages in a Gentoo Linux distribution. Nirvana contains those ebuild that work well, but are too hard to maintain to be pushed in Sunrise or Sabayon overlays. Moreover, this repository is used by me as a playground for creating new ebuilds. On July 2014 Nirvana got officially indexed by Layman, and as a consequence it is now available to all Gentoo users using such tool.

Creator and maintainer of Nirvana Community Repository, 2014–2015
- Nirvana Community Repository contains the same packages included in Nirvana overlay, distributed in a pre-compiled form compatible with Sabayon Linux Entropy package manager.

Sabayon Linux, 2008–2014
- Member of both testing team and developers team. Sabayon Linux is a Gentoo-based distribution which follows the works-out-of-the-box philosophy, aiming to give the user a wide number of applications that are ready for use and a self-configured operating system.

A.St.I.Ce. Executive Board Member, January 2006 to November 2009
- Founded "I$^2$ — Informa Ingegneri", the technical journal of Seconda Facoltà di Ingegneria, containing articles about the research activity of the faculty.
- Founded "Linux Libera Tutti", a project meant to allow students access without any charge DVDs and CDs of various Linux distributions, with a special focus on Sabayon Linux.

SKILLS

Hardware assembling:
- Server and Desktop systems assembling
- Overclocking

Software configuration:
- Windows installation and configuration
- Linux installation and configuration for personal computers, servers, and embedded systems with specific skills for Gentoo Linux, its derivatives and Arch Linux.
- Server and Desktop systems assembling

Computer Programming:
- Java, C, Python, Prolog, Groovy, C++, UNIX shell scripting, SQL, Jason, MATLAB, XText, Xtend, and others.
- Object Oriented design
- Distributed systems
- Concurrent / multithreaded programming
- Mobile programming (Android)

Development techniques:
- Distributed Version Control Systems (Mercurial, Git)
- Build systems (Gradle, Maven)
- Continuous Integration (drone.io)
- Software Deployment on Maven Central

Information/Internet Technology:
- Networking (UDP, TCP, ARP, DNS)
- Services (SQL, HTTP, application-specific daemon design)
- Content Managing (Joomla)

Operating Systems:
- Linux, with specific skills for Gentoo, Sabayon and Arch
- other UNIX variants
- Microsoft Windows family

Productivity Applications:
- LaTeX, BibTeX, Nano, Libreoffice, Microsoft Office, most common productivity packages (for Windows and Linux platforms)

Multimedia:
- Scalar image editing and analysis (basic Computer Vision skills, Photoshop, GIMP)
- Vectorial image editing (Dia, Inkscape)
- RAW image processing
- Non-linear video editing (Kdenlive, Pinnacle Studio, Openshot)
- 3D Design (Blender)
- 3D Programming (OpenGL)

EXPERTISE

Mathematics:
- Applied Mathematics, Real and Complex Analysis, Discrete Mathematics, Geometry.

Physics:
- Mechanics, Electromagnetism.

Control Theory and Engineering:
- Distributed and Self-adaptive Control, Dynamic Optimization, Bio-mimicry, Bio-inspiration.

Communications and Signal Processing:
- Probability, Random Variables, Stochastic Processes, Networks

Computer Science and Engineering:
- Model Checking, Software Verification, Component-Based Reusable Software, Object Oriented Programming, Logic Programming, Concurrent Programming, Distributed Systems, Benchmarking, Model Driven Software Development.

Natural Sciences (Biology, Microbiology, Chemistry, Biochemistry):
- Molecular orbital theory, stoichiometry, organic chemistry, DNA transcription and replication processes, PCR, metabolic processes, virus classification, bacteria classification, human morphology, physiology, Earth sciences, astronomy.

REFERENCES
AVAILABLE TO
CONTACT

**Dr. Jacob Beal** (e-mail: jakebeal@alum.mit.edu; phone: +1 617 873 7676)
- Scientist, Raytheon BBN Technologies
◇ 10 Moulton Street, Cambridge, MA 02138, USA
⋆ *Dr. Beal was my local supervisor during my research period in Cambridge and Iowa City*

**Dr. Ronaldo Menezes** (e-mail: rmenezes@cs.fit.edu; phone: +1 321 674 7623)
- Associate Professor, Computer Sciences, Florida Institute of Technology
◇ 150 W University Blvd, Melbourne, FL 39201, USA
⋆ *Dr. Menezes was my local supervisor during my research period in Florida Tech*

**Prof. Andrea Omicini** (e-mail: andrea.omicini@unibo.it; phone: +39 0547 3 39220)
- Full Professor, Dipartimento di Informatica – Scienza e Ingegneria
  Alma Mater Studiorum Università di Bologna
◇ Via Venezia 52, 47521 Cesena (FC), Italy
⋆ *Prof. Omicini was my supervisor for Bachelor Thesis and my Italian supervisor during the research period in Florida Tech*

**Prof. Mirko Viroli** (e-mail: mirko.viroli@unibo.it; phone: +39 0547 3 39216)
- Associate Professor, Dipartimento di Informatica – Scienza e Ingegneria
  Alma Mater Studiorum Università di Bologna
◇ Via Venezia 52, 47521 Cesena (FC), Italy
⋆ *Dr. Viroli was my supervisor for Master Thesis and PhD*

November 6, 2015