



12th European Conference on Artificial Life
2-6 September 2013, Taormina, Italy

Conference Program
ECAL 2013

T-BOT

"Life, logic and information: focusing on information flow will help us to understand better how cells and organisms work"

Sir Paul M. Nurse

European Conference on Artificial Life Scientific Program

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Preface

ECAL 2013 continues with its mission to play a unique role as an information and knowledge sharing forum in synthetic life, where the wide range of its offerings allows ECAL attendants to learn and network.

After a pioneering phase lasted more than twenty years, ECAL will show the current state of the art of a mature and autonomous discipline, Artificial Life, that is collocated at the intersection between a theoretical perspective, namely the scientific explanations of different levels of life organizations (e.g., molecules, compartments, cells, tissues, organs, organisms, societies, collective and social phenomena), and advanced technological applications (bio-inspired algorithms and techniques to building-up concrete solutions such as in robotics, data analysis, search engines, gaming).

ECAL 2013, the twelfth European Conference on Artificial Life, is held in Taormina, on the stunning island of Sicily, Italy, in September 2-6, 2013. While hosting the event, the city of Taormina will give the participants the opportunity to enjoy the richness of its historical and cultural atmosphere, its traditions, and the beauty of its natural resources, the sea, and Mount Etna the largest and active volcano of Europe (a UNESCO World Heritage site).

The 12th ECAL is truly “grand celebration” with hundreds of paper and poster presentations, *five focused tutorials* and an impressive constellation of *ten satellite workshops*. The scientific program has been designed to optimize the interactions on all levels. This year’s program includes papers from one of the largest pool of submissions (*267 submissions*).

Moreover, at ECAL 2013 we added *new and exciting tracks*: Adaptive Hardware & Systems and Bioelectronics, Adaptive Living Material Technologies & Biomimetic Microsystems, Artificial Immune, Neural and Endocrine Systems, Artificial Immune Systems – ICARIS, Bioinspired Learning and Optimization, Bioinspired Robotics, Biologically Inspired Engineering, Evolvable Hardware, Evolutionary Electronics & BioChips, Foundations of Complex Systems and Biological Complexity, Mathematical Models for the Living Systems and Life Sciences, Music and the Origins and Evolution of Language, Programmable Nanomaterials, and Synthetic and Systems Biochemistry and Biological Control. So, in the ECAL 2013 program you will find research works written by leading scientists in the field, from *fifty different countries and five continents*, describing an impressive array of results, ideas, technologies and applications.

The keynotes have always been one of the most important parts of ECAL. The nine keynote speakers of ECAL 2013 will focus on a wide spectrum of topics of our scientific and technological ecosystem. In particular, the nine keynote speakers are the following:

Prof. Paolo Arena, University of Catania, Italy
Prof. Roberto Cingolani, Italian Institute of Technology – IIT, Italy
Prof. Roberto Cipolla, University of Cambridge, UK
Prof. Martin Hanczyc, University of Southern Denmark, Denmark
Prof. Henrik Hautop Lund, Technical University of Denmark, Denmark
Prof. Didier Keymeulen, California Institute of Technology – CALTECH, USA
Prof. Steve Oliver, University of Cambridge, UK
Prof. Bernhard Palsson, University of California San Diego – UCSD, USA
Prof. Rolf Pfeifer, Swiss Federal Institute of Technology – ETH, Switzerland

These speakers make a blend of all the Artificial Life topics, in particular their choice represents one of the first cross talk between synthetic (or systems biology) and robotics through the concept of artificial life. We expect both the round table with the speakers and the frequent non-formal interactions with the researchers attending the conference and the workshops will represent remarkable events!

This edition has highlighted a more profound integration of concepts and ideas from life sciences, artificial intelligence, mathematics, engineering and computer science than in the past. Furthermore, the integration between dry and wet lab biological results shows more progress. Although synthetic biology appears on a small number of papers, it is already showing itself as a powerful engine for boosting new ideas into the ECAL breath of topics and new type of researchers, perhaps interested in designing life at different levels of complexity, following ECAL or having ECAL as their main conference.

As organisers of such important event we felt the duty to ask ourselves three questions:

- 1) Will this event attract young inquisitive minds?
- 2) Will this event be full of opportunity and career boosts for established researchers in the artificial life fields?
- 3) Will an ECAL author, or a student attending it, change the world?

We have shaped the conference to answer all these questions. We believe this conference is the place for rapid exchange of very innovative ideas in artificial life and therefore has a very important role in the current geography of places where innovation could take place. A young researcher will be exposed to the largest diversity of ideas in artificial life. The expectations are reflected by the larger number of registrations, papers, and satellite workshops with respect to the previous editions.

Finally, we would like to recognize the enormous efforts of the ECAL organizing committee who made ECAL possible by donating their time, expertise, and enthusiasm. Without their hard work and dedication, ECAL would not be possible. We also could not have organized ECAL 2013 without the excellent work of all of the program committee members, our workshop chair, tutorial chair, publicity chair, financial manager, conference secretary and local organizers. We would like to express our appreciation to the plenary speakers, to the tutorial speakers, to the workshop organizers, and to all the authors who submitted research papers to ECAL 2013.

ECAL is the premier event for science and technology in synthetic life, where scientists from all over the world meet to exchange ideas and sharpen their skills.

Taormina, September 2013

Pietro Liò, Orazio Miglino, Giuseppe Nicosia, Stefano Nolfi, and Mario Pavone.

ECAL 2013 Program Overview

Monday 2 nd September	Tuesday 3 rd September	Wednesday 4 th September	Thursday 5 th September	Friday 6 th September
Registration (8:00 – 9:00)				
	Roberto Cipolla 9:00 – 10:00	Rolf Pfeifer 9:00 – 10:00	Martin Hanczyc 9:00 – 10:00	Bernhard Palsson 9:00 – 10:00
Workshops Session #1 9:00 – 13:00	Coffee Break – Posters (10:00 – 10:30)			
Coffee break: 10:45 – 11:15	Session #1 10:30 – 13:00 ----- 4 parallel sessions	Steve Oliver 10:30 – 11:30 Sessions #2 11:35 – 13:15 ----- 4 parallel sessions	Sessions #4 10:30 – 13:00 ----- 4 parallel sessions	Sessions #6 10:30 – 12:10 ----- 6 parallel sessions
				Didier Keymeulen 12:15 – 13:15
Lunch - Posters (13:30 – 14:30)				
	Roberto Cingolani 14:30 – 15:30	Paolo Arena 14:30 – 15:30	Henrik Hautop Lund 14:30 – 15:30	
Workshops Session #2 14:30 – 18:30	Coffee Break - Posters (15:30 – 16:00)			
Coffee break: 16:15 – 16:45	Poster Presentation 16:00 – 17:00	Session #3 16:00 – 18:55 ----- 4 parallel sessions	Session #5 16:00 – 17:15 ----- 5 parallel sessions	Workshops Session #3 & Tutorial #2 14:30 – 18:30 Coffee break: 16:15 – 16:45
	Tutorials #1 17:00 – 19:00			
	Poster Inauguration & Poster Session ----- start at 19:00	Social Dinner ----- start at 20:30	Social Tour ----- start at 17:30	Closing Ceremony 18:30 – 19:00

ECAL 2013 - Satellite Workshops Program

Satellite Workshops session #1 - Monday 2nd September, 9:00 – 18:30

9:00 – 10:45	Collective Behaviours and Social Dynamics	HSB 2013	ERLARS 2013	Protocells: Back to the Future	A TRUCE workshop on Unconventional Computing in 2070	Workshop on the Evolution of Physical Systems	Fundamentals of Collective Adaptive Systems
10:45 – 11:15	Coffee Break						
11:15 – 13:30	Collective Behaviours and Social Dynamics	HSB 2013	ERLARS 2013	Protocells: Back to the Future	A TRUCE workshop on Unconventional Computing in 2070	Workshop on the Evolution of Physical Systems	Fundamentals of Collective Adaptive Systems
13:30 – 14:30	Lunch						
14:30 – 16:15	Collective Behaviours and Social Dynamics	HSB 2013	ERLARS 2013	Protocells: Back to the Future	A TRUCE workshop on Unconventional Computing in 2070	Artificial Life in Massive Data Flow	Fundamentals of Collective Adaptive Systems
16:15 – 16:45	Coffee Break						
16:45 – 18:30	Collective Behaviours and Social Dynamics	HSB 2013	ERLARS 2013	Protocells: Back to the Future	A TRUCE workshop on Unconventional Computing in 2070	Artificial Life in Massive Data Flow	Fundamentals of Collective Adaptive Systems

Ettore Majorana room	Archimede room	Antonello da Messina room	Pirandello room	Quasimodo room	Vincenzo Bellini room	Vincenzo Bellini room	Hotel San Domenico Etna room

ECAL 2013 - Satellite Workshops Program

Satellite Workshops session #2 - Friday 6th September, 14:30 – 18:30

14:30 – 16:15	What Synthetic Biology can offer to Artificial Intelligence? Perspectives in the Bio-Chem-ICT and other scenarios	Artificial Life Based Models of Higher Cognition
16:15 – 16:45	<i>Coffee Break</i>	
16:45 – 18:30	What Synthetic Biology can offer to Artificial Intelligence? Perspectives in the Bio-Chem-ICT and other scenarios	Artificial Life Based Models of Higher Cognition

Ettore Majorana room



Pirandello room



ECAL 2013 – Tutorials Program

Tutorial session #1 - Tuesday 3rd September, 17:00 – 19:00

PyCX: A Python-Based Simulation Code Repository for Complex Systems Education <i>Hiroki Sayama</i>	Designing Adaptive Humanoid Robots Through the FARSA Open-Source Framework <i>Gianluca Massera, Tomassino Ferrauto, Onofrio Gigliotta & Stefano Nolfi</i>	Next Generation Sequencing Data Production, Analysis, and Archiving <i>Heiko Muller & Luca Zammataro</i>	Exploring Prebiotic Chemistry Spaces <i>Jakob L. Andersen, Christoph Flamm, & Daniel Merkle</i>
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Ettore Majorana room



Archimede room



Pirandello room



Vincenzo Bellini room



Tutorial session #2 - Friday 6th September, 14:30 – 16:30

Cell Pathway Design for Biotechnology and Synthetic Biology

Claudio Angione, Jole Costanza, Giovanni Carapezza, Pietro Lió & Giuseppe Nicosia

Archimede room



ECAL 2013 – Tuesday 3rd September

8:00 – 8:50	Registration			
8:50 – 9:00	Opening Ceremony			
9:00 – 10:00	Keynote Speaker: Roberto Cipolla <i>Computer Vision: Making Machines that See</i> (Ettore Majorana room)			
10:00 – 10:30	Coffee Break			
10:30 – 13:00	ECAL 2013 #1	ECAL 2013 #2	Bioinspired Robotics #1	Synthetic and Systems Biochemistry and Biological Control
13:00 – 14:30	Lunch			
14:30 – 15:30	Keynote Speaker: Roberto Cingolani <i>Nanotechnologies for Humans and Humanoids</i> (Ettore Majorana room)			
15:30 – 16:00	Coffee Break			
16:00 – 17:00	Poster Presentation			
19:00	Poster Inauguration & Poster Session			

Ettore Majorana room



Archimede room



Pirandello room



Vincenzo Bellini room



ECAL 2013 – Wednesday 4th September

8:00 – 9:00	Registration			
9:00 – 10:00	Keynote Speaker: Rolf Pfeifer <i>"Soft Robotics" - the next generation of intelligent machines</i> (Ettore Majorana room)			
10:00 – 10:30	Coffee Break			
10:30 – 11:30	Keynote Speaker: Steve Oliver <i>The Robot Scientist: Artificial Life Investigates Real Life</i> (Ettore Majorana room)			
11:35 – 12:25	ECAL 2013 #3	ECAL 2013 #4	Artificial Immune, Neural & Endocrine Systems	ECAL 2013 #5
12:25 – 13:15			Bioinspired Learning & Optimization	
13:15 – 14:30	Lunch			
14:30 – 15:30	Keynote Speaker: Paolo Arena <i>Neuro-Inspired Insectoids</i> (Ettore Majorana room)			
15:30 – 16:00	Coffee Break			
16:00 – 18:55	Bioinspired Robotics #2	ECAL 2013 #6	ECAL 2013 #7	ICARIS
20:30	Social Dinner at Hotel Villa Diodoro			

Ettore Majorana room



Archimede room



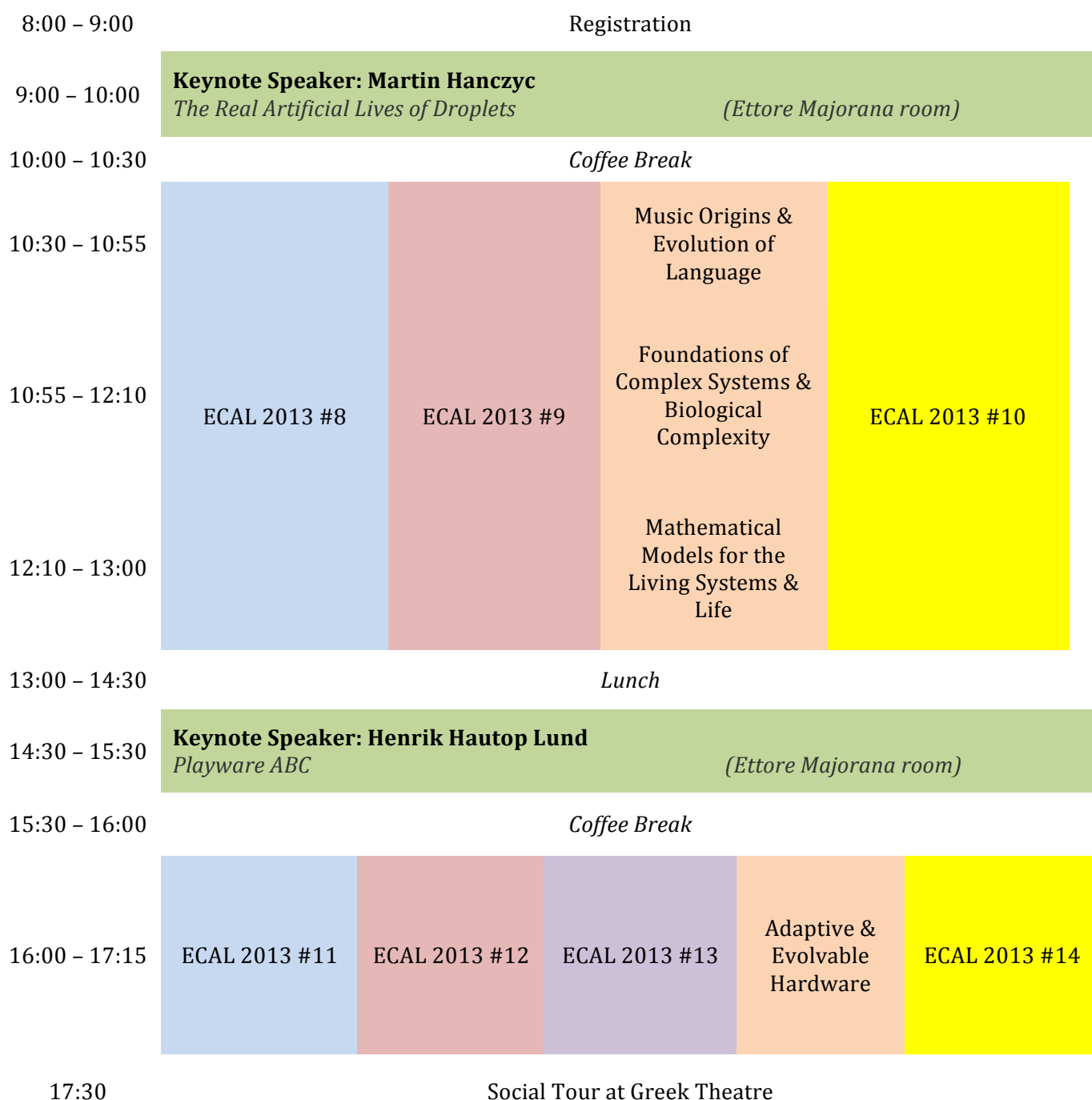
Pirandello room



Vincenzo Bellini room



ECAL 2013 – Thursday 5th September



Ettore Majorana room



Archimede room



Antonello da Messina room



Pirandello room



Vincenzo Bellini room



ECAL 2013 – Friday 6th September

9:00 – 10:00	Keynote Speaker: Bernhard Ø. Palsson <i>An Insight into Metabolic Requirements</i> (Ettore Majorana room)		
10:00 – 10:30	Coffee Break		
10:30 – 12:15	ECAL 2013 #15	ECAL 2013 #16	Late Breaking Papers
10:30 – 10:55	Bioinspired Robotics #3	ECAL 2013 #17	ECAL 2013 #18
10:55 – 11:45	Programmable Nanomaterials		
12:15 – 13:15	Keynote Speaker: Didier Keymeulen <i>Self-Repairing and Tuning Reconfigurable Electronics for Space</i> (Ettore Majorana room)		
13:15 – 14:30	Lunch		
18:30 – 19:00	Closing Ceremony		



2nd September, 9:00-18:30

Quasimodo room

Hotel Villa Diodoro

A Truce Workshop on Unconventional Computing in 2070

Martyn Amos

Artificial life is becoming increasingly important, not just to scientists, but to the wider global community. The growing challenges we face (energy, the environment, a changing demographic profile, to name but a few) will require inherently *inter-disciplinary* strategies. Artificial life and unconventional computing technologies will play an important role in addressing these issues. In this *unconventional workshop*, we will create a vision for what the world *might* look like more than fifty years from now, when artificial life is embedded in our everyday existence. Our aim is to spark a wider debate about the applicability and relevance of unconventional computing techniques, and to imagine a long-term picture of how they may come to influence our lives. We offer a *unique opportunity* for scientists to collaborate with short story writers, journalists and artists to create a collection of speculative fiction, feature articles and artworks, based on the theme of "Unconventional Computing in 2070". Scientists will work (on the day) with authors to draft short stories with a "ucomp" theme, and with journalists to write accessible, popular science introductions to their field of research. While this is happening, an artist will sketch out initial studies for a number of pieces, each based on a different story. The scientists will also have the opportunity to provide an afterword to each story, once they are written, describing the scientific background to the fictional work. Scientists will be required to "pitch" their ideas (based on their research) at the beginning of the workshop, and then the authors will each select one as the basis for their story. The remaining ideas will then be used as the basis for a number of feature articles. *All stories, afterwords, articles and artworks will be collected together in a published volume.* TRUCE is a Coordination Action, supported by the Future and Emerging Technologies (FET) programme within the ICT theme of the Seventh Framework Programme for Research of the European Commission. The aim of this three-year project is to support and facilitate inter-disciplinary research into the foundations and application of unconventional computing.

Martyn Amos, Manchester Metropolitan University
Ra Page, Manchester Metropolitan University
Robin Kassab, Manchester Metropolitan University
Anne Kirby, Manchester Metropolitan University
Katherine Orr, Manchester Metropolitan University
Stuart Evers, Manchester Metropolitan University
Julian Gough, Manchester Metropolitan University
Adam Marek, Manchester Metropolitan University
Zoe Lambert, Manchester Metropolitan University
Daphne Lai, Manchester Metropolitan University
Thomas Ray, University of Oklahoma

<i>Lenka Pitonakova</i> , University of Southampton
<i>Seth Bullock</i> , University of Southampton
<i>Darius Falahat</i> , University of Southampton
<i>German Terrazas</i> , University of Nottingham
<i>Susan Stepney</i> , University of York
<i>Andrew Philippides</i> , University of Sussex

6th September, 14:30-18:30

Pirandello room

Hotel Villa Diodoro

Artificial Life Based Models of Higher Cognition

David Marocco and Onofrio Gigliotta

Artificial Life was originally conceived as a powerful tool to answer to the question about the nature of life. Many researches in the last decades drew attention on different aspects, including chemistry, biology, evolution and some minimal forms of cognition, so as to study a complex phenomenon at different scale domains. Focusing on cognition, AL techniques have been utilized to uncover minimal mechanism of important cognitive processes such as categorization, language, spatial behavior, motor control and the like. However, following this bottom up AL approach we need to address higher cognitive processes in an integrated manner so as to exploit the full power of AL approach. Hence, the aim of this workshop is to promote and to encourage AL modelling of higher cognitive processes, integrating complex motor systems to complex higher cognition. Topics of interest include, but are not limited to: Spatial Cognition, Language, Mental Imagery, Decision Making, Social Learning, Cultural Transmission, Role Allocation, Active Perception, Awareness and Categorisation.

14.30	Invited Talk: Prof. Takashi Ikegami - University of Tokyo Deviate, Studio and Device
15.15	Gigliotta O., Nolfi S. Role of Gaze Shifts in a Simple Manipulation Task on a Simulated iCub Humanoid Robot
15.35	Ponticorvo M., Miglino O. Studying the development of spatial cognition with evolving neuro-agents
15.55	Leitner J., Harding S., Frank M., Forster A., Schmidhuber J. ALife in Humanoids: Developing a Framework to Employ Artificial Life Techniques for High-Level Perception and Cognition Tasks on Humanoid Robots
16.15	Coffee Break
16.45	Mirolli M. From low-level behaviours to high-level cognition through the internalization of language: An Artificial Life Research Program
17.05	Uno R., Suzuki K. Detection and enjoyment of agency that leads to proto-grammatical elements
17.25	Tuci E. The swarm robotics integrated root to the study of higher cognition: the analysis of a case study
17.45	Pugliese F., Acerbi A., and Marocco D. The role of genetic temperaments variation in the emergence of Leadership
18.05	Bilotta E., Chiaravalloti F., and Pantano P. Modeling artificial neuro-degeneration of the human hippocampus cells, using memresistive circuits
18.25	Workshop conclusion

2nd September, 14:30-18:30

Vincenzo Bellini room

Hotel Villa Diodoro

Artificial Life in Massive Data Flow

Takashi Ikegami, Mizuki Oka, Norman Packard, Mark Bedau and Rolf Pfeifer

Computer synthesized world models are now much richer than those 20 years ago. Nowadays, a great deal of data can be acquired from various fields, and the world presented by this data is much richer than artificial ones. Analysis and synthesis of the vast real-time dimension of this data, as well the massive data flow over long time scales has now become possible. This is what we call the era of Massive Data Flow (MDF). Huge floods of data are often referred to as Big Data, which connotes the era of "business" using big data; from more pro table Web advertisements to customized medical services. What we aim to present here, by the name of MDF, is not business applications but the discussion of MDF as a basic science, which we name MDF science. We focus not only on the quantitative, but also the qualitative diversity available today. For example, if you were free to take the spatial and temporal data from all the cells of a cat, anytime and anywhere, what would you do? Would it significantly advance the problem of development? Or, in doing so would you come to understand what is life? We notice a striking absence of an adequate theory or model of MDF and of an epistemological account for MDF science. For example, in the Artificial Life community, we have tried to understand the behavior of high-dimensional dynamical systems by projecting them onto a low-dimensional space. However, this is not applicable for MDF science. MDF has revealed that such conventional means do not work well and we are required to develop new means of analysis and concepts. How to understand a system without reducing its complexity is the slogan of complex systems science. Challenges in a variety of cross-disciplinary sciences under this slogan still need to be encouraged and a new epistemology for analyzing MDF without losing its complexity is still yet to be proposed. We have organized several such sessions in the Japanese Artificial Intelligence community, and it is now time to propose a session in the Artificial life community to widely discuss the potential of artificial life in MDF! Therefore, we have organized a workshop by unifying two recently developed concepts; one is known as Living Technology and the other is Web science. Any basic science can lead to innovative applications and artificial life studies is no exception. The purpose of living technology is to bring to fruition the concepts developed through the study of artificial life, such as self-reproduction, autonomy, enaction, robustness, open-ended evolution, and evolvability in a real-world context. The Web is one of the most complex artificial systems that we know. Web science is a new field of computer science which aims to manage new media based on the enormous amount of relevant information collected, analyzed and synthesized, in order to provide better communication and services between people. We are now analyzing Web dynamics as a larger model, when compared to the traditional size of neural nets, to understand a brain dynamics in terms of information flow, the default mode network, and bursting behavior. Creating and studying a minimalistic model of life has been the traditional approach to artificial life. Here we take a maximalistic model for life (creating a large and complex model). Thus, by extending the models of artificial life into the MDF world, we would like to argue what sort of new technology and concepts we can develop in order to understand life in both the artificial and the real world. What living technology can we think of by applying the concept of artificial life to Web science? How do we build a new understanding of the living condition through MDF? We hope that these kinds of questions around MDF will be intensively discussed in this workshop.

12:55	Welcome notes by the workshop organizers
13:00	Takashi Ikegami Science of Massive Data Flow
<i>1st session: Robotics</i>	
13:30	Georg Martius Quantifying Emergent Behavior of Autonomous Robots
14:00	Kohei Nakajima Memory Traces in a Silicone-based Soft Robotic Arm
14:30	coffee break
<i>2nd session: The Web</i>	
14:45	Norman Packard Twitter and Evolvability measure
15:15	Mizuki Oka Analysis of Bursting Behaviors in Twitter
15:45	coffee break
<i>3rd session: Artificial Intelligence</i>	
16:00	Matthias Scheutz Big data and the cloud: an enabling mix for super-human capabilities in artificial intelligence that will affect us deeply
16:30	Open Discussions
17:00	Closing remarks

2nd September, 9:00-18:30

Ettore Majorana room

Hotel Villa Diodoro

Collective Behaviours and Social Dynamics

Stefano Nolfi, Marco Dorigo, Francesco Mondada, Tom Wenseleers, Vito Trianni, Michael Spranger

This workshop is at the intersection of several disciplines, from ethology to swarm intelligence, from collective robotics to evolutionary linguistics. Despite very heterogeneous, these disciplines share a common ground when they refer to the mechanisms and the dynamics of social interaction, both at the ontogenetic and the phylogenetic level (e.g., referring to developmental or evolutionary factors). Despite the similar scientific questions, the study of collective behaviour and social dynamics is characterised by very different approaches, and few places for discussion and comparison are available. Therefore, the workshop represents a unique occasion in which such a juxtaposition of diverse disciplines can take place. The goal of the workshop is to confront the current trends and advancements in the study of collective behaviour and social dynamics, and to promote cross-fertilisation and contamination between disciplines and approaches that rarely meet together.

8:55	Opening
9:00	Keynote: Simon Garnier Ant wuz here! Following the trail of recent ant network research
9:45	Melanie E. Moses Beyond Pheromones: An integrated ant-inspired approach to swarm robotics
10:00	Sean T. Wilson Design of stochastic policies for synchronous collective transport of multiple payloads by robotic swarms
10:15	Alexandre Campo Collective memory in a swarm of self-organized oblivious robots
10:30	Roman Miletitch Exploration and exploitation of distributed resources through Social Odometry
10:45	Coffee break
11:15	Randal S. Olson Studying the Evolution of Swarm Behavior in Action
11:30	Eliseo Ferrante Evolution of Task Partitioning in Swarm Robotics
11:45	Farshad Arvin Cue-based Aggregation with a Mobile Robot Swarm using a Novel Fuzzy-based Method
12:00	Andrew Vardy The Impact of Informed Individuals on Collective Object Sorting

12:15	Hiroki Sayama Swarm-Based Morphogenetic Artificial Life
12:30	Ali Abdul Khaliq Stigmergic Algorithms for Multiple Minimalistic Robots
12:45	Lunch break
14:30	Keynote: Andrea Baronchelli The role of social complexity in convention spreading
15:15	Michael Spranger Evolutionary Semantics - Experiments in Spatial Language
15:30	Kazutoshi Sasahara Emergence of Collective Attention and Dynamics of Retweet Networks
15:45	Mads P Buch Trust versus contracts in social interactions
16:00	Whitney Tabor Human coordination in a group number game exhibits physics-like energy loss and symmetry breaking
16:15	Coffee break
16:45	Pedro Mariano Extinctions Are a Population Level Dilemma
17:00	Alan FT Winfield Noisy Social Learning and the Dynamics of Behavioural Evolution
17:15	Lars A Bach On the evolutionary dynamics of simple group games
17:30	Nicolas Bredeche From Self-adaptive Collective Robotics to Artificial Evolutionary Ecology (and back)
17:45	Evert Haasdijk MONEE: Combining Environment- and Task-driven Evolution
18:00	Adam Erskine PSO+C: Criticality in Particle Swarm Optimization
18:15	Closing remarks

2nd September, 9:00-13:30

Vincenzo Bellini room

Hotel Villa Diodoro

2nd International Workshop on the Evolution of Physical Systems

John Rieffel, Nicolas Bredeche, Jean-Baptiste Mouret and Evert Haasdijk

Rodney Brooks once famously said that the real world is its own best model. His statement is particularly true in the context of genetic algorithms, where novel solutions to problems are often discovered by exploiting the substrate of evolution. We use the term Evolution of Physical Systems (EPS) to refer to evolutionary algorithms, which occur entirely in real-world physical substrates rather than in simulation. The term encompasses both parallel Embodied Evolution (Watson et al., 2002), in which evolution is distributed across a population of robots, as well as Evolutionary Robotics (Floreano and Mondada, 1994) where evaluation is serialized on a single robot. Notable examples of EPS occur across a wide variety of systems, ranging from Robotics (Zykov et al., 2004)] to FPGAs (Thompson, 1996) to 3D printers (Rieffel and Sayles, 2010). Although EPS comes at a cost (the speed of the real world, unlike CPUs, does not follow Moore's Law), by definition it avoids the "reality gap" imposed by simulation, and has produced novel and tangeable real-world results. Regardless of application or method, all implementations of EPS are bound by many of the same constraints and technical challenges. The aim of this workshop is to bring together researchers who are currently involved in the Evolution of Physical Systems, as well as those interested in the technique, in order to share ideas and innovations. As the frontiers of artificial life move from the computer to the petri dish, the Evolution of Physical Systems offers to provide inroads into domains which are otherwise impossible to simulate.

Keynote: A Retrospective on the Evolution of Physical Systems: Noise and Dirt in the Reality Gap

Inman Harvey (University of Sussex)

On-line On-board Evolution for Modular Robot Organisms
Berend Weel, Florian Schlachter, Wenguo Liu, A.E. Eiben

Physical Evolution of Tensegrity Robots
Mark Khazanov, Julian Jocque, John Rieffel

Online Evolutionary Algorithms in Real World Robots
Danny Zoetemelk, Evert Haasdijk

Highly Resilient Hexapod Robot Thanks to Evolution
Jean-Baptiste Mouret

The ChIRP, a Cheap Interchangeable Robotic Platform for Swarm Robotics: presentation and applications

Christian Skjetne, Anders Rye, Havard Schei, Jean-Marc Montanier and Pauline Haddow

Evolving Aquatic Robots
Anthony Clark, Jared Moore, Philip McKinley

2nd September, 9:00-18:30

Antonello da Messina room

Hotel Villa Diodoro

ERLARS 2013 – 6th International Workshop on Evolutionary and Reinforcement Learning for Autonomous Robot Systems

Nils T. Siebel

Autonomous robot systems tend to have limited learning capabilities. Reinforcement learning systems use a simple evaluative feedback to learn a robot control. This has the advantage of not assuming pre-defined knowledge about ideal robot actions in a particular situation, but has the disadvantage of requiring many robot actions and/or learning cycles before an acceptable mapping from perceptions to actions is found. Evolutionary learning systems manage a population of hypothetical control strategies in parallel. This can lead to a global optimal robot control, but again many learning cycles are needed. Therefore learning is often done in a simulation. How to use simulations well and map results to reality are open issues. This workshop addresses the challenge to develop efficient and versatile learning architectures for autonomous robot systems, with the main focus on adequate evolutionary and reinforcement learning algorithms.

9:00	Opening
9:15	Paulo Urbano and Henrique Vaz Using Fitness as Minimal Criteria for Novelty Search in the Maze Navigation Domain
9:45	Yohannes Kassahun Learning in Compressed Space: A Survey
10:15	Seyed Reza Ahmadzadeh, Matteo Leonetti and Petar Kormushev Online Direct Policy Search for Thruster Failure Recovery in Autonomous Underwater Vehicles
10:45	Coffee break
11:15	Matthew J Rose, Anthony J Clark, Jared M Moore and Philip K. McKinle Just Keep Swimming: Accounting for Uncertainty in Self-Modeling Aquatic Robots
11:45	Alberto Rovetta Brain Flow in Application for SYNAP New Robotic Platform
12:15	Rico Jonschkowski and Oliver Brock Learning Task-Specific State Representations by Maximizing Slowness and Predictability
12:45	Nils T Siebel Benchmark Problems for Neuro-Evolution

13:30	Lunch break
14:30	Best Paper Award to the chosen authors
14:45	Open Discussion: Algorithms and their Development / Training Domains and Competitions / Simulation and Reality by/with You
16:00	Closing / Plan for ERLARS 2014

2nd September, 9:00-18:30

Etna room

Hotel San Domenico

Fundamentals of Collective Adaptive Systems

Emma Hart and Ben Paechter

Collective Adaptive Systems (CAS) is a broad term that describes large scale system that comprise of many units/nodes, each of which may have their own individual properties, objectives and actions. Decision-making in such a system is distributed and possibly highly dispersed, and interaction between the units may lead to the emergence of unexpected phenomena. CAS are open, in that nodes may enter or leave the collective at any time, and boundaries between CASs are fluid. The units can be highly heterogeneous (computers, robots, agents, devices, biological entities, etc.), each operating at different temporal and spatial scales, and having different (potentially conflicting) objectives and goals. Our society increasingly depends on such systems, in which collections of heterogeneous 'technological' nodes are tightly entangled with human and social structures to form 'artificial societies'. Yet, to properly exploit them, we need to develop a deeper scientific understanding of the principles by which they operate, in order to better design them. This workshop solicits conceptual papers that address new methodologies, theories and principles that can be used in order to develop a better understanding of the fundamental factors underpinning the operation of such systems, so that we can better design, build, analyse such systems. We expect that such a research effort will require significant inter-disciplinary working, and that ideas will come from communities such as ALife, Biology, Games Theory, Evolutionary Computing, Network Science, etc.

9:00	Welcome, Introduction and Overview
<i>Session 1 Adaptation</i>	
9:15	Continuous Adaptation for Collaborating Adaptive Systems <i>Vivek Nallur, Hui Song, Siobhan Clarke</i>
9:30	Can Adaptability be Measured ? Yes, it's entropy! <i>Rupert Regier</i>
9:45	Discussion: Key aspects of adaptation in FOCAS
10:45	Coffee Break
<i>Session 2 Collectives</i>	
11:15	The Sociopsychological Ergonomy of the Collective Awareness Platforms (CAPs) <i>Andrea Guazzini</i>
11:30	Human-machine coexistence in groups <i>George Kampis, Paul Lukowicz and Stuart Anderson</i>
11:45	Morphogenetic Multi-robot Pattern Formation Using Hierarchical Gene Regulatory Networks <i>Yaochu Jin and Hyondong Oh</i>

12:00	Discussion: Collectives; heterogeneity and conflict
13:30	Lunch
<i>Session 3 Methodologies and Frameworks</i>	
14:30	A Quantitative Approach to the Design and Analysis of Collective Adaptive Systems <i>Rocco De Nicola, Nicolas Gast, Stephen Gilmore, Jane Hillston, Mieke Massink, Mirco Tribastone</i>
14:45	A Unified Framework for Collective Adaptive Systems. <i>Emma Hart, Jeremy Pitt, Ulle Endriss</i>
15:00	Towards Hybrid and Diversity-Aware Collective Adaptive Systems <i>Fausto Giunchiglia, Vincenzo Maltese, Stuart Anderson, Daniele Miorandi</i>
15:15	Discussion: Pros and cons of frameworks Discussion: Moving Forward – Towards a Journal Paper
16:15	Coffee Break
16:45	Invited Talk & Discussion The Science Cafe method for crowdsourcing and public engagement, <i>Franco Bagnoli and Giovanna Pacini</i>

2nd September, 9:00-18:30

Archimede room

Hotel Villa Diodoro

HSB 2013 – 2nd International Workshops on Hybrid Systems and Biology

Thao Dang and Carla Piazza

Systems biology aims at providing a system-level understanding of biological systems by unveiling their structure, dynamics and control methods. The intrinsic multi-scale nature of these systems, both in space, in organization levels, and in time, makes extremely difficult to model them in a uniform way, e.g., by means of differential equations or discrete stochastic processes. Furthermore, such models are often not easily amenable to formal analysis and their simulations at the organ or even the cell level are frequently impractical. Indeed, an important open problem is finding appropriate computational models that scale well for both simulation and formal analysis of biological processes. Hybrid modeling techniques, combining discrete and continuous processes, are gaining more and more attention in systems biology, and they have been applied to successfully capture the behavior of several biological complex systems, ranging from genetic networks, biochemical reactions, signaling pathways and cardiac tissues electrophysiology. This workshop aims at collecting scientists working in the area of hybrid modeling applied to systems biology, in order to discuss about current achieved goals, current challenges and future possible developments.

9:00	Opening Session
9:10	Invited Talk: Alessandro Astolfi Immune response enhancement via hybrid control
<i>Session 1</i>	
10:25	Nicolas Mobilia, Alexandre Donzé, Jean Marc Moulis and Eric Fanchon. Producing a Set of Models for the Iron Homeostasis Network
10:45	Coffee Break
<i>Session 2</i>	
11:15	Ezio Bartocci, Luca Bortolussi, Laura Nenzi and Guido Sanguinetti. On the Robustness of Temporal Properties for Stochastic Models
11:55	Lubos Brim, Jana Fabriková, Tomáš Vejputsek and David Šafránek. Robustness Analysis for Value-Freezing Signal Temporal Logic
12:35	Ricardo G. Sanfelice and Qin Shu. A Hybrid Model of a Genetic Regulatory Network in Mammalian Sclera
12:55	Lunch

<i>Session 3</i>	
14:30	Tommaso Dreossi and Thao Dang. Falsifying Oscillation Properties of Parametric Biological Models
15:10	Vincent Noel, Sergey Vakulenko and Ovidiu Radulescu. A hybrid mammalian cell cycle model
15:50	Oded Maler, Adam Halasz, Olivier Lebeltel and Ouri Maler. Exploring the Dynamics of Mass Action Systems
16:10	Coffee Break
<i>Session 4</i>	
16:45	Ye Chen, Adam Halasz and Jeremy Edwards. VEGF Signaling with One Receptor Cluster
17:25	Closing Session

2nd September, 9:00-18:30

Pirandello room

Hotel Villa Diodoro

Protocells: Back to the Future

Timoteo Carletti, Alessandro Filisetti, Norman Packard and Roberto Serra

Cells are the basic entities upon which all life forms known today on Earth are based. Such cells are the result of billions of years of Darwinian evolution, hence even the simplest bacterium has developed a very complex network of chemical pathways allowing it to adapt to the changing environments and thus to survive. However it is generally believed that this was not the case once the first life forms appeared on Earth. Starting from this hypothesis, strong efforts have been done by researchers, to unravel the mechanisms at work in the simplest primitive life forms, the protocells. Because data from experiments are very scarce and difficult to obtain, this is a field where computational and analytical models are very useful to explore all the possible behaviors and possibly provide guidelines to new experiments. In understanding the step from “inanimate” chemical reactions networks to “live ones”, the “compartmentalization”, namely the fact that such pathways could develop on the surface, or in the interior, of vesicles or micelles, has played a major role. A protocell life cycle must exploit a synergetic interaction between these two elements. Models that have this character, chemical reaction networks coupled to containers, we consider to be protocell models. After several years of researches and efforts, we believe it's time to propose a workshop to look to the past (recent) history with a glimpse to the future: Protocells: back to the future. The proposed workshop has multiple goals:

- To draw collectively the “state of the art” of the currently available main families of hypotheses (protocell models), the corresponding set of emergent dynamics (results) and the different analytical tools used.
- To foster the research by exchanging knowledge concerning methods for abstract protocell models, with the goal of understanding emergent phenomena displayed by the models.
- To discuss the main challenges to address by the field in the years to come.
- To consider current protocell experimental results and suggestions they give for modeling efforts.
- To find a common framework to design new experimental techniques that could be used to validate protocell models.

Session 1	
9:15	Roberto Serra <i>Stochastic dynamics of replicators in protocells</i>
10:10	Atsushi Kamimura et al <i>Relevance of minority molecules to reproductions of protocells with a limiting resource for replications</i>
10:45	Coffee Break

Session 2	
11:25	Fabio Mavelli <i>In silico minimal cell model systems</i>
12:20	Duccio Fanelli <i>Stochastic dynamics of autocatalytic reactions</i>
13:30	lunch
Session 3	
14:45	Steen Rasmussen <i>TBA</i>
15:40	Arvydas Tamulis et al <i>Quantum Entanglement in Photoactive Prebiotic Systems</i>
16:15	coffee break
Session 4	
16:45	Jean Sirmai <i>Interactors: a new class of spatial automata</i>
17:15	Eors Szathmary <i>Protocells as units of selection and evolution</i>
18:10	Conclusions

6th September, 14:30-18:30

Ettore Majorana room

Hotel Villa Diodoro

What Synthetic Biology can offer to Artificial Intelligence? Perspectives in the Bio-Chem-ICT and other scenarios

Luisa Damiano, Pasquale Stano and Yutetsu Kuruma

Traditionally Artificial Intelligence (AI) research, broadly conceived as the study of intelligence through the construction of artificial models of natural cognitive systems, has been developed in the context of computer science and robotics. Today the scientific and technical advancements of biological sciences, leading to the emergence of Synthetic Biology (SB) conceived as the chemical synthesis of biological parts/systems/processes, allow the scientific community to extend AI research within the field of experimental biology. The workshop aims at offering an interdisciplinary forum in which nascent programs involving cooperation between SB and AI in the exploration of biological and cognitive processes can be discussed in their groundings, their procedures, their possibilities and their limits, as well as enriched through scientific exchange of ideas. The main focus will be on current and possible applications in AI research of the emerging bio-chemical based Information and Communication Technologies (ICT), founded on the convergence of biological, chemical, physical approaches, often in combination with progresses in miniaturization like micro-fluidic devices and Micro Electro-Mechanical Systems (MEMS). But the workshop is interested also in introducing and discussing other actual and possible approaches and research programs which involve SB in AI research. Most of the participants will have a SB, AI, and/or bio-chem-ICT background, or come from scientific disciplines dealing with theoretical, epistemological and/or experimental issues related to the synthetic study of life and cognition. Our goal is to stimulate the interaction between applied research and theoretical/epistemological reflections, and to promote a front line in SB and AI that focuses on (some of) these questions:

- Can intelligence be studied through the construction and exploration of synthetic biological systems and processes? In which conditions? More specifically: What SB, and in particular its bio-chem-ICT tools and issues, can offer to AI?
- Which are the groundings, procedures, possibilities, limits, expected results, and impacts of current and possible research programs involving SB in AI research? How AI will advance by encompassing SB and bio-chem-ICT approaches?
- Can we nowadays plan concrete collaborations between computer science, robotics and SB in the scientific study natural forms of intelligence? How?
- Are the emerging directions of research in AI (such as embodied AI, enactive AI, soft robotics, ...) good candidate to cooperate with SB in the exploration of natural forms of cognition? Can SB contribute to the development of artificial forms of cognition (artificial cognitive systems which do not model natural cognitive systems)?

The workshop intends to bring together researchers interested in investigating one or more of these aspects of the (possible/actual) relationships between SB and AI. The aim is developing an interdisciplinary dialogue able to promote the reflected involvement of SB in AI, and to create a interdisciplinary community concretely developing research programs based on the cooperation of SB and AI.

14:30	Welcoming Note by the Organizers
14:40	What can Synthetic Biology offer to Artificial Intelligence? Focusing the issue on Embodiment L. Damiano
15:00	Synthetic biology projects that might be relevant for biochem-ICT and AI P. Stano and G. Rampioni
15:25	Synthetic biology approach for in vitro cell signaling <u>Y. Kuruma</u>
15:50	Invited talk: Exchange of chemicals between artificial cells and natural cells via synthetic junction S. M. Nomura
16:15	Coffee Break
16:45	Biological regulation and the synthetic investigation of minimal cognition L. Bich and A. Moreno
17:10	Invited talk: Bottom-up synthetic biology: an experimental approach to understanding intelligence <u>M. Hanczyc</u>
17:35	Embodied Cognition in Chemical Systems N. Virgo and T. Ikegami
18:00	Open discussion
18:30	Concluding Remarks

6th September, 14:30-16:30

Archimede room

Hotel Villa Diodoro

Cell Pathway Design for Biotechnology and Synthetic Biology

Claudio Angione, Jole Costanza, Giovanni Carapezza, Pietro Liò and Giuseppe Nicosia

We will introduce the BioCAD framework that we have developed to analyse, optimise and re-design biological models. The framework includes 1) *Multi-Objective Optimisation*, 2) *Sensitivity*, 3) *Identifiability* and 4) *Robustness analyses*.

More specifically, we will present *single- and multi-objective optimization algorithms* able to handle genetic strategies or uptake rates in a given model. We will show that the condition of Pareto optimality can be relaxed (e.g., *epsilon-dominance*) to include suboptimal points that can be used to boost the algorithm in its convergence process.

The *Sensitivity Analysis* (SA) is used to compute an index for each parameter that indicates its influence in the model. The *Identifiability Analysis* (IA) detects functional relations among decision variables through a statistical analysis on the values after and before the optimisation. The *Robustness Analysis* (RA), *Local*, *Global* and *Glocal robustness*, proves useful to assess the robustness of the Pareto optimal solution (or of a given feasible solution) as a result of a perturbation occurring in the model.

Our methodology is suitable for (i) *any model* consisting of ordinary differential equations, differential algebraic equations, flux balance analysis and gene-protein reaction mappings and for (ii) *any simulator* (e.g., SBML, MatLab, NEURON, C/C++ program). In the tutorial, we will show how these techniques offer avenues to systematically explore, analyse, optimise, design and cross-compare biological models (e.g., metabolic models, gene regulatory networks).

3rd September, 17:00-19:00

Vincenzo Bellini room

Hotel Villa Diodoro

Exploring Prebiotic Chemistry Spaces

Jakob L. Andersen, Christoph Flamm and Daniel Merkle

We have developed a graph grammar based formalism to model chemical transformations. Within our formalism molecules are treated as vertex and edge labeled graphs and reactions (between molecules) are handled as graph rewrite. This approach nicely captures the algebraic properties of real chemistry, where novel molecules can be produced during chemical reactions. Graph grammars, i.e. a set of reaction rules and starting molecules, are very compact representations of entire chemical space. These spaces can contain interesting chemical transformation patterns such as auto-catalytic sub-networks, or alternative routes to molecules of interest. Such sub-networks are usually hard to find due to the vastness of chemical spaces. The situation is especially bad in the origin of life realm, where several

putative prebiotic chemistries, all combinatorial complex in nature, have been suggested. Efficient computational methods for constructing and exploring chemical spaces are therefore essential to explore alternative scenarios, or to shade light on potential chemical processes, which could have resulted in the emergence of life. The tutorial will offer a mix between short background presentations and accompanying practical examples. To ensure that attendees have the right libraries and programs available, we will provide a working environment. The attendees will learn (i) how to translate chemical reactions to graph rewrite rules, (ii) various methods to explicitly construct chemical spaces (iii) query the chemical space for interesting sub-networks.

3rd September, 17:00-19:00

Archimede room

Hotel Villa Diodoro

Designing Adaptive Humanoid Robots Through the FARSA Open-Source Framework

Gianluca Massera, Tomassino Ferrauto, Onofrio Gigliotta and Stefano Nolfi

In this tutorial we will illustrate FARSA, an open-source tool available from <http://laral.istc.cnr.it/farsa/> that allows to carry on research on Adaptive Robotics. Farsa allows to simulate different robotic platforms (the iCub humanoid robot, and the Khepera, e-Puck, and marXbot wheeled robots), design the sensorimotor system of the robots, design the environment in which the robots operate, perform collective experiments with many interacting robots, design the robots' neural controllers, and allow the robots to develop their behavioural skills through an evolutionary or learning process. It is a cross-platform framework that works on Linux, Windows and Mac on both 32bit and 64bit systems, constituted by a collection of integrated open-source object-oriented C++ libraries. The framework comes with a powerful graphical application that allow to create and run a large variety of experiments and to analyse and test the obtained results. Furthermore, FARSA has a plugin mechanism that allow to add new features (new robots, new motors, new neural networks, new learning algorithms, etc.) that are integrated and accessible by the graphic interface without modifying and recompiling the core code. FARSA is well documented, easy to use and comes with a series of exemplificative experiments that allow users to quickly gain a comprehension of the tool and a base for running a large spectrum of new experiments that can be set up simply by changing the available parameters. The aim of the tutorial is that to allow also non-technical user to quickly acquire the knowledge required to use the tool and personalize it to specific research interests.

3rd September, 17:00-19:00

Pirandello room

Hotel Villa Diodoro

Next Generation Sequencing Data Production, Analysis, and Archiving

Heiko Muller and Luca Zammataro

Application of Next Generation Sequencing (NGS) in cancer research is becoming routine in laboratories all over the world and new applications of NGS are being developed at increasing speed. The generation, analysis, interpretation, and storage of NGS data poses a number of technical challenges. Here, the computational infrastructure and the analysis pipelines used at the Center of Genomic Science in Milan (Italian Institute of Technology) are described. In the second part, meta-analysis approaches facilitating the interpretation of NGS data are being discussed. In particular, we will highlight international efforts in cancer genomics aimed at collecting genomic data (e.g. somatic mutations, gene expression, epigenetic modifications, copy number variation) from cancer samples and correlating these data with clinical parameters with the aim of identifying novel biomarkers of cancer subtypes and eventually novel targets for therapeutic intervention. The joined analysis of genomic data of various kinds is a field of active research that is often referred to as Integromics. We will provide an overview of the current state of the art and illustrate the use of selected novel bioinformatics resources of general interest.

3rd September, 17:00-19:00

Ettore Majorana room

Hotel Villa Diodoro

PyCX: A Python-Based Simulation Code Repository for Complex Systems Education

Hiroki Sayama

This tutorial will introduce PyCX, an online repository of sample codes, all written in plain Python, of various complex systems simulation, including iterative maps, cellular automata, dynamical networks and agent-based models. These sample codes are designed as educational materials so that students can gain practical skills for both complex systems simulation and computer programming simultaneously. The target audience of this tutorial will primarily be educators and researchers who teach complex systems-related courses and thus need simple, easy-to-understand examples of complex systems simulation. The tutorial will also be helpful for students who want to learn basics of writing complex systems simulation themselves. Prior knowledge of Python is helpful but not required. Participants should bring their own laptops to the tutorial so they can work on hands-on coding activities.

Tuesday, 3rd September

9:00 – 10:00

Chair: Giuseppe Nicosia

Ettore Majorana room

Roberto Cipolla, University of Cambridge, UK

Computer Vision: Making Machines that See



Computer vision is the science and technology of making machines that see. The talk will begin with an overview of the state-of-the-art in the 3R's of computer vision: registration, reconstruction and recognition and will include demonstrations of research projects from the University of Cambridge. and Toshiba Research Europe' s Cambridge Laboratory. The second part of the talk will introduce a novel digital interface - a talking head created by Toshiba Research Europe and the University of Cambridge. We have developed a system that can generate a realistic expressive talking head animation. The user enters input text and selects an expression such as 'happy' and 'angry' and the software

makes a previously recorded face model talk at an unprecedented level of realism. The face and speech model was learned from a large training dataset where sentences are spoken with a number of different emotions. In addition to a neutral style, the corpus includes angry, happy, sad, tender and fearful expressions. The realism of the animation is achieved by novel training and face modelling algorithms. A key technology behind training the expressive "talking head" model is Cluster Adaptive Training (CAT), which allows flexible control over the expressiveness of both the voice and the face model. The new technology allows next generation interfaces. By combining speech and face video synthesis, so-called visual speech synthesis, interaction with computers will become more similar to interacting with another person. A demonstration will be included at the end of the talk.

Professor Roberto Cipolla FREng is Professor of Information Engineering at the University of Cambridge and the Director of Toshiba's (Toshiba Research Europe) Cambridge Research Laboratory. <http://mi.eng.cam.ac.uk/~cipolla/biography.htm>

Tuesday, 3rd September

14:30 – 15:30

Chair: Giuseppe Nicosia

Ettore Majorana room

Roberto Cingolani, Italian Institute of Technology, Italy
Nanotechnologies for Humans and Humanoids



Nanotechnology is developing along a pathway, which is parallel to that of evolution. Nanocomposite biomimetic materials, new sensing devices, interconnection of living cells (organs) and circuits are boosting the development of complex integrated systems such as humanoids and animaloids, whose performances, either biomechanic or cognitive, are continuously improving. A number of new technologies is thus first developed for these advanced machines, and then transferred to humans. Following the concept of the evolutionary pathway of technology we will briefly describe a few representative examples developed at IIT over the last few years: - Artificial molecules and artificial antibodies, and their application to drug delivery and diagnostics - Plantoids and robots

with sensing roots - Animaloid (quadrupeds) with advanced equilibrium and motion characteristics and their application to disaster recovery - Humanoids with unprecedented cognitive and biomechanic capabilities, and their application as human companions, and for rehabilitation and prosthetic tools - New biocompatible materials for soft machines

Roberto Cingolani is the Scientific Director of IIT since December 8th, 2005. He earned a Ph.D. in Physics from the University of Bari in 1988. From 1989 to 1991, he was a staff member at Max Planck Institute for Festkörperforschung in Stuttgart (Germany). Since 2001, he has been member of various panels of the European Commission within the Sixth and Seventh Frame Programs in the field of Nanotechnology, New materials and New production systems. From 2002, he has been member of different panels of the Ministry of Research and University (Technical Secretariat for the National Research Plan, Commission for the selection the Centres of Excellence). From 2000 to 2003, he was executive Vice-president of the National Institute for the Physics of the Matter (INFN). Founder and Director of the National Nanotechnology Laboratory (NNL) of INFN at University of Lecce in 2001, R. Cingolani is author or co-author of about 700 papers in international journals and holds about 30 patents in the fields of structural, optical and electronic properties of quantum nanostructures of semiconductors, molecular nanotechnologies for plastic photonics, OLED e plastic electronic devices (since 2000), bio-nanotechnologies, biomimetic systems, biological electronic devices (since 2003) and smart nanocomposite materials.

Wednesday, 4th September

9:00 – 10:00

Chair: Stefano Nolfi

Ettore Majorana room

Rolf Pfeifer, ETH, Switzerland

"Soft Robotics" - the next generation of intelligent machines



Researchers from robotics and artificial intelligence increasingly agree that ideas from biology and self-organization can strongly benefit the design of autonomous robots. Biological organisms have evolved to perform and survive in a world characterized by rapid changes, high uncertainty, indefinite richness, and limited availability of information. The term "Soft Robotics" designates a new generation of robots capable of functioning in the real world by capitalizing on "soft" designs at various levels: surface (skin), movement mechanisms (muscles, tendons), and interaction with other agents (smooth, friendly interaction). Industrial robots, in contrast, operate in highly controlled environments with no or very little uncertainty. By "outsourcing" functionality to

morphological and material characteristics - e.g. to the elasticity of the muscle-tendon system - the distinction between control and to-be-controlled, which is at the heart of manufacturing and control theory, breaks down and entirely new concepts will be required. In this lecture I will argue that the next generation of intelligent machines – robots – will be of the "soft" kind and I will explore the theoretical and practical implications, whose importance can hardly be over-estimated. I will be using many examples and case studies. In particular I will be introducing the tendon-driven "soft" robot "Roboy" that we have been developing in our laboratory over the last few months. Although many challenges remain, concepts from biologically inspired "soft" robotics will eventually enable researchers to engineer machines for the real world that possess at least some of the desirable properties of biological organisms, such as adaptivity, robustness, and versatility.

Master's degree in physics and mathematics and Ph.D. in computer science (1979) from the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland. Three years as a post-doctoral fellow at Carnegie-Mellon and at Yale University in the US. Since 1987: professor of computer science at the Department of Informatics, University of Zurich, and director of the Artificial Intelligence Laboratory. Visiting professor and research fellow at the Free University of Brussels, the MIT Artificial Intelligence Laboratory in Cambridge, Mass., the Neurosciences Institute (NSI) in San Diego, the Beijing Open Laboratory for Cognitive Science, and the Sony Computer Science Laboratory in Paris. Elected "21st Century COE Professor, Information Science and Technology" at the University of Tokyo in 2004. In 2009: visiting professor at the Scuola Superiore Sant'Anna in Pisa, and at Shanghai Jiao Tong University in China; appointed "Fellow of the School of Engineering" at the University of Tokyo. Currently: Deputy Director of the NCCR Robotics, the "National Competence Center for Research in Robotics" in Switzerland. Research interests: embodied intelligence, biorobotics, morphological computation, modular robotics, self-assembly and educational technology. Authored books: "Understanding Intelligence", MIT Press, 1999 (with C. Scheier), "How the body shapes the way we think: a new view of intelligence," 2007 (with Josh Bongard) MIT Press (popular

science style), "Designing intelligence - why brains aren't enough" (short version - with Josh Bongard and Don Berry, e-book), and "La révolution de l'intelligence du corps", 2012 ("The revolution of embodied intelligence"; with Alexandre Pitti) (in French). Lecture series: "The ShanghAI Lectures", a global mixed-reality lecture series on embodied intelligence, broadcast in 2012 from the University of Zurich, and Shanghai Jiao Tong University, China in cooperation with other universities from around the globe. World exhibition: ROBOTS ON TOUR - World Congress and Exhibition of Robots, Humanoids, Cyborgs, and more. 9 March 2013, Zurich (Puls 5): robotsontour.org

Recent project: Roboy, a "soft" tendon-driven small humanoid: roboy.org
ailab.ifi.uzh.ch

Wednesday, 4th September

10:30 – 11:30

Chair: Pietro Liò

Ettore Majorana room

Steve Oliver, University of Cambridge, UK

The Robot Scientist: Artificial Life Investigates Real Life



Science involves the generation of hypotheses and the testing of those hypotheses by experiments whose results are recorded in sufficient detail to enable reproducibility. We developed the Robot Scientist "Adam" to advance the automation of both these processes. Adam has autonomously generated functional genomics hypotheses about the yeast *Saccharomyces cerevisiae*, and experimentally tested those hypotheses using laboratory automation. We, and others, have manually confirmed Adam's conclusions using additional experiments. To describe Adam's experiments we developed an ontology and logical language. The resulting formalisation involves over 10,000 different research units in a nested tree-like structure, ten levels deep that relates the

6.6 million biomass measurements to their logical description. This formalisation describes how a machine discovered new scientific knowledge. We have now developed a second Robot Scientist, "Eve". Like Adam, Eve is a laboratory automation system that uses artificial intelligence techniques to discover scientific knowledge through cycles of experimentation. Eve automates the screening of candidate drugs, hit confirmation, and lead generation through QSAR learning and testing. Econometric modelling has identified the conditions where Eve outperforms standard automation. The second advance is the development of assays based on cellular analog computers. These utilize *Saccharomyces cerevisiae* synthetic biology to compute arbitrary Boolean functions of compound properties. These advances have enabled us to reposition multiple compounds as drugs likely to be effective at inhibiting specific enzyme targets in parasites causing tropical diseases.

Steve Oliver started to work on yeast as a graduate student and has studied it ever since, with occasional excursions into the filamentous fungi and even *Streptomyces* bacteria. The yeast genome-sequencing project was initiated in his lab in the mid-1980's when he started to sequence chromosome III. This turned into a major European Project, which eventually led to

the sequencing of the entire yeast genome. He then took up the challenge presented by all the genes of unknown function revealed by the genome sequence, leading the EUROFAN Consortium that pioneered many of the 'omic and other high-throughput technologies in current use. His lab is dedicated to unravelling the workings of the yeast cell, using both top-down and bottom-up systems biology strategies. He is also concerned with developing yeasts as systems to both understand and combat human diseases, including through the use of automated ("Robot Scientist" methods in collaboration with Ross King's group in Aberystwyth). Finally, he takes an interest, at both the bioinformatics and experimental levels, in the evolution of genomes and networks, and is starting to apply this to mammalian systems. The models and experimental systems he uses with yeast sometimes lead in unexpected directions, such as predicting the impact of gene copy number variation in cancer, constructing network models to identify genes important in Alzheimer's Disease, or using yeast "surrogates" to screen for drugs against parasitic diseases.

Wednesday, 4th September

14:30 – 15:30

Chair: Stefano Nolfi

Ettore Majorana room

Paolo Arena, University of Catania, Italy

Neuro-Inspired Insectoids



It is becoming more and more evident how insects, though possessing a much simpler brain than mammals, succeed in showing surprisingly complex adaptive behaviors that enable them to solve, concurrently, large variety of complex tasks: these are a real challenge even for the most advanced adaptive machine nowadays available. Adaptive locomotion, motor learning, attention, expectation, decision making, capability to distinguish "the same and the different" are just examples of the cognitive tasks easily solved by insects. The insect brain will be seen as a complex adaptive, non linear control system and the

lecture will concentrate on an insect model organism: the fruit fly *Drosophila melanogaster*. The actual knowledge will be reviewed on the main neural structures in the drosophila brain involved in solving the tasks listed above. The most updated insect brain computational structure actually available will be reviewed, where the above mentioned skills can be shown. Simulations as well as real experiments, where robot behaviors are compared with the wild type and mutant drosophilae in focalised experimental setup, will be presented.

Degree in Electronic Engineering and the Ph.D. in Electrical Engineering in 1990 and in 1994, respectively, from the University of Catania, Italy. Associate Professor of System Theory, Biorobotics and Bioengineering. Co-author of more than 260 technical papers, six books and several industrial patents. Research interests: adaptive and learning systems, neural networks and optimisation algorithms, cellular neural networks and collective behaviours in living and artificial neural systems for locomotion and perception control. Prof. P. Arena is a Senior Member of the IEEE, Chair elect of the Chapter of the IEEE Circuits and Systems Society,

Central and South Italy, and served as an Associate Editor of the IEEE Transaction on Circuits and Systems-Part I in the period 2002-2003 and 2005. He coordinated several National and international research projects. He was the coordinator of the EU FP6 and FP7 funded projects SPARKI and SPARK II "Spatial Temporal patterns for action-oriented perception in roving robots II: an insect brain computational model". He actually participates to the EU Project EMICAB: Embodied motion intelligence for cognitive autonomous robots.

Tuesday, 5th September

9:00 – 10:00

Chair: Pietro Liò

Ettore Majorana room

Martin Hanczyc, University of Southern Denmark, Denmark

The Real Artificial Lives of Droplets



My work is focused on understanding the fundamental principles of living and evolving systems through experimental science. To this end, I build synthetic systems where dynamic life-like properties emerge when self-assembled systems are pushed away from equilibrium. I will present an experimental model of bottom-up synthetic biology: chemically-active oil droplets. This system has the ability to sense, metabolize and the potential to evolve. Specifically, I will present how sensory-motor coupling can produce chemotactic motile droplets and may form the basis for intelligent and self-replicating materials. In addition, I am involved with a new consortium to develop a robotic interface with feedback to maintain and manipulate the non-equilibrium state of the chemical systems in real time. This represents the integration of chemical, computational, and robotic artificial life.

Martin Hanczyc is an Associate Professor at the Institute of Physics and Chemistry at the University of Southern Denmark. He formally was an Honorary Senior Lecturer at the Bartlett School of Architecture, University College London and Chief Chemist at ProtoLife. He received a bachelor's degree in Biology from Pennsylvania State University, a doctorate in Genetics from Yale University and was a postdoctorate fellow under Jack Szostak at Harvard University. He has published in the area of protocells, complex systems, evolution and the origin of life in specialized journals including JACS and Langmuir as well as PNAS and Science. He is also a mentor for the first iGEM synthetic biology student team from Denmark. He is developing novel synthetic chemical systems based on the properties of living systems. Martin actively develops outreach for his research by giving several public lectures and collaborating with architects and artists in several exhibitions world wide including the Architecture Biennale in Venice Italy in 2010 to bring experiments out of the lab and into the public space. His approach to science has been integrative, multidisciplinary and publicly visible with over 20 press items including Nature News, Scientific American, Discovery Channel, and BBC Radio. Martin gave an invited public lecture at TED in 2011, which now has over 500,000 views.

Tuesday, 5th September

14:30 – 15:30

Chair: Mario Pavone

Ettore Majorana room

Henrik Hautop Lund, Technical University of Denmark, Denmark

Playware ABC



Embodied Artificial Life research has led to the development of playware defined as intelligent hardware and software that creates play and playful experiences for users of all ages. With recent technology development, we become able to exploit robotics, modern artificial intelligence and embodied artificial life to create playware, which acts as a play force that inspires and motivates users to enter into a play dynamics. In such play dynamics, users forget about time and place, and simultaneously increase their creative, cognitive, physical, and social skills. The Playware ABC concept allows you to develop solutions for anybody, anywhere, anytime through building bodies and brains

to allow people to construct, combine and create. Designing playware technology that results in specific behaviors of the user is not a trivial task, and it demands an array of background knowledge in a number of scientific fields. Indeed, definition of desired interactions and behaviors should arise from deep knowledge of the field of application (e.g. play of a specific user group, clinical knowledge of therapy of a specific patient group, professional music knowledge, and professional sport knowledge). In order to meet a practice, where several disciplines can join to develop such playware, and inspired by early artificial life work, we conceptualized the approach of modular playware in the form of building blocks. Building blocks should allow easy and fast expert-driven or user-driven development of playware applications for a given application field. The development of such modular playware technology takes its inspiration from modular robotics, human-robot interaction and embodied artificial life. In this talk, I will present the design principles for creating such modular playware technology with focus on the embodied AI principles that forms the foundation for the design principles of modular playware technology. I will exemplify the design principles with practical applications from the fields of play, sports, music, performance art, and health.

Professor Henrik Hautop Lund, Technical University of Denmark, is head of the Center for Playware. He is World Champion in RoboCup Humanoids Freestyle 2002, has developed shape-shifting modular robots, and has collaborated closely on robotics, ALife and AI with companies like LEGO, Kompan, BandaiNamco, etc. for the past two decades. His Center for Playware at the Technical University of Denmark has a long track record of developing modular playware for playful contextualized IT training in Sub-Saharan Africa and for playful rehabilitation of mentally and physically handicapped children and adult in rural areas of Sub-Saharan Africa. These modular playware technology developments include I-Blocks (LEGO bricks with processing power) and modular interactive tiles (larger bricks for physical rehab). Further, with the development of East-Africa's first science and business park, local entrepreneurship has been fostered amongst students graduating from the university degree programs in contextualized IT. Combining such skills, it became possible to develop technical

skill enhancing football games and global connectivity based on modular playware for townships in South Africa for the FIFA World Cup 2010. Lately, together with international pop star and World music promoter Peter Gabriel, it has been possible to develop the MusicTiles app as a music 2.0 experience to enhance music creativity amongst everybody, even people with no initial musical skills whatsoever. In all cases, the modular playware technology approach is used in a playful way to enhance learning and creativity amongst anybody, anywhere, anytime.

Friday, 6th September

9:00 – 10:00

Chair: Pietro Liò

Ettore Majorana room

Bernhard Ø. Palsson, University of California, San Diego, USA

An Insight into Metabolic Requirements of Life



Whole genome sequencing has enabled us to understand the basic gene portfolio of living cells. A class of gene products that are well known are metabolic enzymes. Based on genome annotation and legacy data it has become possible to reconstruct metabolic networks. These networks are amenable to modeling as systems and have given the basis for in silico cells that are the best representation of their living counterparts. We will discuss the conceptual basis for this field, the difficult and laborious process of network reconstruction, and give examples of the use of in silico cell simulations.

Professor Palsson earned a Ph.D. from the University of Wisconsin in 1984. He held a faculty position at the University of Michigan from 1984 to 1995. He has been with UCSD since 1995. He is the author of over 350 peer reviewed scientific articles. He co-authored the text TISSUE ENGINEERING, Prentice Hall in 2004, and wrote SYSTEMS BIOLOGY: properties of reconstructed networks, Cambridge University Press in 2006, and SYSTEMS BIOLOGY: simulation of dynamic network states, Cambridge University Press in 2011. He sits on the editorial boards of several biology, bioengineering and biotechnology journals. Professor Palsson current research at UCSD focuses on 1) the reconstruction of genome-scale biochemical reaction networks (metabolism, transcriptional regulation & signaling), 2) the development of mathematical analysis procedures for genome-scale models (constraint-based and dynamic models), and 3) the experimental verification of genome-scale models with current emphasis on cellular metabolism and transcriptional regulation in E. coli, human pathogens, and organisms that are environmentally & bioprocess importance. He received an Institute of International Education Fellowship in 1977, Rotary Fellowship in 1979, a NATO fellowship in 1984, was named the G.G. Brown Associate Professor at Michigan in 1989, a Fulbright Fellow in 1995, an Ib Henriksen Fellow in 1996, the Olaf Hougen Professorship at the University of Wisconsin in 1999, the Lindbergh Tissue Engineering award in 2001, was named the Galetti Chair of Bioengineering in 2004, was elected into the National Academy of Engineering in 2006, received the UCSD Chancellor's Associates award in Science and

Technology in 2006, and was selected as the developer of one of the most influential technologies on Biotech over the past 10 years by Nature Biotechnology (March 2006). He was the Richard S.H. Mah Lecturer at Northwestern University in 2007, received the Ernst W. Bertner Memorial Award, from the MD Anderson in Houston in 2008, an honorary doctorate from Chalmers University in Gothenburg, Sweden, in 2009, the Marvin Johnson Award from the ACS in 2010, elected fellow of the AAAS in 2011, and received the ASM Promega Biotechnology Research Award in 2012. Professor Palsson is an inventor with over 35 U.S. patents, many of which are in the area of hematopoietic stem cell transplantation, cell culture technology, bioreactor design, gene transfer, cell separations, high-throughput single cell manipulation, pedigree-controlled drug screening, network reconstruction, laboratory adaptive evolution, in silico model building and metabolic engineering. He co-founded a biotechnology company, AASTROM BIOSCIENCES (NASDAQ: ASTM) in 1988, where he served as the Vice President of Developmental Research for two years. Dr. Palsson is the founder and co-founder of ONCOSIS, a company that was focused on the purging of occult tumor cells in autologous bone marrow transplants, renamed as CYNTELLECT, focusing on instrumentation for high-throughput screening and in situ cell sorting and processing, GENOMATICA, a company that is focused on the production of commodity chemicals by fermentation (a spin-off from UCSD), and GT LIFE SCIENCES, an in silico biology (a spin-off from Genomatica).

Friday, 6th September

12:15 – 13:15

Chair: Mario Pavone

Ettore Majorana room

Didier Keymeulen, California Institute of Technology, USA

Self-Repairing and Tuning Reconfigurable Electronics for Space



Space missions often require technologies not yet available for earth applications. This talk will present the development of self-reconfigurable electronics for few real-world problems encountered in space applications: survival in extreme environment, high precision inertial measurement for navigation, and in-situ adaptive control for space instruments. Radiation and extreme-temperature hardened electronics is needed to survive the harsh environments beyond earth's atmosphere. Traditional approaches to preserve electronics incorporate radiation shielding, insulation and redundancy at the expense of power and weight. This presentation will demonstrate the implementation of a self-adaptive system using a field programmable gate array (FPGA) and data converters, which can autonomously recover the lost functionality of a reconfigurable analog array (RAA) integrated circuit (IC). The second application is related to the development of inexpensive, navigation grade, miniaturized inertial measurement unit (IMU), which surpasses the state-of-the art in performance, compactness (both size and mass) and power efficiency used by current space missions. The talk will explain a self-tuning method for reconfigurable Micro-Electro-Mechanical Systems (MEMS) gyroscopes based on evolutionary computation that has the capacity to efficiently increase the sensitivity of MEMS gyroscopes through in-situ tuning. Finally, we will address the path forward of using adaptive electronics for space.

Didier Keymeulen joined the computer science division of the Japanese National Electrotechnical Laboratory as senior researcher in 1996. In 1998 he moved to the California Institute of Technology and is currently principal member of the technical staff in the Bio-Inspired Technologies Group. He is leading several research tasks on adaptive computing, fault-tolerant electronics, and autonomous and adaptive sensor technologies. He was the electronics test lead of the tunable laser spectrometer (TLS) instrument on the 2011 Mars Science Laboratory (MSL) rover mission to Mars. He serves as chair, co-chair, and program-chair of the NASA/ESA Annual Conferences on Adaptive Hardware and Systems. Didier received his BSEE, MSEE and Ph.D. in Electrical Engineering and Computer Science from the Free University of Brussels, Belgium.

Tuesday 3rd September
session #1
General track ECAL 2013 #1 – September 3, session 10:30-13:00
room: Ettore Majorana - Chair: Mario Pavone

- 10:30 *Impact of Personal Fabrication Technology on Social Structure and Wealth Distribution: An Agent-Based Simulation Study*
Amber Ferger, Wai Fai Lau, Philipp Ross, Wyman Zhao, Hiroki Sayama and Steen Rasmussen
- 10:55 *The detection of intermediate-level emergent structures and patterns*
Marco Villani, Alessandro Filisetti, Stefano Benedettini, Andrea Roli, David Avra Lane and Roberto Serra
- 11:20 *Evolution of G-P mapping in a von Neumann Self-reproducer within Tierra*
Declan Baugh and Barry McMullin
- 11:45 *Indirectly Encoded Sodarace for Artificial Life*
Paul Szerlip and Kenneth Stanley
- 12:10 *Empowerment and State-dependent Noise - An Intrinsic Motivation for Avoiding Unpredictable Agents*
Christoph Salge, Cornelius Glackin and Daniel Polani
- 12:35 *Spatial Organisation of Cooperation with Contingent Agent Migration*
Pierre Buesser and Marco Tomassini

General track ECAL 2013 #2 – September 3, session 10:30-13:00
room: Archimede - Chair: Alan Winfield

- 10:30 *Prebiotic Evolution of Molecular Assemblies: From Molecules to Ecology*
Omer Markovitch and Doron Lancet
- 10:55 *Information Aggregation Mechanisms in Social Odometry*
Roman Miletitch, Vito Trianni, Alexandre Campo and Marco Dorigo
- 11:20 *Evolved digital ecosystems: Dynamic steady state, not optimal fixed point*
Randal Olson, Masoud Mirmomeni, Tim Brom, Eric Bruger, Arend Hintze, David Knoester and Christoph Adami
- 11:45 *Self-organized game dynamics in complex networks*
Flavio L. Pinheiro, Vítor V. Vasconcelos, Francisco C. Santos and Jorge M. Pacheco
- 12:10 *Synthetic signalling protocell networks as models of neural computation*
Matthew Egbert, Gerd Gruenert, Gabi Escuela and Peter Dittrich
- 12:35 *Autocatalysis Before Enzymes: The Emergence of Prebiotic Chain Reactions*
Nathaniel Virgo and Takashi Ikegami

Tuesday 3rd September

session #1

Bioinspired Robotics #1 – September 3, session 10:30-13:00

room: Pirandello - Chair: Stefano Nolfi

- 10:30 *Evolving Error Tolerance in Biologically-Inspired iAnt Robots*
Joshua Hecker, Karl Stolleis, Bjorn Swenson, Kenneth Letendre and
Melanie Moses
- 10:55 *Exploiting Dynamical Complexity in a Physical Tensegrity Robot to Achieve Locomotion*
Mark Khazanov, Ben Humphreys, William Keat and John Rieffel
- 11:20 *Conformity and Nonconformity in Collective Robotics: A Case Study*
Gregory Vorobyev, Andrew Vardy and Wolfgang Banzhaf
- 11:45 *Speciation Dynamics: Generating Selective Pressure Towards Diversity*
Heiko Hamann
- 12:10 *Heterogeneous complexification strategies robustly outperform homogeneous strategies for incremental evolution*
Adam Stanton and Alastair Channon
- 12:35 *A Situated and Embodied Model of Ant Route Navigation*
Andrew Philippides, Bart Baddeley, Phil Husbands and Paul Graham

Synthetic and Systems Biochemistry and Biological Control – September 3, session 10:30–13:00

room: Vincenzo Bellini - Chair: Heiko Muller

- 10:30 *Synthetic biology manipulations in 3D printed wet-ware*
Leroy Cronin
- 10:55 *Steady state analysis of a vesicle bioreactor with mechanosensitive channels*
Ben Shirt-Ediss, Ricard Solé and Kepa Ruiz-Mirazo
- 11:20 *Recent advancements in synthetic cells research*
Pasquale Stano, Erica D'Aguanno, Paolo Carrara, Alfred Fahr and Pier
Luigi Luisi
- 11:45 *Evolution of Cheating DNA-based Agents Playing the Game of Rock-Paper-Scissors*
Nathanael Aubert, Quang Huy Dinh, Masami Hagiya, Hitoshi Iba,
Teruo Fujii, Nicolas Bredeche and Yannick Rondelez
- 12:10 *Barrier Trees for Metabolic Adjustment Landscapes*
Christoph Flamm, Chris Hemmingsen and Daniel Merkle
- 12:35 *Reconstitution of the protein synthesis system on a glass microchip*
Yoshihiro Shimizu and Yo Tanaka

Wednesday 4th September

session #2

General track ECAL 2013 #3 – September 4, session 11:35-13:15

room: Ettore Majorana - Chair: Hiroki Sayama

- 11:35 *Coevolutionary Dynamics Caused by Asymmetries in Predator-Prey and Morphology-Behavior Relationships*
Takashi Ito, Marcin Pilat, Reiji Suzuki and Takaya Arita
- 12:00 *The Effect of the Environment in the Synthesis of Robotic Controllers: A Case Study in Multi-Robot Obstacle Avoidance using Distributed Particle Swarm Optimization*
Ezequiel Di Mario, Iñaki Navarro and Alcherio Martinoli
- 12:25 *Boolean network robotics as an intermediate step in the synthesis of finite state machines for robot control*
Lorenzo Garattoni, Andrea Roli, Matteoaducci, Carlo Pinciroli and Mauro Birattari
- 12:50 *Insect Type MEMS Micro Robot Controlled by CMOS IC of Hardware Neural Networks*
Minami Takato, Shinpei Yamasaki, Shiho Takahama, Junichi Tanida, Ken Saito and Fumio Uchikoba

General track ECAL 2013 #4 – September 4, session 11:35-13:15

room: Archimede - Chair: Takashi Ikegami

- 11:35 *GOLEM: Generator Of Life Embedded into MMOs*
Andrea Guarneri, Dario Maggiorini, Laura Anna Ripamonti and Marco Trubian
- 12:00 *The insect Mushroom Bodies: a paradigm of neural reuse*
Paolo Arena, Luca Patanè and Roland Strauss
- 12:25 *The role of arousal in embodying the cueXdeficit model in multi-resource human-robot interaction*
Kiril Kiryazov and Robert Lowe
- 12:50 *On the evolution of self-organised role-allocation and role-switching behaviour in swarm robotics: a case study*
Elio Tuci, Boris Mitavskiy and Gianpiero Francesca

Wednesday 4th September
session #2
Artificial Immune, Neural and Endocrine Systems – September 4, session 11:35–12:25
room: Pirandello - Chair: Jon Timmis

- 11:35 *Image Similarity Search using a Negative Selection Algorithm*
Stein Keijzers, Peter Maandag, Elena Marchiori and Ida Sprinkhuizen-Kuyper
- 12:00 *EMANN - a model of emotions in an artificial neural network*
Ronald Thenius, Payam Zahadat and Thomas Schmickl

Bioinspired Learning and Optimization – September 4, session 12:25–13:15
room: Pirandello - Chair: Jon Timmis

- 12:25 *Using explicit averaging fitness for studying the behaviour of rats in a maze*
Ariadne Costa, Patrícia Vargas and Renato Tinós
- 12:50 *Quantifying the Impact of Parameter Tuning on Nature-Inspired Algorithms*
Matthew Crossley, Andy Nisbet and Martyn Amos

General track ECAL 2013 #5 – September 4, session 11:35-13:15
room: Vincenzo Bellini - Chair: Onofrio Gigliotta

- 11:35 *Autonomous construction of synthetic cell membrane*
Yutetsu Kuruma, Hideaki Matsubayashi and Takuya Ueda
- 12:00 *The ALife Zoo: cross-browser, platform-agnostic hosting of Artificial Life simulations*
Simon Hickinbotham, Michael Weeks and James Austin
- 12:25 *In silico evolution of transferable genetic elements*
Dusan Misevic, Antoine Frenoy and François Taddei
- 12:50 *Cyclic Behavior in Gene-Culture Coevolution Mediated by Phenotypic Plasticity in Language*
Tsubasa Azumagakito, Reiji Suzuki and Takaya Arita

Wednesday 4th September

session #3

Bioinspired Robotics #2 – September 4, session 16:00-18:30

room: Ettore Majorana - Chair: Paolo Arena

- 16:00 *From Microbiology to Microcontrollers: Robot Search Patterns Inspired by T Cell Movement*
G. Matthew Fricke, Francois Asperti-Boursin, Joshua Hecker, Judy Cannon and Melanie Moses
- 16:25 *An evolutionary approach to road following: a simulated case study*
Sebastian Clarke, Frederic Labrosse, Vito Trianni and Elio Tuci
- 16:50 *Artificial Reaction Network Agents*
Claire E. Gerrard, John Mccall, George Coghill and Christopher Macleod
- 17:15 *A Neuromechanical Controller of a Hexapod Robot for Walking on Sponge, Gravel and Snow Surfaces*
Xiaofeng Xiong, Florentin Woergoetter and Poramate Manoonpong
- 17:40 *FIMO: Framework for Intrinsic Motivation*
Fabien Hervouet and Eric Bourreau
- 18:05 *Conditions for Outperformance of Recombination in Online Evolution of Swarm Robots*
Christopher Schwarzer and Nico Michiels

General track ECAL 2013 #6 – September 4, session 16:00-18:55

room: Archimede - Chair: Andrea Roli

- 16:00 *An artificial lizard regrows its tail (and more): regeneration of 3-dimensional structures with hundreds of thousands of artificial cells*
Alessandro Fontana and Borys Wrobel
- 16:25 *Simulating Sleeping Sickness: a two host agent-based model*
Simon Alderton and Jason Noble
- 16:50 *The role of backward reactions in a stochastic model of catalytic reaction networks*
Alessandro Filisetti, Alex Graudenzi, Chiara Damiani, Marco Villani and Roberto Serra
- 17:15 *Ballistic Action Planning in Robotics by means of Artificial Imagery*
Alessandro Di Nuovo, Davide Marocco, Santo Di Nuovo and Angelo Cangelosi

Wednesday 4th September

session #3

- 17:40 *Exploring the Role of the Tail in Bipedal Hopping through Computational Evolution*
Jared Moore, Anne Gutmann, Craig McGowan and Philip McKinley
- 18:05 *An alife game to teach evolution of antibiotic resistance*
Guillaume Beslon, Bérénice Batut, David P. Parsons, Dominique Schneider and Carole Knibbe
- 18:30 *Evolution of Incremental Complex Behavior on Cellular Machines*
Stefano Nichele and Gunnart Tufte

General track ECAL 2013 #7 – September 4, session 16:00-18:55
room: Pirandello - Chair: Hiroki Sayama

- 16:00 *A-Bees See: A Simulation to Assess Social Bee Visual Attention During Complex Search Tasks*
Zoe Bukovac, Alan Dorin and Adrian Dyer
- 16:25 *Cell Division Behaviour in a Heterogeneous Swarm Environment*
Adam Erskine and Michael Herrmann
- 16:50 *Social Inhibition Manages Division of Labour in Artificial Swarm Systems*
Payam Zahadat, Karl Crailsheim and Thomas Schmickl
- 17:15 *Controlling Ant-Based Construction*
Lenka Pitonakova and Seth Bullock
- 17:40 *ASAP: an Ant resource Search Algorithm for swarm-like P2P networks*
António Homem Ferreira and Carlos Martinho
- 18:05 *Swarm dynamics with limited perception - how do mosquitoes recognize a friend?*
Anna Shcherbacheva and Tuomo Kauranne
- 18:30 *Evolving Plastic Neuromodulated Networks for Behavior Emergence of Autonomous Virtual Characters*
Yuri Lenon Barbosa Nogueira, Carlos Eduardo Fisch de Brito, Creto Augusto Vidal and Joaquim Bento Cavalcante Neto

Wednesday 4th September
session #3
ICARIS – September 4, session 16:00-18:55
room: Vincenzo Bellini - Chair: Emma Hart

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| 16:00 | <i>Immune-Inspired Error Detection for Multiple Faulty Robots in Swarm Robotics</i>
Huikeng Lau, Iain Bate and Jon Timmis |
| 16:25 | <i>An Artificial Immune System-based Many-Objective Optimization Algorithm with Network Activation Scheme</i>
Wilburn W. P. Tsang and Henry Y. K. Lau |
| 16:50 | <i>The use of Agent-based Simulation to Discover Extreme Cases in Immune-Interactions with Early-Stage Cancer Scenarios</i>
Grazziela Figueredo, Peer-Olaf Siebers, Douglas Augusto, Helio Barbosa and Uwe Aickelin |
| 17:15 | <i>Learning to Solve Bin Packing Problems with an Immune Inspired Hyper-heuristic</i>
Kevin Sim, Emma Hart and Ben Paechter |
| 17:40 | <i>Automated calibration of agent-based immunological simulations</i>
Mark Read, Magnus Tripp, Hannah Leonova, Louis Rose and Jon Timmis |
| 18:05 | <i>Real-Valued Negative Databases</i>
Dongdong Zhao and Wenjian Luo |
| 18:30 | <i>An immune network approach for self-adaptive ensembles of autonomic components: a case study in swarm robotics</i>
Nicola Capodieci, Emma Hart and Giacomo Cabri |

Thursday 5th September

session #4

General track ECAL 2013 #8 – September 5, session 10:30-13:00

room: Ettore Majorana - Chair: Pietro Liò

- 10:30 *Evolution of Tail-Call Optimization in a Population of Self-Hosting Compilers*
Lance Williams
- 10:55 *Controlling development and chemotaxis of soft-bodied multicellular animats with the same gene regulatory network*
Michal Joachimczak, Taras Kowaliw, Rene Doursat and Borys Wrobel
- 11:20 *Cooperation, Congestion and Chaos in Concurrent Computation*
Mizuki Oka, Takashi Ikegami, Alex Woodward, Yiqing Zhu and Kazuhiko Kato
- 11:45 *Tipping points in Complex Coupled Life-Environment Systems*
James Dyke and Iain Weaver
- 12:10 *Emergence of diverse behaviors from interactions between nonlinear oscillator complex networks and a musculoskeletal system*
Hiroki Mori, Yuzi Okuyama and Minoru Asada
- 12:35 *A Temporal Pattern Predictor for Virtual Characters*
Micah Rosenkind, David Arnold and Graham Winstanley

General track ECAL 2013 #9 – September 5, session 10:30-13:00

room: Archimede - Chair: Alan Winfield

- 10:30 *FARSA: An Open Software Tool for Embodied Cognitive Science*
Gianluca Massera, Tomassino Ferrauto, Onofrio Gigliotta and Stefano Nolfi
- 10:55 *An Energy-Based Model for Spatial Social Networks*
Alberto Antonioni, Mattia Egloff and Marco Tomassini
- 11:20 *Evolution of Social Representation in Neural Networks*
Solvi F. Arnold, Reiji Suzuki and Takaya Arita
- 11:45 *Robustness and Directed Structures in Ecological Flow Networks*
Taichi Haruna
- 12:10 *Detecting regime shifts in artificial ecosystems*
Vasthi Alonso Chavez, James G. Dyke and C. Patrick Doncaster
- 12:35 *Evolution of Altruism and Spatial Dispersion: an Artificial Evolutionary Ecology Approach*
Jean-Marc Montanier and Nicolas Bredeche

Thursday 5th September

session #4

Music, Origins and Evolution of Language – September 5, session 10:30- 10:55
room: Pirandello - Chair: Pasquale Stano

- 10:30 *The perception of potential: interference, dimensionality and knowledge*
 Jonathan Impett and Leonardo Impett

Foundations of Complex Systems & Biological Complexity – September 5, session 10:55-12:10
room: Pirandello - Chair: Pasquale Stano

- 10:55 *Sequence selection and evolution in a binary polymer model*
 Steen Rasmussen, Harold Fellermann and Shinpei Tanaka
- 11:20 *On the preservation of limit cycles in Boolean networks under different updating schemes*
 Gonzalo Ruz, Marco Montalva and Eric Goles
- 11:45 *Using Reproductive Altruism to Evolve Multicellularity in Digital Organisms*
 Jack Hessel and Sherri Goings

Mathematical Models for the Living Systems and Life – September 5, session 12:10-13:00
room: Pirandello - Chair: Pasquale Stano

- 12:10 *An Environmental Model of Self-Compatibility Transitions in the Solanaceae Plant Family*
 Paul Calcraft, Phil Husbands and Andrew Philippides
- 12:35 *Population Dynamics of Centipede Game using an Energy Based Evolutionary Algorithm*
 Pedro Mariano and Luis Correia

General track ECAL 2013 #10 – September 5, session 10:30-13:00
room: Vincenzo Bellini - Chair: Andrea Roli

- 10:30 *The coevolution of costly heterogeneities and cooperation in the prisoner's dilemma game*
 Markus Brede and Jason Noble
- 10:55 *Using MapReduce Streaming for Distributed Life Simulation on the Cloud*
 Atanas Radenski
- 11:20 *When congestion can be useful: modelling driver diversion behaviour in road traffic networks*
 James Snowdon and Ben Waterson

Thursday 5th September**session #4**

- 11:45 *Replication strategies and the evolution of cooperation by exploitation*
Markus Brede and Simon Tudge
- 12:10 *Coevolutionary Cartesian Genetic Programming in FPGA*
Radek Hrbacek and Michaela Sikulova
- 12:35 *Multi-Objective Optimization of Intrusion Detection Systems for Wireless Sensor Networks*
Martin Stehlík, Adam Saleh, Andriy Stetsko and Vashek Matyas

Thursday 5th September

session #5

General track ECAL 2013 #11 – September 5, session 16:00- 17:15

room: Ettore Majorana - Chair: Onofrio Gigliotta

- 16:00 *Exploring the Point-mutation Space of a von Neumann Self-reproducer within the Avida World*
Tomonori Hasegawa and Barry McMullin
- 16:25 *Autopoiesis Facilitates Self-Reproduction*
Jean Sirmai
- 16:50 *Learning Schooling Behavior from Observation*
Brian Hrolenok and Tucker Balch

General track ECAL 2013 #12 – September 5, session 16:00- 17:15

room: Archimede - Chair: Melanie Moses

- 16:00 *Behavior as broken symmetry in embodied self-organizing robots*
Ralf Der and Georg Martius
- 16:25 *Environmental Feedback Drives Multiple Behaviors from the Same Neural Circuit*
Paul Williams and Randall Beer
- 16:50 *Hidden information transfer in an autonomous swinging robot*
James Thorniley and Phil Husbands

General track ECAL 2013 #13 – September 5, session 16:00- 17:15

room: Antonello da Messina - Chair: Davide Marocco

- 16:00 *SimianWorld - A Study of Social Organisation Using an Artificial Life Model*
Sue Attwood, Lola Canamero and Rene Te Boekhorst
- 16:25 *Neural agents can evolve to reproduce sequences of arbitrary length*
Benjamin Inden and Jürgen Jost
- 16:50 *The Influence of Cell Type on Artificial Development*
John Maher

Adaptive & Evolvable Hardware – September 5, session 16:00- 17:15

room: Pirandello - Chair: Luca Zammataro

- 16:00 *Linking Evolution in Silico, Hardware, and Chemistry to discover or engineer Inorganic Biology*
Leroy Cronin

Thursday 5th September**session #5**

16:25 *Acoustic sensor arrays for understanding bird communication. Identifying Cassin's Vireos using SVMs and HMMs*
Julio G. Arriaga, George Kossan, Martin L. Cody, Edgar E. Vallejo and Charles E. Taylor

16:50 *Evolution of an artificial visual cortex for image recognition*
Samuel Chapman, David Knoester, Arend Hintze and Christoph Adami

General track ECAL 2013 #14 - September 5, session 16:00- 17:15**room: Vincenzo Bellini - Chair: German Terrazas Angulo**

16:00 *Follow the Leader: a Scalable Approach for Realistic Group Behavior of Roaming NPCs in MMO Games*
Dario Maggiorini, Laura Anna Ripamonti and Samuele Panzeri

16:25 *Open-Ended Evolution of a Circadian Rhythm*
Tiago Baptista and Ernesto Costa

16:50 *Beyond the Schelling's Segregation Model Attractiveness Vs. Repulsiveness is it Equivalent to be Repulsed by Dissimilar Rather to be Attracted by Similar?*
Philippe Collard

Friday 6th September

session #6

Bioinspired Robotics III – September 5, session 10:30-10:55

room: Ettore Majorana - Chair: Paolo Arena

- 10:00 *Multi-crease Self-folding by Uniform Heating*
Shuhei Miyashita and Daniela Rus

Programmable Nanomaterials – September 5, session 10:55-11:45

room: Ettore Majorana - Chair: Paolo Arena

- 10:55 *Programming the Assembly of Inorganic Nanomaterials Using Networked Chemical Reactions*
Leroy Cronin
- 11:20 *Catalytic Molecular Walkers: Aspects of Product Release*
Darko Stefanovic, Milan Stojanovic, Mark Olah and Oleg Semenov

General track ECAL 2013 #15 – September 6, session 10:30-12:10

room: Archimede - Chair: Stefano Nolfi

- 10:30 *Bootstrapping back the climate with self-organization*
Vitor V. Vasconcelos, Flavio L. Pinheiro, Francisco C. Santos and Jorge M. Pacheco
- 10:55 *Self-Organisation of Generic Policies in Reinforcement Learning*
Simón C. Smith and J. Michael Herrmann
- 11:20 *Quantifying Political Self-Organization in Social Media. Fractal patterns in the Spanish 15M movement on Twitter*
Miguel Aguilera, Ignacio Morer, Xabier E. Barandiaran and Manuel G. Bedia
- 11:45 *Machine Consciousness and Creativity: Some Preliminary Considerations*
Antonio Chella

General track ECAL 2013 #16 – September 6, session 10:30- 12:10

room: Antonello da Messina - Chair: Mario Pavone

- 10:30 *Some Remarks on Dynamics of Binary Chromosomes Population*
Zbigniew Pliszka and Olgierd Unold
- 10:55 *Balancing the Costs and Benefits of Learning Ability*
Kai Olav Ellefsen

Friday 6th September

session #6

- 11:20 *Evolved Sensitive Periods in Learning*
Kai Olav Ellefsen
- 11:45 *Multiple Time Scales Observed in Spontaneously Evolved Neurons on High-density CMOS Electrode Array*
Eiko Matsuda, Takeshi Mita, Julien Hubert, Mizuki Oka, Douglas Bakkum, Urs Frey, Hirokazu Takahashi and Takashi Ikegami

Late Breaking Papers – September 6, session 10:30- 12:10

room: Vincenzo Bellini - Chair: Onofrio Gigliotta

- 10:30 *How Fast Can We Evolve Something?*
Inman Harvey
- 10:55 *An Emergent Model for Mimicking Human Neuronal Pathways in Silico*
Önder Gürçan
- 11:20 *The emergence of life and evolution: Towards a categorial approach*
Roland Cazalis
- 11:45 *Using novel bio-inspired principles to improve adaptability of evolutionary robots in dynamically changing environments*
Yao Yao, Kathleen Marchal and Yves Van de Peer

General track ECAL 2013 #17 – September 6, session 10:30-11:45

room: Pirandello - Chair: Davide Marocco

- 10:30 *Molecular robotics approach for constructing an artificial cell model*
Shin-Ichiro M. Nomura, Yusuke Sato and Kei Fujiwara
- 10:55 *An Artificial Behavioral Immune System for cognitive robotics*
Ignazio Infantino and Riccardo Rizzo
- 11:20 *Human-Robot Analogy – How Physiology Shapes Human and Robot Motion*
Veljko Potkonjak, Vladimir M. Petrović, Kosta Jovanović and Dragan Kostić
- 11:45 *Evolving Behaviour-Dependent Strategies in Agent Negotiations*
Darius Falahat, Enrico Gerding and Markus Brede

Friday 6th September**session #6****General track ECAL 2013 #18 – September 6, session 10:30-11:45****room: *Quasimodo* - Chair: Takashi Ikegami**

- | | |
|-------|--|
| 10:30 | <i>The Origin of Money: An Agent-Based Model</i>
Timothy Moran, Markus Brede, Antonella Ianni and Jason Noble |
| 10:55 | <i>Biology of Digital Organisms: How Language and tools Constructs Reality</i>
Orly Stettiner |
| 11:20 | <i>Stackelberg-based Coverage Approach in Nonconvex Environments</i>
Bijan Ranjbar-Sahraei, Katerina Stankova, Karl Tuyls and Gerhard Weiss |

Tuesday 3rd September

16:00-17:00 & 19:00

posters session - ECAL 2013

POSTERS – Presentation: 16:00-17:00 – Poster Inauguration: 19:00

- 1) Evolution of Spatial Pattern Formation by Autonomous Bio-Inspired Cellular Controllers
Payam Zahadat, Thomas Schmickl and Karl Crailsheim
- 2) The influence of assortativity on the robustness and evolvability of gene regulatory networks upon gene birth
Dov Pechenick, Jason Moore and Joshua Payne
- 3) An alternative route to robustness: The relationship between assortativity, incomponents, and characteristic path length in gene regulatory networks
Dov Pechenick, Joshua Payne and Jason Moore
- 4) Evaluation of an Experimental Framework for Exploiting Vision in Swarm Robotics
Sjriek Alers, Bijan Ranjbar-Sahraei, Stefan May, Karl Tuyls and Gerhard Weiss
- 5) A practical approach to Humanoid Introspection
Filippo Vella, Ignazio Infantino, Giovanni Pilato and Riccardo Rizzo
- 6) The Triangle of Life
A.E. Eiben, Nicolas Bredeche, Mark Hoogendoorn, Juergen Stradner, Jon Timmis, Andy Tyrrell and Alan Winfield
- 7) Cooperation and the Division of Labour
Simon Tudge, Richard Watson and Markus Brede
- 8) Experimental studies on growing chemical organisms
Jerzy Maselko, James Pantaleone and Vitaliy Kaminker
- 9) Expanding the Time Horizon in Underwater Robot Swarms
Vincenzo Fioriti, Stefano Chiesa and Fabio Fratichini
- 10) Multiplicity of Interpretation in an Asynchronous Updating Rule: Emergence of Collective Cognition
Takayuki Niizato
- 11) Analyzing Program Evolution in Genetic Programming using Asynchronous Evaluation
Tomohiro Harada and Keiki Takadama
- 12) Multiple Life-History Stage Competition and its Effect on Coexistence
Miguel Gonzalez, Richard Watson, Jason Noble and Patrick Doncaster
- 13) Predator prey molecular landscapes
Adrien Padirac, Alexandre Baccouche, Teruo Fujii, Andre Estevez-Torres and Yannick Rondelez
- 14) Simulating Limited Diversity in Evolution of Influenza
Takahiro Sasaki
- 15) The only wrong cell is the dead one: On the enactive approach to normativity
Manuel Heras-Escribano, Jason Noble and Manuel De Pinedo
- 16) Task Allocation Strategy for Time-Constrained Tasks in Robots Swarms
Yara Khaluf and Franz Rammig
- 17) Influence of a Social Gradient on a Swarm of Agents Controlled by the BEECLUST Algorithm
Daniela Kengyel, Ronald Thenius, Karl Crailsheim and Thomas Schmickl
- 18) Construction of a remote-controlled supramolecular micro-crawler
Daiki Komatsu, Kei Fujiwara and Shin-Ichiro M. Nomura
- 19) Formal Model of Living Systems
Margareta Segerstahl

Tuesday 3rd September

16:00-17:00 & 19:00

posters session - ECAL 2013

- 20) Emergence of Autonomous Behaviors of Virtual Characters through Simulated Reproduction
Yuri Lenon Barbosa Nogueira, Carlos Eduardo Fisch de Brito, Creto Augusto Vidal and Joaquim Bento Cavalcante Neto
- 21) In vitro Synthesis of Membrane Protein Machinery toward the Construction of Artificial Cell
Hideaki Matsubayashi, Yutetsu Kuruma and Takuya Ueda
- 22) Controlling Task Distribution in MONEE
Evert Haasdijk and Nicolas Bredeche
- 23) Robust Optimization of Adjustable Control Factors Using Particle Swarm Optimization
Takeo Kato, Koichiro Sato and Yoshiyuki Matsuoka
- 24) Collective Dynamics and Homeostatic Emergence in Complex Adaptive Ecosystem
Dharani Punithan and Bob Mckay
- 25) Analysis of Path Planning Algorithms : a Formal Verification-based Approach
Arash Khabbaz Saberi, Jan Friso Groote and Sarmen Keshishzadeh
- 26) Bladder cancer specific pathway interaction networks
Qinxin Pan, Ting Hu, Angeline Andrew, Margaret Karagas and Jason Moore
- 27) Lévy-like Distribution Shown by Intermittent Search Model with Misunderstanding Switch Pattern
Hisashi Murakami and Yukio Gunji
- 28) A cardiopulmonary system for a virtual patient
Vincent Ducharme, Richard Egli and Sylvie Jetté
- 29) Artificial Causal Space-Time
Yukio Gunji, Tomoko Sakiyama, Sohei Wakisaka, Naotaka Fujii and Tomoaki Nakamura
- 30) Rapid Rule Compaction Strategies for Global Knowledge Discovery in a Supervised Learning Classifier System
Jie Tan, Jason Moore and Ryan Urbanowicz
- 31) Comparing Reinforcement Learning and Evolutionary Based Adaptation in Population Games
Ana L. C. Bazzan
- 32) Cooperation of two different swarms controlled by BEECLUST algorithm
Tobias Meister, Ronald Thenius, Daniela Kengyel and Thomas Schmickl
- 33) The relationship between Flocking Behavior and the Emergence of Leadership
Francesco Pugliese and Davide Marocco
- 34) Family Bird: A Heterogeneous Simulated Flock
Jure Demšar and Iztok Lebar Bajec
- 35) Evolution of Mutual Trust Protocol in Human-based Multi-Agent Simulation
Hirota Osawa and Michita Imai
- 36) Radiofrequency triggered enzymatic reaction inside hydrogel microparticles
Martin Ullrich, Petra Haufová, Mandeep Singh and František Štěpánek
- 37) Hebbian Learning In A Multimodal Environment
Julien Hubert, Eiko Matsuda and Takashi Ikegami
- 38) "Artificial spores" - hybrid alginate microcapsules with encapsulated yeast cells
Jitka Cejkova, Damian Gorny, Petra Haufova and Frantisek Stepanek
- 39) Cellular Automata Coevolution of Update Functions and Topologies: A Tradeoff between Accuracy and Speed
Christian Darabos, Craig O. Mackenzien, Marco Tomassini, Mario Giacobini and Jason H. Moore

Tuesday 3rd September

16:00-17:00 & 19:00

posters session - ECAL 2013

- 40) Analysis of Ultrastability in Small Dynamical Recurrent Neural Networks
Eduardo J. Izquierdo, Miguel Aguilera and Randall D. Beer
- 41) Improving Grammatical Evolution in Santa Fe Trail using Novelty Search
Paulo Urbano and Loukas Georgiou
- 42) Bipartite Networks Show the Genotype-to-Phenotype Relationship in Biological Systems Models: A Study of the Robustness, Evolvability, and Accessibility in Linear Cellular Automata
Christian Darabos, Britney E. Graham, Ting Hu and Jason H. Moore
- 43) Prebiotic Organic Microstructures as Model Protocells
Henderson Cleaves and Neil Anthony
- 44) Heterogeneity and complexity of a simulated terrestrial environment account for the superiority of the altruistic gene
Tadao Maekawa, Manabu Honda, Norie Kawai, Emi Nishina, Osamu Ueno and Tsutomu Oohashi
- 45) Epigenetic adaptation in action selection environments with temporal dynamics
John Lones and Lola Cañamero
- 46) The Effects of Assortment on Population Structuring Traits on the Evolution of Cooperation
Adam Jackson and Richard Watson
- 47) A hybrid genetic/immune strategy to tackle the multiobjective quadratic assignment problem
Arnaud Zinflou, Caroline Gagne and Marc Gravel
- 48) Beyond Life Cycles
Maja Murnik, Špela Petrič and Miha Turšič
- 49) One way to see two in one
Martin Biehl and Daniel Polani
- 50) Adapting the Bak-Sneppen Model to a Dynamic and Partially Connected Grid of Hierarchical Species
Carlos Fernandes, Juan Laredo, Juan Julian Merelo, Carlos Cotta and Agostinho Rosa
- 51) Evolving gene regulatory networks controlling foraging strategies of prey and predators in an artificial ecosystem
Joachim Erdei, Michal Joachimczak and Borys Wrobel
- 52) On the Role of the AIS Practitioner
Emma Hart, Mark Read, Chris McEwan, Uwe Aickelin and Julie Greensmith
- 53) Modelling the migration and maturation of dendritic cells for automatic optimization of complex engineering problems
Henry Lau and Nicole Lee
- 54) SimSoup: Molecules Designed for Switchable Autocatalytic Memory
Chris Gordon-Smith
- 55) Evolutionary Explanations for Spatial Language - A Case Study on Landmarks
Michael Spranger
- 56) The Artificial Immune Systems Domain: Identifying Progress and Main Contributors Using Publication and Co-Authorship Analyses
Alaa Abi Haidar, Adrien Six, Jean-Gabriel Ganascia and Veronique Thomas-Vaslin

Tuesday 3rd September

16:00-17:00 & 19:00

posters session - ECAL 2013

- 57) Accelerating Immunos 99
Paul Taylor, Fiona Polack and Jon Timmis
- 58) Effects of inducer intake kinetics on the dynamics of gene expression
Huy Tran and Andre S. Ribeiro
- 59) Crawling Posture Learning in Humanoid Robots using a Natural-Actor-Critic CPG Architecture
Cai Li, Robert Lowe and Tom Ziemke
- 60) Adaptive long-range migration promotes cooperation under tempting conditions
Genki Ichinose, Masaya Saito, Hiroki Sayama and David Sloan Wilson
- 61) Testing Biological Models for Non-linear Sensitivity with a Programmability Test
Hector Zenil, Gordon Ball and Jesper Tegner
- 62) The Transmission of Migratory Behaviors
Geoff Nitschke and Olaf Witkowski
- 63) CARDINAL-E: AIS Extensions to CARDINAL for Decentralised Self-Organisation for Network Security
Peter Scully, Jingping Song, Jules Pagna Disso and Mark Neal

Taormina

As soon as you arrive in Taormina, you will feel the magical, mythical atmosphere spread all around which has enchanted visitors from all over the world for years. Settled on a hill of the Monte Tauro, Taormina dominates two grand, sweeping bays below and on the southern side, the top of Mount Etna, the European highest active volcano, often capped with snow, offering to the visitors a breath taking, dramatic and memorable view over almost one hundred miles of Mediterranean sea.



Taormina seems to be born as a tourist resort since past times, when ancient people like the Sicels, Greeks, Romans Byzantines, Saracens, Arabs, Norman and Spaniards chose it as their residential site thanks to its favourable position, mild climate and magic atmosphere. Nowadays, visitors can still find fine examples of Taormina's golden times: the splendid Greek Theatre, the Roman "Naumachiae", the 13th century Cathedral of Saint Nicolò, the 14th century Palazzo Corvaja, the 16th century Palace of the Dukes of Saint Stefano, the public gardens, the "Ancient Abbey" (Badia Vecchia) and many others.

Social Tour at Greek Theatre

The most significant monument in Taormina is the ancient theatre, not just because of its artistic and historical values but also because of its unique position. The view from here is called *panorama par excellence* and is definitely worth experiencing when you come to Sicily.

Second in size only to the Theatre in Syracuse, the Greek Theatre in Taormina although was built during Hellenic times in the 3rd to 2nd centuries BC, it was completely reconstructed and extended 300 years later by the Romans and used for gladiatorial shows. The theatre is situated at the very top of a hill, levelled for the purpose, using the natural incline of the valley for the "cavea": the auditorium seating.



The backdrop view would doubtless have added splendid dramatic impact to past productions.

The remains of a small temple stand on the side of the theatre. Remnants of an arcade, once leading to the theatre, stand at the top of the auditorium. Scenery consisted of nine columns, raised and placed in their original positions during the theatre's restoration in the Eighteen Hundreds.

The majestic panorama, combined with a spectacular view of Etna and the Calabrian mountains, renders this hollowed out hill a natural stage, as well as a stage for natural beauty.

Getting Around

Travelling in Sicily by comfortable buses is a very smart idea: they are fast, reliable and cheap and take the traveller almost everywhere. Taormina has its own bus terminal right in the town centre.

Frequent buses ("Interbus") run from Palermo, Catania (airport included) and Messina. Moreover, there are connections from Rome and Amalfi (Interbuisness), Bari, Brindisi (ferries from Greece) and Taranto (Etna).

Cheaper transportation might be possible by sharing car service. The SAT group (<http://www.satgroup.it/>) arranges transfer service between Catania Airport and Taormina.



Registration Desk

The registration desk is located in the conference centre of the Hotel. *It is open from 17:30 to 20:00 of September 1, and from 8:00 of September 2 until the last day of the conference.* During the conference you can find someone of the organization that can be help you on whatever you need.

Lunch and Coffee Break

Lunch, coffee and soft drinks during the breaks are included in the conference fee. The Coffee break takes place in the beautiful terrace of the Hotel Villa Diodoro where you can see together sea and the Etna volcano. The lunch takes place in the main restaurant of the Hotel.



Wi-Fi Access



The conference room, as well as the parallel sessions rooms, offer to all participants a free wireless Internet access. During the registration desk we will give you all needed access information.

