

Newsletter of the FoCAS Coordination Action Initiative

FUNDAMENTALS OF COLLECTIVE ADAPTIVE SYSTEMS

# FoCAS

ISSUE 3: SPRING 2014

**SUMMER SCHOOL 2014**  
**SASO 2014**  
**UBICOMP 2014**  
**PROJECT NEWS**  
**EVENTS**



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[www.focas.eu](http://www.focas.eu)

# Editorial

## ENGAGE!

Spring has sprung!

This 3rd FoCAS newsletter finds us deep amidst the planning of several exciting FoCAS events. Inside you'll find detailed information on our upcoming **FoCAS Summer School** in Crete at the end of June. There are still places available so please come and join us, or at least pass the word onto your students and colleagues. We are running two workshops in September, both co-located alongside prestigious conferences: The 2nd FoCAS Workshop on the Fundamentals of Collective Adaptive Systems at SASO2014, London in September (a best student paper award with a prize worth 500EUR up for grabs!) and a Workshop on The Superorganism of Massive Collective Wearables at UBICOMP2014 in Seattle, USA. Both workshops are still open for submissions.

The newsletter also reports on a FoCAS Best Paper Award from ALA2014, a detailed Proof of Concept from FoCAS project Allow Ensembles and a Pathway Analysis from project Quanticol, as well as snippets of news from the remaining FoCAS projects and details of interesting, associated upcoming events.

Our website at [www.focas.eu](http://www.focas.eu) continues to house an ever-growing suite of useful resources such as video interviews, research challenges, events details, paper reviews, infographics, slide presentations, project publications, detailed contact information and an up-to-date news stream. Content is always being added so please keep visiting [www.focas.eu](http://www.focas.eu).

FoCAS members (now over 300 researchers) continue to receive regular e-bulletins. If you're not already a member you can 'join us' via our website. We'd also appreciate your participation in completing our **three minute survey**, and/or **submitting a research challenge**. See opposite for how to get involved.

Finally the FoCAS Reading Room with articles relevant to CAS is now online. More info opposite.

Best wishes, the FoCAS Initiative

CFP: Workshop on The Superorganism of Massive Collective Wearables  
at UBICOMP2014, 13th September Seattle, USA  
Full details at: [www.focas.eu/ubicomp-2014](http://www.focas.eu/ubicomp-2014)

### PLEASE TAKE OUR 3 MINUTE SURVEY

Contribute to future research in this area:  
[www.focas.eu/three-minute-survey/](http://www.focas.eu/three-minute-survey/)

### or, SUBMIT A RESEARCH CHALLENGE

[www.focas.eu/research-landscape/challenges](http://www.focas.eu/research-landscape/challenges)

### JOIN THE FoCAS COMMUNITY

That way you can keep informed about our research via occasional e-bulletins: [www.focas.eu/join-focas](http://www.focas.eu/join-focas)

### or, FoCAS ResearchGate GROUP

Collective Adaptive Systems:  
[www.researchgate.net/project/FoCAS](http://www.researchgate.net/project/FoCAS)

### FoCAS READING ROOM LIVE!

The FoCAS Reading Room provides online access to a series of specially-commissioned feature articles on all aspects of collective adaptive systems, and links to relevant news-feeds and articles from other publications. As a collective adaptive system itself, there are opportunities for the community to get involved, either by nominating prospective authors for feature articles, or by contributing a features article.

Please contact the the FoCAS editor:  
Dr Jeremy Pitt  
([j.pitt@imperial.ac.uk](mailto:j.pitt@imperial.ac.uk)).

[www.focas-reading-room.eu](http://www.focas-reading-room.eu)

### SUMMER SCHOOL 2014

Where: Crete, Greece

When: June 23 - 27

REGISTRATION NOW OPEN AT:  
[www.focas.eu/summer-school-2014](http://www.focas.eu/summer-school-2014)

### CFP: 2nd FoCAS Workshop on Collective Adaptive Systems

at SASO 2014, 8th September, London, UK | CFP and full details: [www.focas.eu/saso-2014](http://www.focas.eu/saso-2014)

### FoCAS sponsor invited speaker at WETICE 2014

FoCAS is sponsoring invited speaker Markus Aleksy from ABB, Germany at the WETICE conference taking place in Parma on 23-25 June who will discuss adaptive mobile and wearable applications:  
[www.focas.eu/focas-sponsor-invited-speaker-wetice-2014](http://www.focas.eu/focas-sponsor-invited-speaker-wetice-2014)

## FoCAS best paper award at ALA 2014



Daniel Hennes, Karl Tuyls and Daan Bloembergen receiving the FoCAS Best Paper Award from Giacomo Cabri

FoCAS sponsored a best paper award at ALA 2014 (Adaptive and Learning Agents Workshop) held at the AAMAS 2014 conference in Paris on 5-6 May. The prize of a free place at the FoCAS Summer School in Crete on 23-27 June was won by authors **Daan Bloembergen, Daniel Hennes, Peter McBurney, and Karl Tuyls** for their paper “**Trading in Markets with Noisy Information: An Evolutionary Analysis**”

Daan Bloembergen is a PhD student at the Department of Knowledge Engineering at Maastricht University who is spending his final project year with the Agent ART group at the Department of Computer Science, University of Liverpool working alongside the other authors. Daniel Hennes is from the Advanced Concepts Team at the European Space Agency in the Netherlands, Peter McBurney is from Kings College London and Karl Tuyls is Professor of Computer Science at the University of Liverpool.

Their ALA workshop paper analysed the value of information in a stock market where information can be noisy and costly, using techniques from empirical game theory. Previous work shows that the value of information follows a J-curve, where averagely informed traders perform below market average, and only insiders prevail. However, both noise and cost can change this picture, in several cases leading to opposite results where insiders perform below market average, and averagely informed traders prevail. Their results provide insight into the complexity of real marketplaces, and show under which conditions a broad mix of different trading strategies might be sustainable.

# FoCAS SUMMER

[www.focas.eu/summer-school-2014](http://www.focas.eu/summer-school-2014)

## BACKGROUND

The Summer School is aimed at students and researchers who share an interest in the theoretical, practical, and technological issues related to collective adaptive systems. It will be an active and participative summer school with **networking opportunities** and great social events and it requires attendance for the full summer school week. The main focus will be the case studies, designed to deepen students understanding on relevant aspects of collective adaptive systems, as well as stimulating a maximum interaction with exchange of knowledge and experiences.

The summer school activities include:

- **Keynote talk : Katina Michael**  
(University of Wollongong, Australia)
- **Case studies and lectures by well-known researchers:**  
  
Nicolas Bredeche (UPMC, Paris)  
Gusz Eiben (VU University)  
Lucia Pannese & Dimitra Pappa (Imaginary)  
Jeremy Pitt (Imperial College London)
- Ample time for **team work and mentoring sessions**
- **Team presentations and feedback** by the end of the week

## COST

The **130 GBP registration fee (approx 150 EUR)** includes access to all summer school lectures and tutorials; all presentation slides; lunches and coffee breaks and the summer school social events. Accommodation is available in a range of nearby hotels at a variety of prices.

## TRAVEL AND ACCOMMODATION

This is a list of reasonably priced hotels in Heraklion (Amoudara):

Akti Corali Hotel (<http://www.akticorali.gr/>)

Oasis Hotel (<http://www.oasishotels.gr/en/>)

Georgia Hotel (<http://www.hotel-georgia.gr/en/>)

Lili Hotel (<http://www.lilihotel.com/>)

A bus will be taking lecturers and participants from Amoudara to the summer school venue. More details on the pickup point and departure time will follow.

**REGISTER NOW @ [www.focas.eu/summer-school-2014](http://www.focas.eu/summer-school-2014)**

# SCHOOL 2014

## HERAKLION, CRETE JUNE 23-27

### Keynote

#### **The Consequences of Living and Breathing with Hyperconnectedness. Katina Michael**

Soon after embarking on my PhD, I came across MIT's Auto-ID Center initiative titled, "The Internet of Things". Tiny passive contactless chips, known as radio-frequency identification (RFID) tags and transponders were supposed to revolutionise the way we did business as unlike barcodes they did not require line of sight, did not degrade with time, and could withstand extreme conditions. RFID as a data collection mechanism was about to go 'viral' however, and upgrades to Internet Protocol were about to make that planetary skin possible. From small scale adoption in retail outlets to sophisticated end-to-end supply chain initiatives- everything could now be numbered. And we would not stand for numbering only some "things," this hope now translated into numbering "everything" because we could, leading to the rise of the Internet of Everything (IoE) or as I have alluded to in the past the Web of Things and People (WoTaP). "Systems" that were once easy to detect, define, describe and detail had now begun to blur in scope. But the identification of things was just merely one aspect, knowing how these "things" were connected was another, their meshedness, relationships and interconnectivity. And so bit by bit we have related pets to owners, goods to consumers, and assets to employees. We no longer have anything we can hide, but one could legitimately claim nowhere to hide either. We strive to simplify our lives using systems that can allegedly handle complexity but in our attempt to simplify our newfound hyperconnectedness through mobile phones, social networking applications, and the cloud, we are adding even more noise into our lives. What are the consequences of adopting new and emerging technologies? How do we approach the study of converging complex systems? What kinds of research skills are paramount in interdisciplinary studies?

### Case Studies

#### **1. Lifelong learning and adaptation in collective robotics. Nicolas Bredeche.**

This case study will focus on the application of evolutionary computation methods to the field of collective robotics. The particular setup we are concerned with is that of lifelong learning and/or adaptation in open environments. Two aspects will be discussed: evolutionary optimization and evolutionary adaptation for collective robotics. Evolutionary optimization for collective robotics will focus on providing efficient controllers to solve a task which have been defined by a human supervisor prior to actual deployment. Evolutionary adaptation for collective robotics will be concerned with the more general issue of surviving in an unknown environment, without any considerations for a particular task. Links with evolutionary ecology and biology will also be discussed.

#### **2. Mapping the future of games in a Smart Society. Lucia Pannese and Dimitra Pappa.**

Games, serious games and gamification are now an interesting research and business area where creativity and technology meet. It is a very new field of studies and as such it is in high turbulence and changes with fast speed according to societal development, lifestyle evolution and increasing technology pervasiveness. This case study will feature two interactive exercises: (a) mapping the future: creating visions and scenarios for the future of games and (b) outlining technology trends and signals. Participants to this activity will be called to reflect on the future of digital gaming and express their expectations: how will games look like? What would people like to have that is not available today? Discussions will include what technologies are needed, in order to be able to implement future scenarios, whether these technologies are already available (maybe only to some extent), what needs to be developed further or is still to be invented, what one would do with these technologies now, if they are already available (what kind of games they would be developing).

These whole thoughts and reflections will be applied to a Smart Society CAS system and specifically to a scenario between tourism and care that will be presented during the opening. Participants will be encouraged to envision games and gamification techniques to make the scenario not only entertaining, but also meaningful and matching potential future user expectations. Games should also motivate participants not only to use the system representing a future digital city but also to contribute to it, so that people and machines can be mutually supportive in a hybrid system.

### **3. Algorithmic Self-Governance for Socio-Technical Systems. Jeremy Pitt.**

This case study is concerned with the application of principles of algorithmic self-governance to the design, specification and implementation of self-organising socio-technical systems. We select as our exemplar application a socio-technical system to address the problem of workplace incivility, by allowing occupants of a shared work or living space to decide, and apply, their own rules for regulating their behaviour in that space. This will involve working with a new social interaction platform and a new Internet stack for digital institutions, and specifically aiming to instantiate the services and functions of each layer of the stack and how it might be implemented on the platform, paying particular attention to visualization, interface design and affordances. As well as first-hand experience in designing a new type of collective adaptive socio-technical system, participants will broaden their understanding of social networking, event recognition, self-organisation, collective intelligence and complex systems, all from an inter-disciplinary perspective.

## **LECTURES**

- Evolutionary robotics as a tool for evolutionary biology by Nicolas Bredeche
- Serious Games and Smart Societies by Lucia Pannese
- Ostromopolis: Smart(er) Cities Founded on Design Principles for Successful Collective Action by Jeremy Pitt
- Why is embodied evolution interesting? by Gusz Eiben

## **CONTACT & QUERIES**

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- Evert Haasdijk: [e.haasdijk@vu.nl](mailto:e.haasdijk@vu.nl)

**Full details and registration at: [www.focas.eu/summer-school-2014](http://www.focas.eu/summer-school-2014)**



From left to right - Katina Michael, Gusz Eiben, Jeremy Pitt, Lucia Pannese

# 2nd FOCAS Workshop on Fundamentals of Collective Adaptive Systems

Monday, 8th September 2014 - co-located with SASO 2014, London, UK.

Collective Adaptive Systems (CAS) is a broad term that describes large scale systems 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. CASs 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, even if often the system has a global goal that is pursued by means of collective actions. 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 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, and analyse such systems. We welcome interdisciplinary approaches.

## Suggested Topics (but not limited to)

- Novel theories relating to operating principles of CAS
- Novel design principles for building CAS systems
- Insights into the short and long term adaptation of CAS systems
- Insights into Emergent Properties of CAS
- Insights into general properties of large scale, distributed CAS
- Methodologies for studying, analysing and building CAS
- Frameworks for analysing or developing CAS
- Case-studies/Scenarios that can be used to investigate CAS properties

Invited contributions from the workshop will be published in a Special Issue of the Journal of Scalable Computing: Practice and Experience: <http://scpe.org>

Best Student Paper Award:  
**Prize 500EUR!**

**Paper submission: 11th July 2014**

## Program Chairs

Emma Hart (Edinburgh Napier University): [e.hart@napier.ac.uk](mailto:e.hart@napier.ac.uk)

Giacomo Cabri (University of Modena & Reggio Emilia): [giacomo.cabri@unimore.it](mailto:giacomo.cabri@unimore.it)

Full details at: [www.focas.eu/saso-2014](http://www.focas.eu/saso-2014)

# Workshop on The Superorganism of Massive Collective Wearables

September 13th, 2014 - co-located with UBIComp & ISWC 2014, Seattle, USA

This workshop asks questions on the potential and opportunities of turning massively deployed wearable systems to a globe-spanning superorganism of socially interactive personal digital assistants. While individual wearables are of heterogeneous provenance and typically act autonomously, it stands to reason that they can (and will) self-organize into large scale cooperative collectives, with humans being mostly out-of-the-loop. A common objective or central controller may thereby not be assumed, but rather volatile network topologies, co-dependence and internal competition, non-linear and non-continuous dynamics, and sub-ideal, failure-prone operation. We refer to these emerging massive collectives of wearables as a “superorganism”, since they exhibit properties of a living organism (like e.g. ‘collective intelligence’) on their own.

One essential aspect of such globe-spanning collective ensembles is that they often exhibit properties typical observed in complex systems, like (i) spontaneous, dynamic network configuration, with (ii) individual nodes acting in parallel, (iii) constantly acting and reacting to what the other agents are doing, and (iv) where the control tends to be highly dispersed and decentralized. If there is to be any coherent behavior in the system, it (v) has to arise from competition and cooperation among the individual nodes, so that the overall behavior of the system is the result of a huge number of decisions made every moment by many individual entities.

Regular paper submissions must present original, highly innovative, prospective and forward-looking research in one or more of the themes given above. Full papers must break new ground, present new insight, deliver a significant research contribution and provide validated support for its results and conclusions.

The workshop solicits (i) conceptual papers describing proposals for novel methodologies, theories and principles that might be used in order to design, develop and build, analyse and operate massive collectives of wearables, (ii) observational, epistemological and user study papers to deliver evidence for possible future scenarios, and emerging platforms and technologies as well as (iii) system-development papers proposing ingenious, novel HW/SW platforms.

## Suggested topics include (but not limited to)

- Novel complex adaptive system theories and operational principles.
- Novel design principles for building complex adaptive systems.
- Insights into evolutionary and emergent complex adaptive system properties
- Methodologies, Models, Algorithms, Frameworks and Tools for studying, analyzing and building complex adaptive systems.
- Case-studies / very large scale scenarios that can serve as reference case for future super-organisms of collective wearables.

## Organisers

Alois Ferscha (University of Linz, Austria)

Paul Lukowicz (DFKI, Germany)

Franco Zambonelli

(Universita di Modena e Reggio Emilia, Italy)

## Submission Deadline June 2nd, 2014

**Contact:** [ubicomp14ws@pervasive.jku.at](mailto:ubicomp14ws@pervasive.jku.at)

## Full details at:

[www.pervasive.jku.at/ubicomp14](http://www.pervasive.jku.at/ubicomp14)

[www.allow-ensembles.eu](http://www.allow-ensembles.eu)

The Allow Ensembles core principle to model Collective Adaptive Systems (CASs) is based on the concept of cells and ensembles. Cells are basic building blocks representing the different functionalities provided by entities and ensembles are collections of cells collaborating together to accomplish certain goal in a given execution environment. Each cell, during its life, can specialize or adapt its behavior to achieve a given goal in collaboration with other cells in an ensemble. At the same time, an ensemble must be configured in a such a way that its goal and the goals of the cells collaborating in it are fulfilled.

We present the Allow Ensembles Proof of Concept (PoC): an integrator of the main project concepts based on a scenario in the Smart City domain. The benefits of the PoC are twofold: i) it allows us to present in a unique way the main concepts of the project and ii) it shows the interaction among them. To this end, we defined a life-cycle expressive enough to show how different concepts of the project such as evolution, security, utility, execution and adaptation are related each other. In the context of the integrated urban mobility scenario of the project, we consider an urban mobility system that is simple enough to be described in a few words, yet provides enough complexity to highlight the main project aspects and how these are combined.

We consider a urban mobility system (UMS) that integrates three transportation means: Flexi-Buses (a modern transportation mean that combines features of taxi and regular bus service), Car Pooling and Taxis. When a commuter wants to reach a destination, she queries the UMS that provides different transportation solutions.

Each entity (e.g. users, transportation means, UMS) is characterized by a set of cells and domain properties describing the main characteristic of an entity. A cell is defined by means of its goal and some functionalities (called fragments) that it exposes to the environment in order to collaborate with other cells. The user is characterized by his TripTo Cell (see Figure 1), with the abstract goal to reach the destination. This goal is then refined (using a fragment provided by the UMS) with a more concrete goal that allows the user to query the UMS and successively to choose a particular route/solution. It is clear that depending on the available routes and chosen transportation means the user

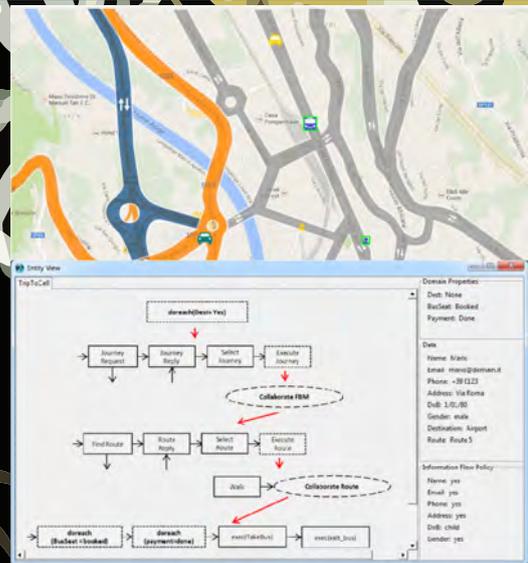
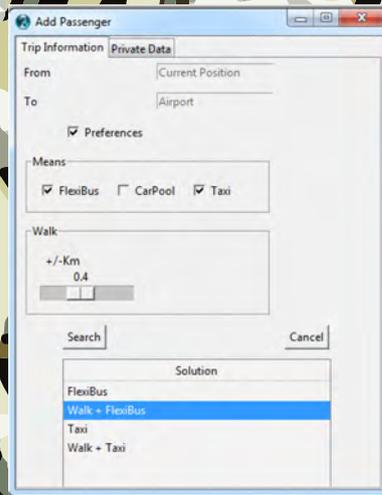


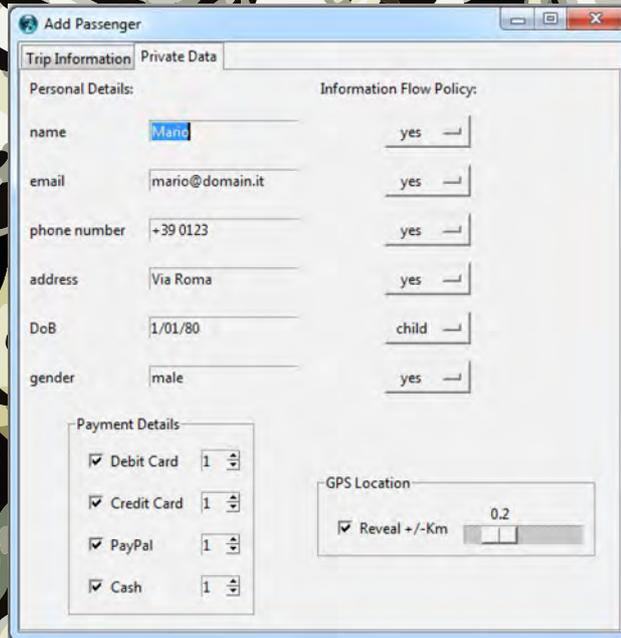
Fig. 1. Allow Ensembles PoC

goal has several ways to be specialized. Moreover the user can indicate some travel preferences and personal data policy to the UMS, and these constraints will also contribute into differentiating the list of solutions that the UMS provides back. More in details, security policy can be used to rule out some transport service providers that according to the user policy are untrusted or that want to exploit some data that the user is not willing to disclose. After that, the remaining service providers are used to calculate the possible solutions. These solution are then ranked according to the (predicted) utility in terms of travel duration and cost. Utility is predicted taking into account the knowledge gained from the past executions (or experiences). The knowledge from the past executions is learned and maintained by evolutionary knowledge component in the system. This evolutionary knowledge is also useful for the transport service providers, for instance, they can predict what will be their gain in creating a new route instead of using the existing ones.

When a user chooses a transportation solution (see Figure 2), he ends up in collaborating with a particular service provider (Flexi-Bus system, taxi system or Car Pool system) and eventually with a route. A route in our PoC is a clear example of an ensemble made of commuters and transportation providers cells. Ensemble creation can be due to some policies of a service provider (e.g. there should be at least 4 passengers for a new Flexi-Bus) or in a more spontaneous way as result of a cell specialization (e.g. a user wants to travel with his own car and registers his trip as a Car Pool



(a) Travel Preferences



(b) Privacy Policies

Solution	Initial Estimated Cost (eu)	Initial Estimated Time (min)	Utility	Corrected Estimated Cost (eu)	Corrected Estimated Time (min)	Corrected Utility
Route 1	2.79	11	0.972	4.79	12	0.953
Route 2	5.63	22	0.736	7.63	27	0.61
Route 3	2.81	11	0.972	5.81	17	0.876
Route 4	5.67	22	0.731	6.67	28	0.593

(c) Utility and Evolution

Fig. 2. Life-cycle

creating in this way a new route/ensemble ). All the cells in an ensemble collaborate each others in order to achieve their individual goals, and the ensemble goal. If adaptation is needed because of the dynamicity of the environment in which a CAS operates (i.e., bus damage, closed road, traffic jams, and so on) then a collective adaptation should have place instead of several individual adaptations (one per cell). When the cells of an ensemble achieve their own goal (they arrive to the destination) then the ensemble successfully terminates.

Our PoC has served as an initial test-bed for some key aspects of the project such as cell and ensemble specialization, ensembles creation, cells utility, cells security and cells and ensembles reconfiguration adaptation . Moreover, it has been useful to derive the interfaces of the modules of each WP and to actualize some patterns of interaction among the WPs (e.g. when specializing a cell security is used to rule out some alternatives and then utility is used to rank the remaining ones). Moreover it allowed us to derive the conceptual architecture of the final project demonstrator.

### Important Publications

- 1) David Richard Schfer, Thomas Bach, Muhammad Adnan Tariq, Kurt Rothermel: Increasing Availability of Workflow Executing in a Pervasive Environment. In: Proceedings of the 11th IEEE International Conference on Service Computing (SCC) 2014.
- 2) Santiago Gmez Sez, Vasilios Andrikopoulos, Frank Leymann, Steve Strauch: Towards Dynamic Application Distribution Support for Performance Optimization in the Cloud. In: Proceedings of the 7th IEEE International Conference on Cloud Computing (CLOUD) 2014.
- 3) Vasilios Andrikopoulos, Marina Bitsaki, Santiago Gmez Sez, Dimka Karastoyanova, Christos Nikolaou, Aggeliki Psycharakis: Utility-based Decision Making in Collective Adaptive Systems. In 4th International Conference on Cloud Computing and Services Science (CLOSER) 2014.
- 4) Vasilios Andrikopoulos, Anja Reuter, Mingzhu Xiu; Frank Leymann: Design Support for Cost-efficient Application Distribution in the Cloud. In: Proceedings of the 7th IEEE International Conference on Cloud Computing (CLOUD) 2014.



[www.quanticol.eu](http://www.quanticol.eu)

## The QUANTICOL Analysis Pathway

We live in a data-hungry world. Users of public transport systems now expect to be able to access live data about arrival times, transit connections, service disruptions, and many other types of status updates and reports at almost every stage of their journey. Studies suggest that providing real-time information on bus journeys and arrival times in this way encourages greater use of buses with beneficial effects for the bus service. In contrast, when use of buses decreases, transport experts suggest that this aggravates existing problems such as out-dated routes, bunching of vehicles, and insufficient provision of greenways or bus priority lanes.

Each of these problems makes operating the bus service more difficult. Bus timetables become less dependable, new passengers are discouraged from using the bus service due to bad publicity, which leads inevitably to budget cuts that further accelerate the decline of the service.

Service regulators are no less data-hungry than passengers, requiring transport operators to report service-level statistics and key performance indicators which are used to assess the service delivered in practice against regulatory requirements on the quality of service expected. Many of these regulatory requirements relate to punctuality of buses, defined in terms of the percentage of buses which depart within the window of tolerance around the timetabled departure time; and reliability of buses, defined in terms of the number of miles planned and the number of miles operated.

With the aim of helping service providers to be able to work with models which can be used to analyse and predict on-time performance, the QUANTICOL project has connected a set of modelling and analysis tools into an analysis pathway, starting from system measurement data, going through data fitting, model generation, simulation and statistical model-checking to compute verification results which are of significance both to service providers and to regulatory authorities.

The QUANTICOL project is devoting more than the usual amount of effort to ensuring that their tools are user-friendly and easy-to-use. This is because they want their software tools to be used “in-house” by service providers because only then can service providers retain control over access to their own proprietary data about their service provision. With respect to ease-of-use in particular, making model parameterisation simpler is a crucial step in making models re-usable. Because vehicle occupancy fluctuates according to the seasons, with the consequence that buses spend more or less time at bus stops boarding passengers, it is essential to be able to re-parameterise and re-run models for different data sets from different months of the year.

It is also necessary to be able to re-run an analysis based on historical measurement data if timetables change, or the key definitions used in the evaluation of regulatory requirements change. Evidently, a high degree of automation in the process is essential, hence the project’s interest in an analysis pathway.

The QUANTICOL project has integrated quantitative analysis tools for data fitting, model generation, simulation, and statistical model-checking, creating an analysis pathway leading from system measurement data to verification results. The analysis pathway has been applied to service data obtained from Lothian Buses about the arrival and departure times of their buses on key bus routes through the city of Edinburgh.

Authors: Andrea Vandin, Mirco Tribastone and Stephen Gilmore.

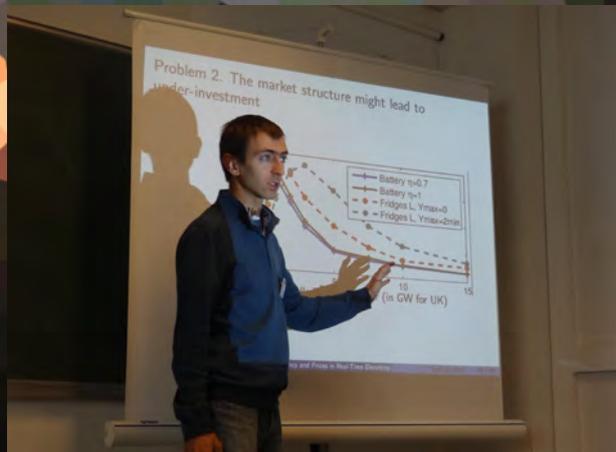


Cassting Workshop participants, ETAPS'14, Grenoble

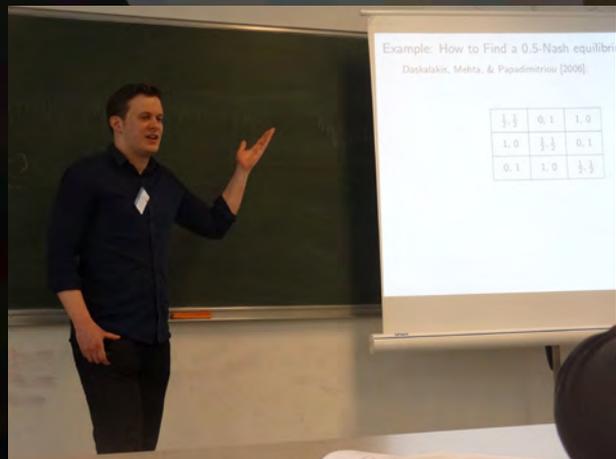
The Cassting project organised a workshop, which was co-located with the European joint Conference on Theory and Practice of Software (ETAPS'14), held in Grenoble. The workshop was organised by Kim G. Larsen and Nicolas Markey from the Cassting project, together with Doron Peled, from Bar-Ilan University in Israel. It took place on April 12th, and gathered around 25 participants. The workshop had two invited talks:

- the first one was given by **Nicolas Gast** (INRIA Rhones-Alpes, France), from the Quanticol project; Nicolas explained how to understand the real-time electricity market as a control problem for a large-scale, complex system, and how to improve it;
- the second one was delivered by **John Fearnley** (U. Liverpool, UK); John talked about algorithmic game theory, and more specifically about the complexity of computing Nash equilibria in matrix games.

Additionally, the programme was composed of seven talks on topics closely related to the Cassting project, including equilibria in infinite games, strategy synthesis, and interacting systems. These presentations gave rise to numerous interesting questions and discussions, and made the workshop very lively and successful.



Nicolas Gast - INRIA



John Fearnley - University of Liverpool

# [www.cassting-project.eu](http://www.cassting-project.eu)

collective adaptive systems synthesis with non-zero-sum games



Swarm Organ's **Yaochu Jin** (University of Surrey) is delivering a keynote at MENDEL 2014: 20th International Conference on Soft Computing

June 25-27, Brno, Czech Republic

[www.mendel-conference.org](http://www.mendel-conference.org)



ASSISI | bf recently spent two days training in Lausanne conducting experiments. During the event a lecture was given by Prof. **Robert Wood** from Wyss Institute for Biologically Inspired Engineering, Harvard, USA on the development of the flying bee robot – RoboBee.

Read all about it on the ASSISI | bf blog (photos and video too)

[www.assisi-project.eu/index.php/blog](http://www.assisi-project.eu/index.php/blog)



DIVERSIFY: Ecology-Inspired Software Evolution for Diversity Emergence

Baudry, Benoit; Monperrus, Martin; Mony, Cendrine; Chauvel, Franck; Fleurey, Franck; Clarke, Siobhan

Proc. of the Int. Conf. on Software Maintenance and Reengineering (CSMR), pp. 444-447, Belgium, 2014



Smart Society have released a video of their upcoming Ridesharing application named **SmartShare!**

You can view the video here:

<http://smart.inf.ed.ac.uk/smartshare-video>

## UPCOMING RELATED EVENTS

**Living Machines 2014:** The 3rd International Conference on Biomimetic and Biohybrid Systems  
July 30 – Aug 1 2014, Milan, Italy - <http://csnetwork.eu/livingmachines/conf2014>

**ALFIE 2014:** THE 14th Int.Conference On The Synthesis And Simulation Of Living Systems  
July 30th–August 2nd 2014, New York, USA - <http://alife14.org>

**FOCLASA 2014:** 13th International Workshop on Foundations of Coordination Languages and Self-Adaptive Systems 6 September 2014, Rome, Italy (In conjunction with CONCUR 2014)  
<http://foclasa.lcc.uma.es>

**BPCAS 2014:** 1st International Workshop on Business Processes in Collective Adaptive Systems  
September 8 2014, Haifa, Israel - <http://www.bpcas.org>

**MORE EVENTS AT:** <http://www.focas.eu/events>

# FUNDAMENTALS OF COLLECTIVE ADAPTIVE SYSTEMS



## FoCAS supported projects:

**ALLOW ENSEMBLES** [www.allow-ensembles.eu](http://www.allow-ensembles.eu)  
New design principles for large-scale collective systems

**ASCENS** [www.ascens-ist.eu](http://www.ascens-ist.eu)  
Autonomic service-component ensembles

**ASSISI | BF** [www.assisi-project.eu](http://www.assisi-project.eu)  
Animal and robot Societies Self-organise and Integrate by Social Interaction

**CASSTING** [www.cassting-project.eu](http://www.cassting-project.eu)  
Collective Adaptive System SynThesIs with Non-zero-sum Games

**DIVERSIFY** [www.diversify-project.eu](http://www.diversify-project.eu)  
Ecology-inspired software diversity for distributed adaptation in CAS

**ORGANIC COMPUTING**  
[www.organic-computing.de](http://www.organic-computing.de)  
Organic computer systems consist of autonomous and cooperating subsystems

**QUANTICOL** - [blog.inf.ed.ac.uk/quanticol](http://blog.inf.ed.ac.uk/quanticol)  
A Quantitative Approach to Management and Design of Collective and Adaptive Behaviours

**SMARTSOCIETY** [www.smart-society-project.eu](http://www.smart-society-project.eu)  
Hybrid and Diversity-Aware Collective Adaptive Systems

**SWARM-ORGAN** [www.swarm-organ.eu](http://www.swarm-organ.eu)  
A theoretical framework for swarms of GRN-controlled agents which display adaptive tissue-like organisation

FoCAS coordinates the research of 9 research projects, but anyone or group can join if they have a research interest in Collective Adaptive Systems:

[www.focas.eu](http://www.focas.eu)

## FoCAS project partners

**Centre for Emergent Computing**  
(Edinburgh Napier University, UK)

**Computational Intelligence Group**  
(VU University, Amsterdam)

**Agent and Pervasive Computing Group**  
(University of Modena & Reggio Emilia, Italy)

**Intelligent Systems & Networks Group**  
(Imperial College London)

**Institute for Pervasive Computing**  
(JKU, Linz, Austria)

The socio-technical fabric of our society more and more depends on systems that are constructed as a collective of heterogeneous components and that are tightly entangled with humans and social structures. Their components increasingly need to be able to evolve, collaborate and function as a part of an artificial society.

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