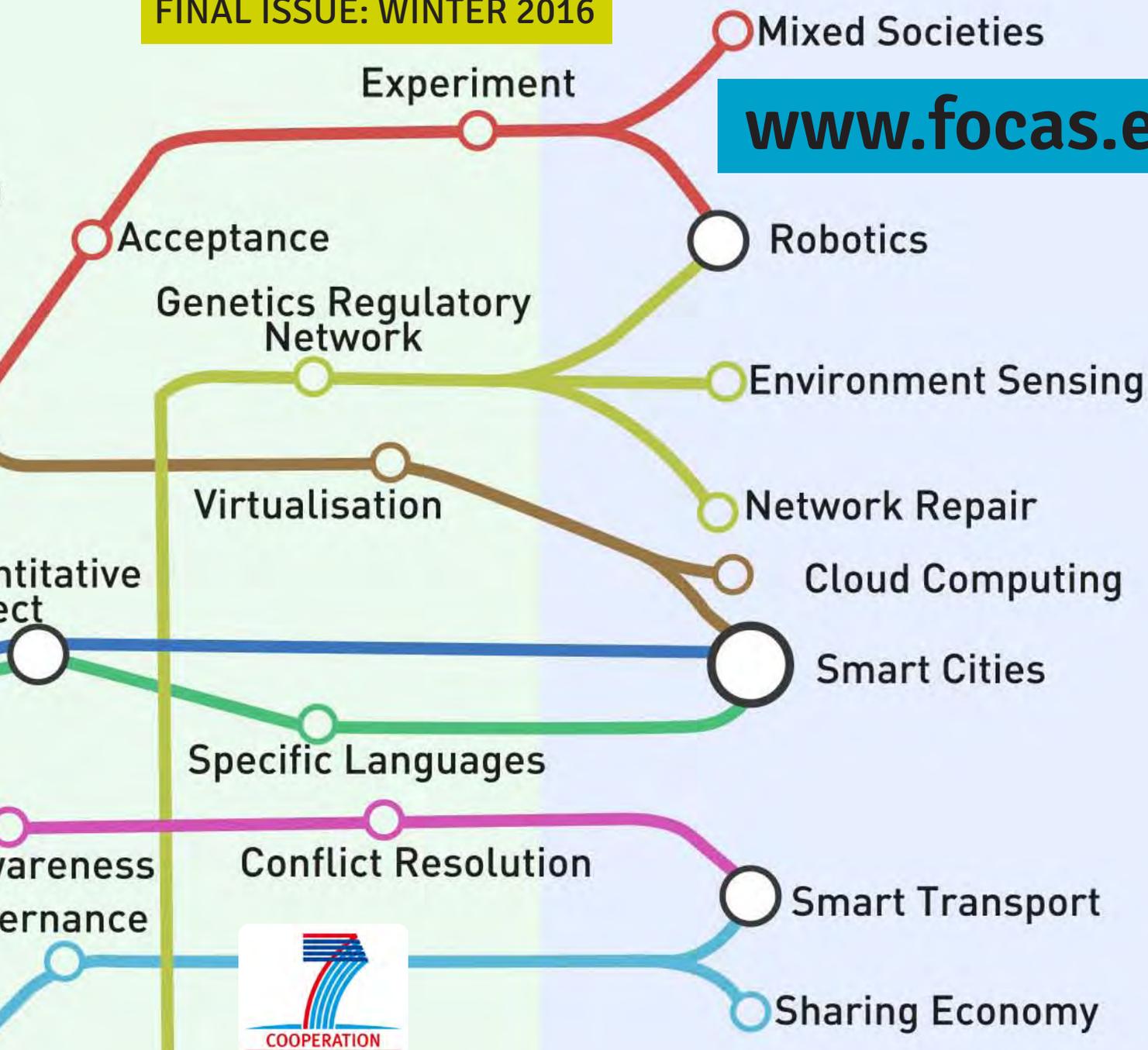


FoCAS

FINAL ISSUE: WINTER 2016

www.focas.eu



Editorial

Three years have flown by and this is the final FoCAS newsletter. The end has also arrived for some of the other projects funded under this initiative although several will continue on for longer so watch out for further updates from them. The FoCAS initiative has proved hugely enjoyable and – we like to think – successful. Lots of new contacts and collaborations have been created, through project members interacting with each other, but also with the wider community. With respect to the former, we were delighted to welcome representatives from all seven projects to Edinburgh in January for a ‘Video Sprint’, details of which are inside this newsletter. This provided a unique opportunity for all the projects to consider collectively what FoCAS as a whole had achieved, and synthesise their new insights and findings. A short video summarising the progress that the proactive initiative has made will shortly be available. In the meantime, previewed inside is the FoCAS Metro Map showing where project research intersects.

Several other events also helped bring projects together and strengthen inter-project links, for example the networking session ‘Perspectives on Collectives’ run at ICT 2015. In addition, FoCAS members have also been reaching out to the wider community and FoCAS workshops were run at conferences ranging from ECAL (European Conference on Alife) to SASO (Self-Adaptive and Self-Organising Systems) to UBICOMP (International Conference on Pervasive and Ubiquitous Computing). SASO in particular has proved a fruitful venue for FoCAS – after running three successful workshops, a permanent Steering Committee has been formed which will ensure that the FOCAS workshop perpetuates in the future. Other permanent resources developed by FOCAS includes some e-learning resources, again developed in collaboration with a wide range of people from the projects and beyond, and a roadmap outlining future directions for the community. The roadmap will soon be available at the FOCAS website.

All that remains is to wish good luck to those projects currently writing up deliverables and to say how much we, the FOCAS umbrella project, have enjoyed meeting you all and working with you over the past three years. To those projects continuing, all the best for the remainder of your funding!

Emma Hart, FoCAS Coordinator

CfPs: ICAC (13th IEEE Int. Conf. on Autonomic Computing) Workshops Jul 19-22, 2016 Wurzburg, Germany. Full details here: www.icac2016.uni-wuerzburg.de/workshops

Explore the FoCAS Research Landscape via videos, paper reviews, research challenges and visualisations: www.focas.eu/research-landscape

FoCAS READING ROOM

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: www.focas-reading-room.eu

DOWNLOAD THE FoCAS APP

The Focas App is the textbook of the future: a free, evolving, searchable and accessible collection of curated material about Collective Adaptive Systems at your fingertips:

www.focas.eu/mobile-app

Assisi_bf winter school 2016 “From bio-inspired to bio-hybrid (robotic) systems”

“From bio-inspired to bio-hybrid (robotic) systems” was the theme of the ASSISI bf Winter School which took place 12-14 January 2016 at the Ecole Polytechnique Fédérale de Lausanne and which was attended by 13 participants.

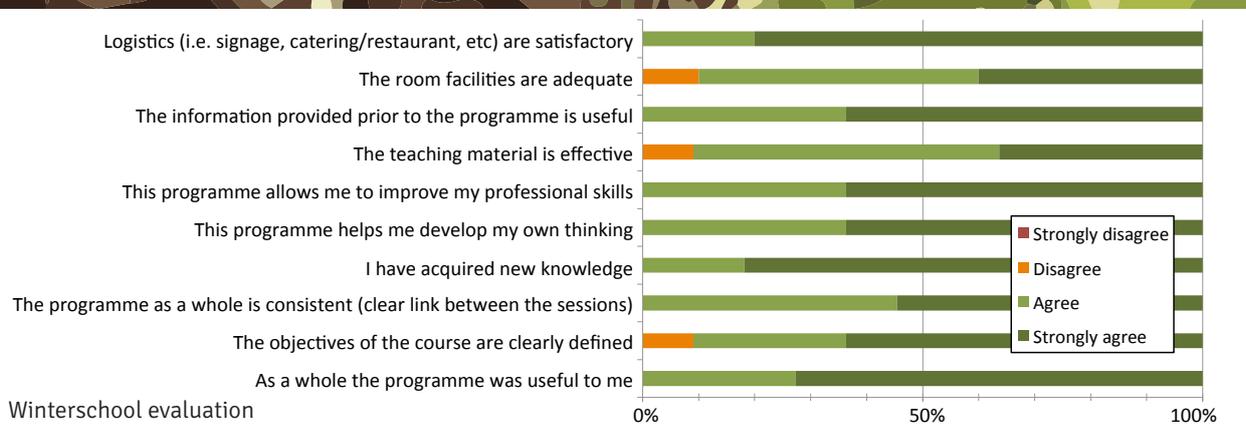
The training aim was to consider the transition from bio-inspired systems focused on developing technology, to bio-hybrid systems, where technology is in symbiosis with living systems. These bio-hybrid systems are capable of making best use of the properties of both components: biological and technological. For this to be achieved, systems and their interactions both need to be modeled, and in greater detail than simply modeling bio-inspired systems. Examples of hybrid systems involving robots and bees, fish and plants were studied.

The Winter School consisted of four main parts: preparation (article reading), lectures, practicals, and a post-event reporting phase for students wanting to submit their practical results for evaluation. A lab visit completed the winter school.

Of the six presented lectures, five were given by members of the ASSISI bf project and one by a member from the Flora Robotica project. Each lecture was supplemented with a practical, and participants pursued this same practical for a total of 17 hands-on hours!



A high degree of interest in the Winter School topic made the practical's extremely constructive and productive. Nine participants used the opportunity to write up their practical to receive feedback from a lecturer. The feedback from participants was very positive, as indicated below:



ASSISI BF look forward to organizing a future training session and hope to involve people as interesting and passionate as this year's participants!

FoCAS Roadmap Process & Video Sprint

The FoCAS Coordination Action has been undertaking an important pathfinding task to determine the current state of CAS research as well as identifying some strategic directions for future. This will result in a FoCAS Research Manifesto pulling together opinions from a wide range of FoCAS researchers to outline emerging research problems, key challenges and strategic developmental areas for problems related to the domain.



Different aspects of the FoCAS Research Landscape are presented at www.focas.eu/research-landscape/ and this reflects the interdisciplinary and international cooperation undertaken in CAS research. A range of views from CAS researchers has been obtained by

Presenting REVIEW OF BACKGROUND PAPERS (www.focas.eu/topic/background-papers/)

Conducting SURVEY QUESTIONNAIRES (www.focas.eu/three-minute-survey/)

Collecting KEY CHALLENGES (www.focas.eu/research-landscape/challenges/)

Making short VIDEO INTERVIEWS (www.focas.eu/topic/video-opinions/)

Compiling CAS PROPERTIES & REQUIREMENTS (www.focas.eu/research-landscape/visualisation/)



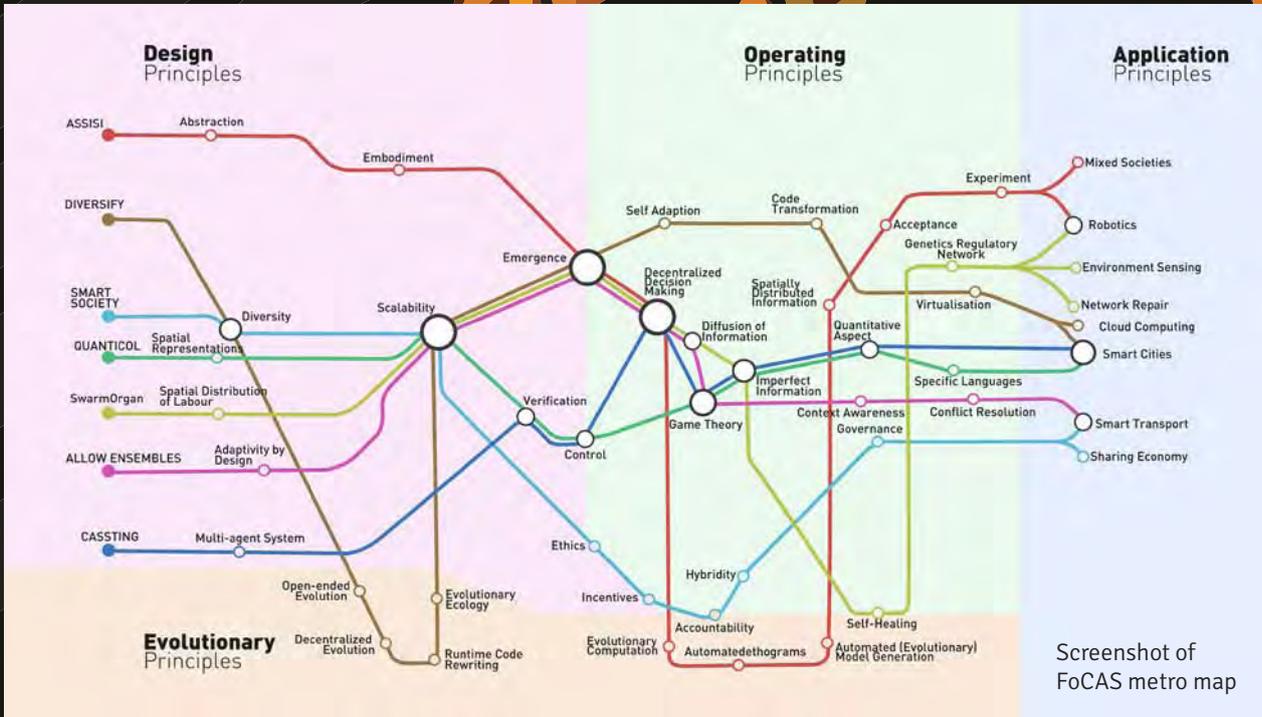
Video Sprint day one -
Insights & Functionalities

Particular attention has been given to identifying potential synergies and complementarities between those working in the FoCAS projects. The FoCAS Video Sprint was an inter-project workshop held in Edinburgh in January 2016, aiming to assess how project research had contributed to the original aims identified by FET for the FoCAS Proactive Initiative; in particular to define what new functionalities and new insights for adaptive ICT systems had been developed. In addition the projects assessed the target outcomes anticipated by FET, that is Operating Principles by which CAS can operate, Design Principles necessary to build and manage CAS, and Evolutionary Properties concerning the evolutionary nature of CAS, to define what contributions their research had made in these areas.

New CAS functionality as identified in the workshop included composability, openness, configurability, predictability, verifiability, goal-reliability, controllability-steerability and incentivisation. FoCAS projects felt that new insights had been developed in their research in connection with complex systems in nature, systems-understanding, ethics and incentives, systems' control, conflict resolution and adaption by design.

In this concentrated workshop held over three days with 20 participants from all FoCAS projects, a series of short videos were planned, story-boarded, filmed, illustrated with project examples. The edited material is available at www.focas.eu/video-sprint and it demonstrates how their FoCAS project research contributed to achieving the objectives and impact as originally envisioned by FET.

In addition, a FoCAS Metro Map was devised by FoCAS project participants, intending to provide a snapshot overview of where project research intersects. This gives a useful visualisation of the seven FoCAS projects in relation to each other, with the keywords identified by each project acting as the metro “stations” and showing where the project “lines” lie in relation to different operating, design and evolutionary principles and also some applications. This video and graphical material generated over the three day Video Sprint provide a useful contribution to the FoCAS research roadmap.



Screenshot of FoCAS metro map



Video Sprint day two - Operating Principles



Video Sprint filming

Video Sprint day two - Design Principles

Perspectives on Collectives

FoCAS have been developing e-learning resources on the theme of Perspectives on Collectives: Scientific Insights into Collective Adaptive Systems (www.focas.eu/idoc). So far we have developed materials with Peter Lewis (Aston University, Birmingham, UK) called Learning To Be Different (www.focas.eu/idoc/learning-to-be-different.html) and Jeremy Pitt (Imperial College London) who explores ideas of The Computational Commons (www.focas.eu/idoc/the-computational-commons.html). The resources involve video interviews, audio clips and links to relevant papers, books and webpages.

Perspectives on Collectives Choose topic: -

The Computational Commons

The basic notion of a #Computer4E™ has changed from one massive immobile monolithic box the size of a house, to collective adaptive systems, built from hundreds of thousands of devices, from tiny sensors to warehouse-sized computers, coexisting in motion, coexisting in life. Many of these collective adaptive systems have one distinguishing feature: they require the components to collectivise their resources in order to satisfy individual and group goals. In other words, they have a problem of common-pool resource management: who gets allocated how much, and when, and in particular, how is the allocation to be made fair and sustainable. Political scientist, economist and Nobel Laureate Elinor Ostrom pioneered a theory of self-governing institutions that communities of people have used to manage waterways, fisheries and forests. In this work, our goal is two-fold: firstly to specify a computational instantiation of Ostrom's theory for collective adaptive systems comprising only computing components, and secondly to transfer that instantiation to socio-technical systems comprising human and computing components, for example as the basis for fair and sustainable resource allocation in Smart Cities.

VIDEO

AN INTERVIEW WITH DR. JEREMY PITT (IMPERIAL COLLEGE LONDON)

COLLECTIVE ADAPTIVE SYSTEMS for COLLECTIVE ACTION SOLUTIONS

AUDIO

Elinor Ostrom - Beyond The Tragedy Of The Commons

Biography

Professor Jeremy Pitt is Reader in Intelligent Systems and Deputy Head of the Intelligent Systems & Networks Group in the Department of Electrical & Electronic Engineering at Imperial College London. His primary research interest is in the science, technology and application of Multi-Agent Systems, especially in communications. Additional interests are in Affective Computing and Computer-Mediated Communication. He supports Brentford FC.

BOOKS

THINK LIKE A COMMONER
THE COMPUTER AFTER ME
THIS PERVERSIVE DAY

LINKS

Elinor Ostrom | Nicholas Rescher
From Bitcoin to Burning Man and Beyond: The Quest for Identity and Autonomy in a Digital Society
Autonomic Power System (EPSRC Project)
City Science (MIT Media Lab Initiative)

The Computational Commons

Perspectives on Collectives Choose topic: -

Learning To Be Different

When building collective adaptive systems, such as sensor networks and swarms, it is normal practice to put the same software in each of the components that make up the collective. But in our recent research, we have shown that it can often be inefficient, leading to limited performance, and unnecessary resource overheads. Instead, it is often beneficial for there to be a diversity in the behaviours of the entities that make up the collective. But it is not good enough to just say that behaviour should be diverse: how should entities within a collective behave differently from each other? In our work, we have used online learning to generate effective diversity on an ongoing basis, over both space and time. We have shown that both these forms of diversity can be beneficial in a range of applications, including smart camera networks, and particle swarm optimisation, a search algorithm inspired by flocking birds. Using online learning to generate diversity helps the diversity stay adaptive, even in an environment full of change. This means that we can continue to maintain efficiency, and ultimately achieve better performance and lower power usage in a collective adaptive system, even as the world it inhabits changes.

VIDEO

What positive impact might your research have on the typical EU citizen?

Biography

Dr Peter Lewis is a lecturer and researcher in Computer Science at Aston University, Birmingham, UK. His primary research interest is concerned with adaptation, online learning and self-organisation in complex agent-based systems. He is a season ticket holder for Aston Villa FC.

ASSOCIATED PAPERS

Static, Dynamic, and Adaptive Heterogeneity in Distributed Smart Camera Networks
A Taxonomy of Heterogeneity and Dynamics in Particle Swarm Optimisation
It's Good to Be Different: Diversity, Heterogeneity, and Dynamics in Collective Systems
Can Diversity amongst Learners Improve Online Object Tracking?

LINKS

ALICE: Aston Lab for Intelligent Collectives Engineering

Dr. Peter Lewis
Lecturer in Computer Science

Learning to be Different

Other CAS resources you may find helpful and interesting include:

- A collection of 34 FoCAS slide presentations: www.slideshare.net/focas-project
- A video conversation between Jon Timmis and Alan Winfield: Can robots evolve? www.focas.eu/can-robots-evolve-jon-timmis-alan-winfield
- A Special Issue on CAS in Scalable Computing: Practice and Experience: www.scpe.org/index.php/scpe/issue/view/128

Casting: underfloor heating case study

The CASSTING project's uses game theory to analyse and design collective adaptive systems. They have developed a demonstrator based on a floor heating case study to simulate the control of hardware devices, with up to a 60% improvement between the actual and desired temperatures.

Daniel Lux from Danish SME Seluxit approached **Prof Kim Larsen** and colleagues from Aalborg University to help improve his home under-floor heating system whereby each of the eleven rooms is controlled separately. The game theory approach sees each room as a "player" and tries to find a strategy suitable for each room individually. This may or may not involve conflict between rooms, since the collective adaptive system has to take account of outside temperature, open-closed doors and flow of heat between rooms, loss of heat through windows, plus the use and preferences for these rooms. Using their UPPAAL Stratego tool for synthesis and optimal synthesis, it was possible to demonstrate continual computation and application of dynamic strategies with positive outcomes.

Kim Larsen believes that new functionality for personalised control software is now possible, "It is easy to personalize a product simply by changing the objectives". Rather than the considerable effort required to develop dedicated control software, objectives can be changed and the synthesis algorithm will adapt the strategy, allowing the new objectives to be satisfied.

See the case study video at www.focas.eu/casting-floor-heating-case-study/



Daniel Lux from Seluxit and Kim Larsen from Aalborg University



Overlay of rooms and heating pipes with actual and desired temperatures

Cassting workshop at ETAPS 2016

The final conference of the Cassting project will take place as a workshop of ETAPS 2016, the main European event in theoretical computer science. The workshop will take place in Eindhoven on 2-3 April. The programme includes four invited talks on various topics related to game theory and controller synthesis, and selected presentations by researchers in the area.

Smart journey planning for bicycle-sharing systems

Bicycle-sharing systems have proven to be very successful in several major cities and are now spreading all across the world. There exist more than 700 such systems that operate on five continents. The benefits for cities are multiple: from a greener image due to more eco-friendly means of transportation to the reduction of traffic congestion, noise and air pollution, they provide an alternative to private motorised vehicles, especially for short-distance trips. From the user's perspective, they offer an affordable and efficient transport alternative with several benefits over the use of a personal bicycle with respect to maintenance, theft or storage issues.

A bicycle-sharing system is composed of a number of stations where a limited number of bikes can be parked. A user arrives at a station to pick up a bike. The ride ends when she returns the bike to any station. User experience and provider revenue can be hampered when the origin station is empty, which forces the user to either resort to another means of transport or try to find an available bike in another station. Similarly, if the destination station is full, the user must either wait until one bike is picked up, or return the bike to another station with at least one parking spot available. The problems caused by empty or full stations need to be solved if the full benefits of bicycle-sharing systems are to be obtained.

Researchers on the QUANTICOL project at INRIA, Edinburgh and IMT Lucca have been studying the problem of forecasting the future availability of bicycles in stations of a bike-sharing system. This is relevant in order to make recommendations guaranteeing that the probability that a user will be able to make a journey is sufficiently high. Probabilistic predictions of successful journeys are obtained from a time-inhomogeneous queueing theory model. The model has been parametrised and successfully validated across an entire one-year historical dataset from the Vélib' system of the city of Paris.

The possibility of making probabilistic forecasts has significant added value, since it broadens the scope of the applicability of predictive models. It directly provides user-centric quantities of interest, useful for journey planning, such as the probability of finding a bike at the origin station (and dually, of finding an empty slot at the destination station).

Reference: Nicolas Gast, Guillaume Massonnet, Daniël Reijsbergen, Mirco Tribastone, Probabilistic Forecasts of Bike-Sharing Systems for Journey Planning. Proceedings of the 24th ACM International on Conference on Information and Knowledge Management, 2015. Pages 703-712.



HAIDM 2015 Proceedings available on smart-society-project.eu

The proceedings from the 2015 workshop on Human-Agent Interaction Design and Models (HAIDM) are now available at the SmartSociety website:

www.smart-society-project.eu/publications/proceedings/haidm15/

The workshop, co-organised by SmartSociety, took place on the 4th of May 2015 and was co-located with AAMAS 2015. Paper titles include: *Modelling of Personality in Agents: From Psychology to Implementation* by Sebastian Ahrndt, Johannes Fährndrich and Sahin Albayrak and *Collaborative Activity Recognition* by George Kampis and Paul Lukowicz.

Diversify: ECSLER: tool support for runtime evolution inside the JVM

Benoit Baudry from the Diversify Project was invited to present at the 45th CREST (Centre for Research on Evolution, Search and Testing) Open Workshop on Genetic Improvement in late January 2016. He presented *ECSLER: tool support for runtime evolution inside the JVM*.

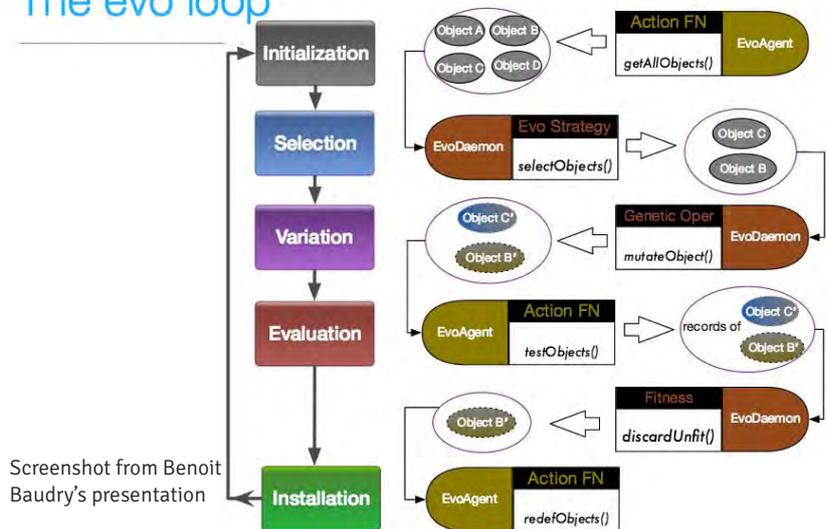
Slides of the talk are available here:

www.crest.cs.ucl.ac.uk/cow/45/slides/cow45_Baudry.pdf

and you can view a video of the talk here:

www.crest.cs.ucl.ac.uk/cow/45/videos/baudry_cow45_480p.mp4

The evo loop



Kilombo: A new simulator software for swarm robotics

The Kilobot is a widely used platform for investigation of swarm robotics. It is a low-cost robot developed by the Self-Organizing Systems Research Group at Harvard University, and manufactured by K-team. Now, several well-known groups own their own Kilobot swarms. Testing algorithms for self-organization on actual physical robots constitutes the ultimate proof-of-principle of the thought-out concepts, mechanisms and hypotheses on which those algorithms are based.

Nevertheless, physical Kilobots are slow moving and require frequent recalibration and charging, which significantly slows down the development cycle. In order to do the testing and exploring hypothesis generation in an efficient and high-throughput manner, it is very important to have tools available in between the drawing board and the physical robots themselves: a simulator. To our knowledge, there are two simulators available for the Kilobot (V-REP and Kbsim), but in both cases, simulation speed is suboptimal and translation of code between simulator and robot is time consuming and error-prone.

In our Swarm-Organ project we have thus developed a novel simulator called Kilombo (already available online), with the aim of being fast, accurate and able to read the same program code that is run on the real kilobots. This last point avoids the need for translating code between simulations and real experiments in both directions: programs optimised on the simulator can be directly transferred to the bots, and additionally the simulator is able to run previously published Kilobot code. Our main goal is to address a new level of research questions regarding emergent behaviour in robotics. Use of our simulator, significantly simplifies and speeds up development, given that a simulation of 1000 robots can be run at a speed 100 times faster than the real robots, making high-throughput pre-screening possible of potential algorithms that could lead to desired emergent behaviour.

Using Kilombo, we have been able to simulate different tests of morphogenesis and patterning for swarms of over 100 bots, and translate directly the same experiments to real bots. The use of the same code means that the direct comparison between simulations and the behaviour of real kilobots is more meaningful. We can replicate the same experiments doubling the number of bots and obtain the result within a few seconds. The figure shows an example of a self-organised shape formation in the simulator with 100, 200 and 300 bots. Furthermore, Kilombo allows us to explore the predicted emergent behaviour for swarms that are too large to perform with the real hardware.



Example of a self-organised shape formation in the simulator with 100, 200 and 300 bots.

The simulator is already available on github (<http://jic-csb.github.io/kilombo/>) and the paper “Kilombo: a Kilobot simulator to enable effective research in swarm robotics” is already online in arxiv (<http://arxiv.org/abs/1511.04285>) and under review on the Applied Soft Computing Journal.

Update from the subCULTron project

Already a few months after its start, the project subCULTron had the great opportunity to present its first prototypes at the AQUAE VENICE 2015 in cooperation with the world exposition EXPO 2015. Over 800 visitors attended the presentation, which took place from the 12th to the 16th of October 2015. Besides highly interesting discussions with visitors from industry and politics, we were very happy to welcome several school classes (picture). Our efforts of developing and presenting the hardware, was rewarded with very enthusiastic discussions about underwater robotics and the necessity of marine science and environmental monitoring. Due to several parallel events at the venue, we had the possibility to present our robots and the ideas of subCULTron to other scientists, policymakers and businessmen from all over Europe. During the discussions with these guests from very different fields, we gained inspiration for novel fields of application for the subCULTron robotic system. Thus our presentation at the EXPO 2015 turned from a simple exhibition into a highly satisfying and inspiring time and interaction with a broad European, multidisciplinary (and multi-aged) audience. This allowed us to take home a lot of new ideas and the memory of a great experience.



Children view subCULTron prototype at AQUAE VENICE 2015

Allow Ensembles Cognitive Computing Workshop

Together with IBM Research, Imperial College London organised a workshop on Cognitive Computing on 2nd October 2015. The workshop brought together researchers from academia and industry to discuss frontiers of cognitive computing.

Example presentations:

Keynote: *Cognitive Computing: From Breakthroughs in the Lab to Applications on the Field*
Guruduth Banavar, VP Cognitive Computing, IBM Research

A Distributional Theory of Content for NLP
Mark Steedman, University of Edinburgh

Panels:

Theory Frontiers for Cognitive Computing.
Moderator: Dr. Eleni Pratsini, IBM Research - Dublin.
Speakers: Vijay Saraswat, Loizos Michael, Mark Steedman, Bjoern Schuller, Maja Pantic

Cognitive Computing: Advanced Applications & Industry potential.
Moderator: Dr. Eleni Pratsini, IBM Research - Dublin.
Speakers: Julie McCann, Lea Deleris, Murray Shanahan, Costas Bekas, Rashik Parmar (IBM UK)

Research from the Organic Computing project: Controlling negative emergent behaviour with norms

The use of norms enables a higher-level observer to guide self-organisation in open distributed systems with selfish autonomous elements, thereby reducing the impact of negative emergent behaviour and optimising system performance.

Open distributed systems can host numerous distributable workloads, used in a variety of applications (e.g., for the distributed rendering of films). Systems such as these are considered open because they lack a central controlling entity. All communication is performed peer-to-peer, agents are free to join and benevolent behaviour cannot be assumed. Nodes in the system participate voluntarily by submitting work and thereby gain an advantage from the system. However, a successful system relies on reciprocity, meaning that agents must also compute work units for other submitters.

We have introduced a trust metric to overcome the problems inherent to an open system in which no particular behaviour can be assumed. Agents receive ratings for all of their actions (i.e., accepting or rejecting a job) from their interaction partners, allowing others to estimate the future behaviour of a certain agent based on its previous actions. Using this trust metric, a series of ratings for a particular agent can be accumulated and used to calculate a single reputation value. Agents are then able to make decisions based on trust values in our Trusted Desktop Grid (TDG).¹ An agent will prefer to cooperate with more trustworthy agents because it reduces the chance that it gets exploited and increases the chance that the other agent will also cooperate if asked.

Emergent behaviour that arises as a consequence of self-organised interactions, which are themselves based on trust among distributed agents, can result in both positive and negative effects. Establishing implicit trusted communities via increased cooperation with other well-trusted agents enables malicious agents to be isolated to a certain degree, thereby leading to what could be considered positive emergent behaviour. In contrast, negative emergent behaviour (NEB) typically impacts the overall system performance and must therefore be countered.

A situation such as this occurs in, for example, the case of a potentially large group of malicious agents joining the system simultaneously. This activity loads the system with additional work packages while simultaneously rejecting to work for others, leading to a trust breakdown. Consequently, benevolent agents will also reject work packages issued by the attacker. As a result, we can observe numerous bad ratings for both benevolent and uncooperative agents, leading to a drastic reduction in trust levels and resulting in a system state in which agents no longer trust each other (i.e. NEB).

To maintain a good utility (i.e., a high speedup) for well-behaving agents in our TDG, we have implemented a variety of counter and security measures. The implementation of most of these measures does, however, come with some attached costs. Although we do not benefit from these mechanisms under normal conditions, they are essential under attack and can lead to significantly faster recovery times. There is no global optimal value for most scenarios and the ideal value or setting generally depends on the current situation.

To obtain the best overall performance, these parameters and settings must therefore adapt to the current situation during runtime. It is not possible, however, to detect global system states (such as trust breakdown or overload situations) from the local viewpoint of an agent. Additionally, it is not possible to influence agents directly due to their autonomy. To overcome these issues, we have introduced a higher-level instance that is able to detect the current system state and consequently guide the agents' behaviour using indirect influences. Our concept for the norm manager (NM), which uses the common observer-controller pattern, is presented in Figure 1.2

To detect the current system state, the controller monitors the work relations of all agents by creating a work graph in which agents are nodes. In this graph, edges connect agents that have cooperated during the monitored period. The intensity of cooperation between two agents determines the weight of the edge connecting them. The controller then applies graph metrics, enabling groups or clusters of similar agents to be identified. Afterwards, it runs statistics on every cluster found and compares them to historic or threshold values. These clusters are tracked over time to detect tendencies and predict future values.

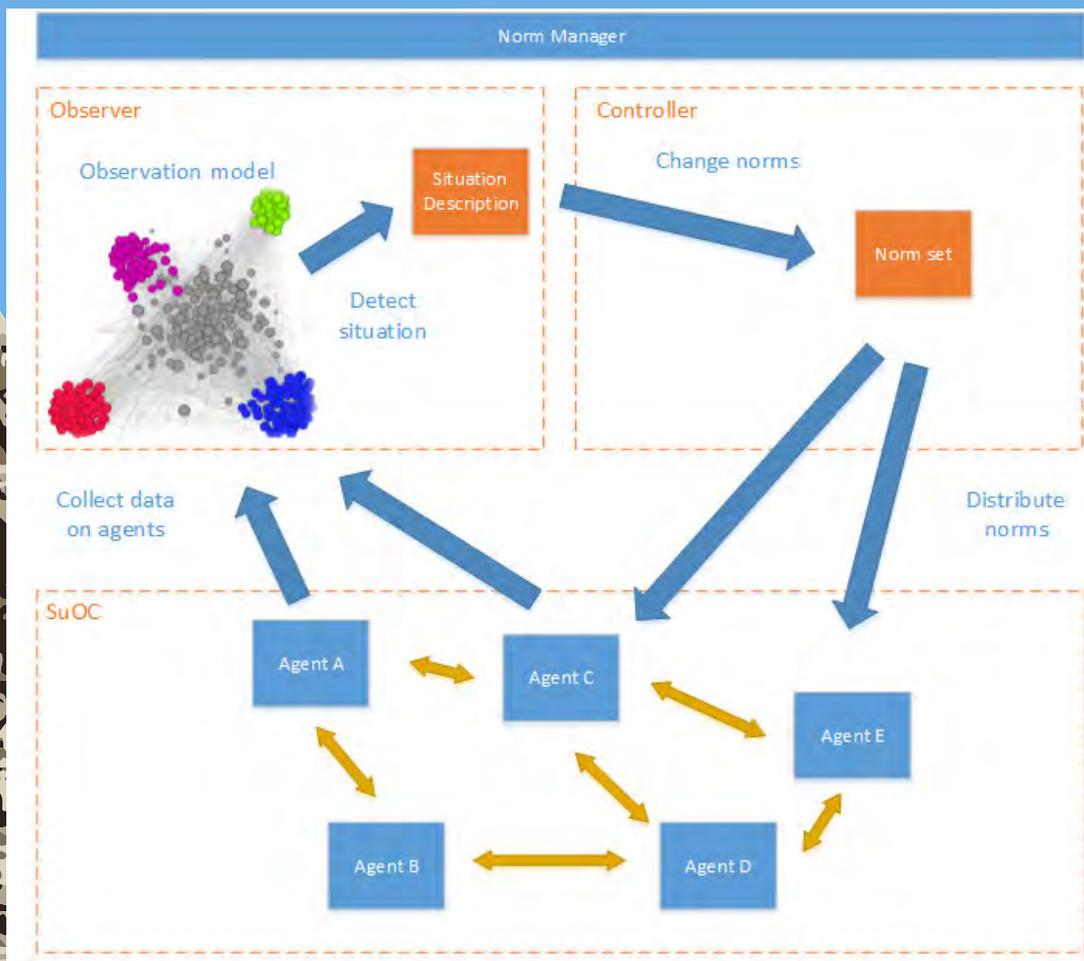


Figure 1: An open distributed system (such as the TDG) is monitored and controlled by a higher-level Norm Manager. At the bottom, a System under Observation and Control (SuOC) consists of multiple agents which interact and perform actions. The observer on the top left monitors the interactions in the SuOC and creates a situation description. On the top right, the controller uses this description and changes norms which are passed to the SuOC.

The controller is responsible for guiding the overall system behaviour by applying norms. A norm contains a rule and a sanction or an incentive. 3 Agents are still autonomous and can violate norms, but risk being sanctioned. A sanction usually results in a bad rating and, thereby, a worse reputation for the agent which reduces the chances for success of the agent in the system. If the NM fails, the system itself is still operational and can continue to run (refers to the desired OC characteristic of non-critical complexity; the approach does not add a single point of failure). 4 When the NM is recovered, it can begin to optimise the system again.

In summary, we have developed a system-wide control loop to guide self-organised behaviour in distributed systems using desktop-grid computing systems as an application scenario. Open systems that allow autonomous and heterogeneous participants to join freely tend to suffer due to uncooperative or even malicious behaviour. This can be countered by applying technical trust. In certain situations, NEB can disturb the appropriate functioning of the system (e.g., its efficiency and fairness). To overcome this issue, we intend to establish an observer/controller loop that issues norms as a response to the currently observed conditions.

Acknowledgements

This research is funded by the research unit "OC-Trust" (FOR 1085) of the German Research Foundation (DFG).

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3. A. Urzic and C. Gratie, Policy-Based Instantiation of Norms in MAS, pp. 287–296, 2013.
4. H. Schmeck, C. Müller-Schloer, E. Çakar, M. Mnif and U. Richter, Adaptivity and self-organization in organic computing systems, ACM Trans. Auton. Adapt. Syst. 5, pp. 10:1–10:32, 2010.

CfP: The 2nd Workshop on Distributed Adaptive Systems (DAS), colocated at the 13th IEEE International Conference on Autonomic Computing (ICAC)

Call for papers [DAS@ICAC2016]

On the account of the recent advances in technology, computational systems have to be thought as ever growing distributed artificial environments in which requirements, constituent components and user needs dynamically change in unpredictable ways. Coping with such uncertainties represents an interesting challenge for the designer of these systems, specifically regarding how to guarantee adaptivity towards both functional and non-functional requirements, as well as autonomously handling coordination and collaboration aspects among constituent units that have to act as autonomous and heterogeneous agents. These agents more often rely on incomplete information regarding the whole system in which they are integrated, but yet, in order to foster their Self-* properties, they need to discover, learn and evolve their behavior by taking into account how other agents are performing within the considered environment. The purpose of this workshop is therefore to create a useful forum of discussion on how Self-* properties and design & implementation concepts that are nowadays considered in Autonomic Computing literature can be extended and exploited in case of distributed autonomous systems, hence how to create adaptivity as a whole by starting from single autonomous units. Practitioners and researchers are therefore invited to submit interesting contributions both in theoretical work and real world applications so to create a fruitful discussion regarding the presented challenges and the following related topics:

- Models and Methods for designing DAS
- Distributed learning and experience sharing among agents
- Advances in Multi-Agent System coordination
- Formal methods and languages for distributed adaptive systems
- Modelling distributed adaptive systems
- Collectivism in distributed adaptive systems
- Optimization in distributed adaptive systems
- Framework and design patterns for distributed adaptive systems
- Bio-inspired and evolutionary approaches to distributed adaptive systems
- Tools and simulation software for distributed adaptive systems
- Case studies and real world applications.
- Mechanisms and Patterns for decentralized decision making and control
- Industrial best practices and case studies
- Surveys and Comparative studies in distributed adaptive systems

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Paper submission

All papers must represent original and unpublished work that is not currently under review. Papers will be judged on originality, significance, interest, correctness, clarity, and relevance to the broader community. Papers are strongly encouraged to report on experiences, measurements, user studies, and provide an appropriate quantitative evaluation if at all possible. The maximum number of allowed pages is 6. Submission instructions will follow.

Author Kit/Submission Instructions can be found at:

http://www.ieee.org/conferences_events/conferences/publishing/templates.html

The submission of paper can be done by EasyChair at:

<https://easychair.org/conferences/?conf=dasicac2016>

Accepted papers will be included in the ICAC Workshop 2016 Proceedings, which will be published in IEEE Xplore

Outstanding papers will be recommended for publication in IEEE SMC magazine, special issue,

<http://www.ieeesmc.org/publications/smc-magazine>

IET Software, special issue on Software Architectures for Decentralized Adaptive Systems,

http://digital-library.theiet.org/files/IET_SEN_DAS_SI_CFP.pdf

At least one author of each accepted paper is expected to attend the workshop.

Important dates

Paper Submission March 20, 2016

Notification April 30, 2016

Camera Ready May 8, 2016

Quanticol Summer School

The QUANTICOL project will have a Spring School in **Bertinoro, Italy** to disseminate the project results to PhD students and other researchers from around the world. The summer school on **Formal Methods for the Design of Computer, Communication and Software Systems: Quantitative Evaluation of Collective Adaptive Systems**, will take place 20th – 24th June 2016

This event is being organised with **Professor Marco Bernardo**, as part of the series of workshops on “Formal Methods for ” which Professor Bernardo has been organising at the Centro Universario Residenziale di Bertinoro for more than fifteen years.



Bertinoro

There will also be a Springer volume associated with the summer school. Further details can be found at the webpage: www.sti.uniurb.it/events/sfm16quanticol/

Recent project publications



ALLOW
Ensembles

Vukojevic-Haupt, Karolina; Gómez Sáez, Santiago; Haupt, Florian; Karastoyanova, Dimka; Leymann, Frank: A Middleware-centric Optimization Approach for the Automated Provisioning of Services in the Cloud. In: Proceedings of the 7th IEEE International Conference on Cloud Computing Technology and Science, 2015.

Gómez Sáez, Santiago; Andrikopoulos, Vasilios; Hahn, Michael; Karastoyanova, Dimka; Leymann, Frank; Skouradaki, Marigianna; Vukojevic-Haupt, Karolina: Performance and Cost Trade-Off in IaaS Environments: A Scientific Workflow Simulation Environment Case Study. In: Cloud Computing and Service Science, Springer International Publishing Switzerland, 2016 (to appear).



ASAP

García-Galán, Jesús; Pasquale, Liliana; Trinidad, Pablo and Ruiz-Cortés, Antonio, User-centric Adaptation Analysis of Multi-tenant Services, ACM Transactions on Autonomous and Adaptive Systems (to appear, 2015).

Bennaceur, Amel and Issarny, Valérie (2014). Automated synthesis of mediators to support component interoperability.. IEEE Transactions on Software Engineering, 41(3): 221-240.



ASSISI|bf

Karlo Griparic, Tomislav Haus, Damjan Miklic, Stjepan Bogdan: Combined Actuator Sensor Unit for Interaction with Honeybees. In Proc. of. IEEE Sensors Applications Symposium (SAS 2015)

Ana Paula Cláudio, Carolina Meireles and José Soeiro: Jogo móvel BeeFish: Inteligência Artificial para movimentar personagens animais. In: Procs SciTecN'15 (VideoJogos track), chapter 15. (2015), 267-293



Cassting

François Laroussinie, Nicolas Markey. Augmenting ATL with strategy contexts. In Information and Computation. Elsevier, 2015. (To appear)

Jonas F. Jensen, Kim G. Larsen, Jiří Srba, Lars K. Østergaard. Efficient Model-Checking of Weighted CTL with Upper-Bound Constraints. In International Journal on Software Tools for Technology Transfer. Springer, 2015. (To appear)



COLLMOT

K. Ozogány and T. Vicsek (2015) Modeling the emergence of modular leadership hierarchy during the collective motion of herds made of harems J. Stat. Phys. 158 628 - 646

E. Mones, A. Czirók and T. Vicsek (2014) Anomalous segregation dynamics of self-propelled particles submitted to Phys. Rev. X [url] arXiv preprint arXiv:1401.0951

E. Mones, P. Pollner and T. Vicsek (2014) Universal hierarchical behavior of citation networks JSTAT 2014

T. Nepusz and T. Vicsek (2013) Hierarchical Self-Organization of Non-Cooperating Individuals PLoS ONE 8 e81449 Public Library of Science



DIVERSIFY

Cardozo, Nicol'as; Nallur, Vivek; Clarke, Siobh'an, Enabling Participatory Routing Using a Smart Routing Platform (Inproceeding) IEEE International Smart Cities Conference, IEEE, Guadalajara, Mexico, 2015.

Yeboah-Antwi, Kwaku; Baudry, Benoit, Embedding Adaptivity in Software Systems using the ECSELR framework (Inproceeding) Proc. of the Genetic Improvement Workshop, 2015.



Organic Computing – Self-Organization in Embedded Real-Time Systems
Editors: Müller-Schloer, Christian, Schmeck, Hartmut, Ungerer, Theo
Birkhäuser (2011), 627 pages, ISBN-10: 3034801297, ISBN-13: 978-3034801294



florarobotica

Heiko Hamann, Mostafa Wahby, Thomas Schmickl, Payam Zahadat, Daniel Hofstadler, Kasper Stoy, Sebastian Risi, Andres Faiña, Frank Veenstra, Serge Kernbach, Igor Kuksin, Olga Kernbach, Phil Ayres, Przemyslaw Wojtaszek “flora robotica – Mixed Societies of Symbiotic Robot-Plant Bio-Hybrids” IEEE Symposium on Artificial Life (IEEE ALIFE’15), 2015
Mostafa Wahby, Mohammad Divband Soorati, Sebastian von Mammen, Heiko Hamann “Evolution of Controllers for Robot-Plant Bio-Hybrids: A Simple Case Study Using a Model of Plant Growth and Motion” Workshop Computational Intelligence, Dortmund, 26.-27.11.2015



Bisimulation of Labelled State-to-Function Transition Systems Coalgebraically. D. Latella, M. Massink and E. de Vink. Logical Methods in Computer Science (LMCS), Vol. 11(4:16)2015 p 1–40. DOI:10.2168/LMCS-11(4:16)2015

An experimental spatio-temporal model checker. Vincenzo Ciancia, Gianluca Grilletti, Diego Latella, Michele Loreti and Mieke Massink. In Proceedings of VERY*SCART 2015. LNCS 9509. DOI:10.1007/978-3-662-49224-6_24

S. Gilmore and D. Reijbergen. Validation of Automatic Vehicle Location Data in Public Transport Systems. Electronic Notes in Theoretical Computer Science, Volume 318, 25 November 2015, Pages 31–51. DOI: 10.1016/j.entcs.2015.10.018



Mirela Riveni, Hong-Linh Truong, Schahram Dustdar, “Trust-aware Elastic Social Compute Units”, The 14th IEEE International Conference on Trust, Security and Privacy in Computing and Communications (IEEE TrustCom-15), Helsinki, Finland, 20-22 August 2015.

O. Scekcic, T. Schiavinotto, D. I. Diochnos, M. Rovatsos, H.-L. Truong, I. Carreras, S. Dustdar, Programming Model Elements for Hybrid Collaborative Adaptive Systems, 1st IEEE International Conference on Collaboration and Internet Computing (CIC’15), 27-30 October 2015, Hangzhou, China.



Payam Zahadat, Sibylle Hahshold, Ronald Thenius, Karl Crailsheim, Thomas Schmickl: From Honeybees to Robots and Back: Division of Labour based on Partitioning Social Inhibition. Bioinspiration & Biomimetics , in press (2015)



Fredrik Jansson, Matthew Hartley, Martin Hinsch, Ivica Slavkov, Noemí Carranza, Tjelvar S. G. Olsson, Roland M. Dries, Johanna H. Grönqvist, Athanasius F. M. Marée, James Sharpe, Jaap A. Kaandorp, Verônica A. Grieneisen - Kilombo: a Kilobot simulator to enable effective research in swarm robotics (Submitted on 13 Nov 2015) arXiv:1511.04285 [cs.RO]

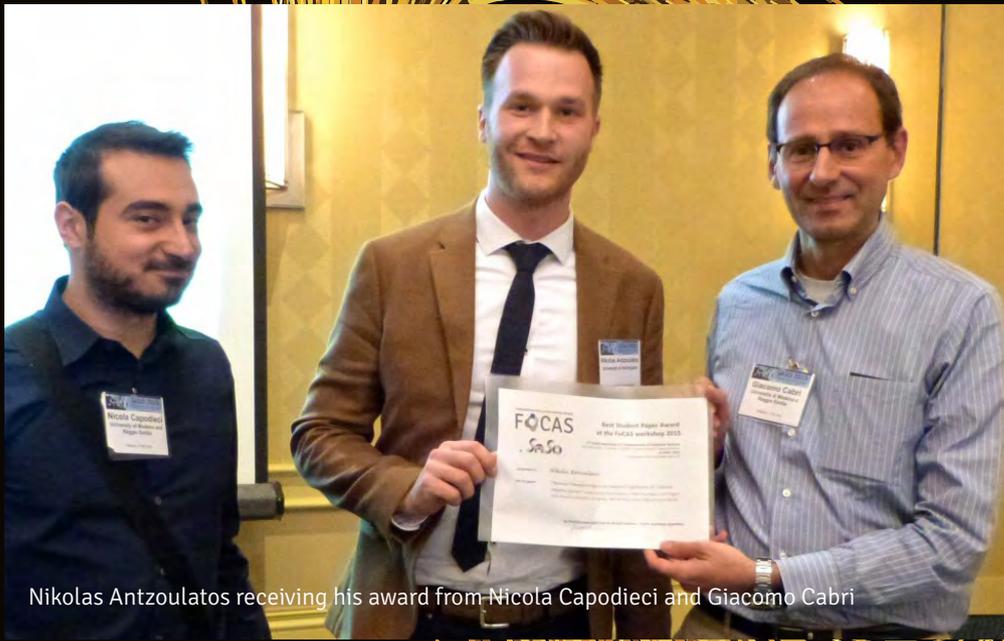
el-Showk S, Help-Rinta-Rahko H, Blomster T, Siligato R, Marée AFM, Mähönen AP, et al. (2015) Parsimonious Model of Vascular Patterning Links Transverse Hormone Fluxes to Lateral Root Initiation: Auxin Leads the Way, while Cytokinin Levels Out. PLoS Comput Biol 11(10): e1004450. doi:10.1371/journal.pcbi.1004450

FoCAS Workshop @ SASO 2015

FoCAS held its third Workshop on Fundamentals of Collective Adaptive Systems in September 2015 in conjunction with SCOPES (Spatial and COLlective PErvasive Computing Systems) at Cambridge, Massachusetts, USA as part of SASO, the ninth IEEE international conference on Self-Adaptive and Self-Organising Systems which was hosted by MIT.

The workshop brought together three distinct, yet closely related areas of research expected to play a major role in developing large-scale adaptive distributed systems in future: *spatial computing, pervasive computing and collective adaptive systems*.

Nine workshop papers were presented to an audience of 55 participants including project representatives from ASCENS, ALLOW ENSEMBLES, DIVERSIFY, ORGANIC COMPUTING, PRIME, QUANTICOL, SAPERE, SMART SOCIETY.



Nikolas Antzoulatos receiving his award from Nicola Capodieci and Giacomo Cabri

The best student paper was awarded to **Nikolas Antzoulatos** for the paper “Advanced Manufacturing as an Industrial Application for Collective Adaptive Systems “ co-authored with David Sanderson, Jack Chaplin, Dídac Busquets, Jeremy Pitt, Carl German, Alan Norbury, Emma Kelly and Svetan Ratchev.



The **FoCAS Science Café** was also incorporated into the workshop programme and presented a preview of the FoCAS Research Roadmap to obtain feedback and comments from a range of views. Additional audience suggestions will be included in the final version of the FoCAS Research Agenda.

FoCAS also sponsored two travel bursaries at the **SASO Doctoral Symposium**. The aim was for PhD Students to have an opportunity to discuss their research in an international forum, and with a panel of well-known

experts in the field. Accepted PhD Symposium papers were submitted to IEEE Xplore as part of the SASO proceedings and are available as part of the IEEE Digital Library. Doctoral Symposium Chair was Antonio Bucchiarone from FBK-DAS, Italy, a member of the Allow Ensembles project. FoCAS Executive member Jeremy Pitt, from Imperial College London gave an invited symposium talk entitled “How To Get a PhD in Self-Organizing Systems”.



FoCAS Executive member Evert Haasdijk (centre) with two travel bursary recipients for the supported FAS Doctoral Symposium at SASO 2015

Ognjen Scekic is research assistant at the Distributed Systems Group, TU Wien, Austria, where he is working towards his PhD in the area of socio-technical (hybrid) Collaborative Adaptive Systems (CAS), in the context of the EU FP7 “SmartSociety” research project. His research focuses on incentive management and programming models for hybrid CAS.

Benedikt Eberhardinger is from Augsburg University, Germany. His research deals with quality assurance themes where testing in self-organizing, adaptive systems is more problematic because of system properties like inherent nondeterministic behavior, an ever-changing environment, a high number of interacting components, and interleaving operations.

This book is about understanding, designing, controlling, and governing adaptive collective systems. It is intended for readers from master's students to Ph.D. students, from engineers to decision makers, and anyone else who is interested in understanding how technologies are changing the way we think and live.

The authors are academics working in various areas of a new rising field: adaptive collective systems.

Stuart Anderson (The University of Edinburgh, United Kingdom)
 Nicolas Bredesche (Université Pierre et Marie Curie, France)
 A.E. Eilben (VU University Amsterdam, Netherlands)
 George Kampis (DFKI, Germany)
 Maarten van Steen (VU University Amsterdam, Netherlands)

Book Sprint collaborative writing session facilitator: Adam Hyde
 Editor: Sandra Sarala
 Designer: Henrik van Leeuwen

Adaptive Collective Systems

Herding black sheep



BookSprints for ICT research

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FUNDAMENTALS OF COLLECTIVE ADAPTIVE SYSTEMS



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Animal and robot Societies Self-organise and Integrate by Social Interaction

CASSTING www.cassting-project.eu

Collective Adaptive System Synthesis with Non-zero-sum Games

COLLMOT www.hal.elte.hu/flocking

Complex structure and dynamics of collective motion

DIVERSIFY www.diversify-project.eu

Ecology-inspired software diversity for distributed adaptation in CAS

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Organic computer systems consist of autonomous and cooperating subsystems

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FoCAS coordinates the research of 12 research projects, but anyone or group can join if they have a research interest in Collective Adaptive Systems:

www.focas.eu

FoCAS project partners

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(VU University, Amsterdam, Netherlands)

Agent and Pervasive Computing Group

(University of Modena & Reggio Emilia, Italy)

Intelligent Systems & Networks Group

(Imperial College London, UK)

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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FoCAS is an FP7 coordination action supporting collective adaptive systems projects funded by the European Commission under the Future and Emerging Technologies FOCAS Proactive Initiative