Newsletter of the FoCAS Coordination Action Initiative

FUNDAMENTALS OF COLLECTIVE ADAPTIVE SYSTEMS

FoCAS

ISSUE 4: SUMMER 2014

Interviews Events Reports Results CFPs Publications and More

FoCAS is a Future and Emerging Technologies Proactive Initiative funded by the European Commission under FP7.

www.focas.eu

Editorial

Autumn approaches!

Already we've reached issue four of our newsletter and this finds FoCAS and the projects aflood with exciting developments - workshops planned, summer schools past, spring schools to the fore, research published in journals and books and reports and observations from ongoing project investigations.

In the coming weeks FoCAS are running two workshops, both co-located alongside prestigious conferences: The 2nd FoCAS Workshop on the Fundamentals of Collective Adaptive Systems at SASO2014, London on September 8th with a Science Cafe in the evening, and a Workshop on The Superorganism of Massive Collective Wearables at UBICOMP2014 in Seattle, USA. Details on pages seven and eight.

Also, inside we've an interview with Dario Floreano, reports from the FoCAS Summer School and on **Thomas Schmickl** at EvoStar and **Makus Aleksey** at WETICE.

Furthermore, SmartSociety detail some recent activities, Diversify report on observing software monoculture, Quanticol highlight new software they've released and we give details of Swarm Organ's appearance on BBC Radio 4!

As ever, you'll find details of upcoming related events such as the ASCENS Spring School in March 2015, the FoCAS App Sprint, BPCAS 2014 in Haifa, Israel and NIR 2014 at PPSN where we're sponsoring a best paper award.

We'd also like to draw your attention to the CFP for a Special Issue on CAS in Scalable Computing: Practice and Experience. Details opposite.

Our website at **www.focas.eu** houses an ever-growing suite of useful resources and our FoCAS membership now stands at over 300 researchers who receive regular e-bulletins. If you're not already a member, see opposite on how to get involved.

Best wishes, the FoCAS Initiative

COLLABORATE!

PLEASE TAKE OUR 3 MINUTE SURVEY
Contribute to future research in this area:
www.focas.eu/three-minute-survey/

or, **SUBMIT A RESEARCH CHALLENGE**
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

or, **FoCAS ResearchGate GROUP**
Collective Adaptive Systems:
www.researchgate.net/project/FoCAS

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. 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).

www.focas-reading-room.eu

FoCAS TWEETS

We like to use Twitter to communicate our work and that of our partners and associated individuals and organisations.

Follow us: @FETFoCAS | #FETFoCAS

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

CFP: Scalable Computing: Practive and Experience, Special Issue on Collective Adaptive Systems
Submission Deadline: December 15th 2014
www.scpe.org/index.php/scpe/pages/view/Call-issue-3-2015

2nd FoCAS Workshop on Collective Adaptive Systems

at SASO 2014, 8th September, London, UK | Accepted papers at: www.focas.eu/saso-2014

FoCAS sponsor best paper award at NIR 2014 part of PPSN

FoCAS sponsor best paper award at **Workshop on Nature-inspired techniques for robotics** on September 13 th in Ljubljana, Slovenia. Details available here: www.focas.eu/nir-2014

Interview with Dario Floreano at GECCO 2014

Prof. Dario Floreano is the director of the Laboratory of Intelligent Systems and director of the Swiss National Center of Competence in Robotics. His interests lie in the conjunction of robotics, biology and artificial intelligence, work that has resulted in his membership of the Global Agenda Council on Robotics and Smart Devices of the World Economic Forum, in co-founding the company senseFly S.A., and founding the popular robotics podcast series Talking Robots (which later became RobotsPodcast).

We caught up with Prof. Floreano at GECCO 2014, the Conference on Genetic and Evolutionary Computation Conference in Vancouver, where he was giving a keynote talk on how artificial evolution can be used to address biological questions and explain phenomena for which there is no fossil record or no experimental evidence, such evolution of behavior, altruism, and communication.

Our interviewer, Nicola Capodieci, talked to Prof. Floreano about his views on the field of collective adaptive systems:

What do you see as the key topics in the field of collective adaptive systems?

The most important and in fact most challenging topic is the reverse-engineering of collective adaptive systems. We see colonies of ants that perform amazing things, we see multi-cellular organisms such as ourselves in which cells with competing and conflicting interests work together, but we still do not know how we can synthesize such systems. Therefore, **reverse-engineering** of such systems is a key topic at the moment.

Are there any particular challenges regarding engineering such systems?

To reverse-engineer systems, we need heuristics, or some kind of numerical or physical experiments. There are currently strong limitations with this. Think about simulating an organism made of billions of soft cells – we can't do it. We can't even simulate ant colonies as physics based simulations take too long. The tools for studying collective systems are currently a big limitation.

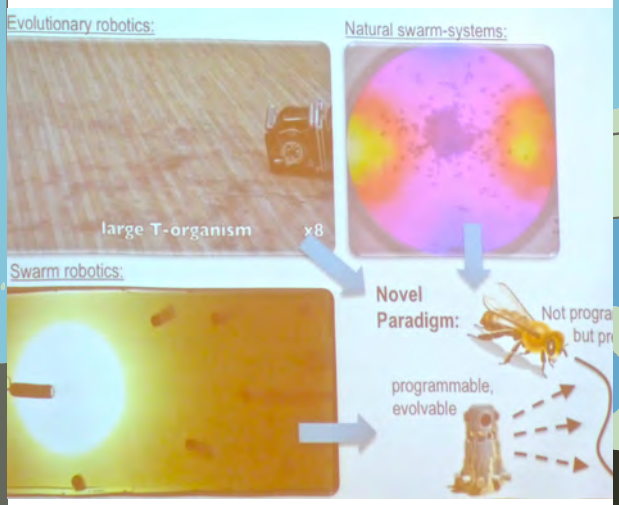
And finally what kind of collective adaptive systems do you think we will see in the future?

Staying with robotics, I think we will see multi-cellular robots: current robots are designed using technologies such as gears and electronics that go back to the last century, emanating from the car and manufacturing industries. Thinking about evolving robots that are able to grow and self-repair will require us to go back to a cellular model for designing robots, which will have a huge impact on what they can do in the future.

FoCAS events in April and June

EvoSTAR conferences in Granada, Spain in April 2014

Prof Thomas Schmickl from the FoCAS project ASSISI bf gave the opening talk entitled "Evolving bio-hybrid societies of animals and robots" at the five EvoStar co-located conferences on evolutionary and bio-inspired computing held in Granada in April 2014 (www.evostar.org). Showing video demonstrations from ASSISI bf, Prof Schmickl explained how robots and computational devices are used to trick animals to help study their behavior and the social language of interaction between animals. Bio mimicking can play an active role to help form new behaviours. Evolutionary computation and machine learning help computational devices to adapt and learn over time to better integrate into bio-hybrid societies.



WETICE conference in Parma, Italy in June 2014

FoCAS sponsored the invited speaker for the 23rd IEEE conference on Enabling Technologies: Infrastructures for Collaborative Enterprises, WETICE. **Prof Markus Aleksy,** senior scientist from ABB, a global leader in power and automation technologies, spoke about "Wearable and Mobile Systems for Improved Service Delivery and Collaboration". His talk considered how increasingly smart factories are able to provide flexible, resource-efficient and ergonomic capabilities, while acknowledging the importance of planning through-life service solutions. His particular focus was on wearable and mobile systems which can access, process, store and communicate information without being constrained to a single location. However, context-aware and smart systems are challenging to design, maintain and integrate especially into non-instrusive systems with user-friendly interfaces, and adaptation and remote collaboration add to the complexity.

ascens

Spring School on Engineering Collective Autonomic Systems

organized by the ASCENS project

March 23-27, 2015 | Lucca, Italy

www.ascens-ist.eu/springschool2015

The ASCENS Spring School is aimed to give PhD students and other young researchers a comprehensive overview of theoretical, practical, and technological issues related to collective self-aware autonomic systems - so-called ensembles.

Keynote speakers: **Marco Dorigo** and **Joseph Sifakis**

Industry Talks to be announced

Activities

Presentations by ASCENS experts on

- Languages for collective autonomic systems
- Adaptation, awareness and knowledge representation of ensembles
- Modeling and verification of self-aware systems
- Engineering ensembles

Team work on case studies
Team presentations and feedback

Gusz Eiben reports on FoCAS SUMMER SCHOOL 2014

The FOCAS Summer School 2014 took place at the University of Crete from 23-27 June. The backbone of the Summer school was formed by three case studies, each led by one or two tutors. Tutors gave an outline of their case studies to the participants on Monday morning, followed by bottom-up team forming, where participants were grouped around the case studies. A case study required that the team solved a given problem by Friday afternoon and presented the results in a plenary session. In this year's edition the case studies were:

- **Lifelong learning and adaptation in collective robotics** by **Nicolas Bredeche** (Université Pierre et Marie Curie, Paris, France)
- **Mapping the future of games in a Smart Society** by **Lucia Pannese** (I-maginary srl, Milan, Italy) and Dimitra Pappa (National Centre for Scientific Research, Athens, Greece
- **Algorithmic Self-Governance for Socio-Technical Systems** by **Jeremy Pitt** (Imperial College, London, UK)

The self-organized team forming resulted in four teams, two for Case Study 1 and one for Case Study 2 and 3. The teams started with great enthusiasm and made long working days usually ending at 7pm, when a coach took everybody from the university back to their hotels.

Further to the hands-on case studies, the summer school offered a scientific programme by invited lectures. Additionally to the tutors (who each gave a presentation about their research area) there were two invited speakers to break the week on Wednesday. **Franco Zambonelli** (Universita' di Modena, Italy) talked about "**Engineering Socio-technical Urban Superorganisms**" in the morning. The afternoon presentation by **Katina Michael** (University of Wollongong, Australia) about "**The Consequences of Living and Breathing with Hyperconnectedness**" implied a technical challenge, since she gave her talk through videoconferencing. Perhaps to everybody's surprise, everything went well and the five invited lectures contributed greatly to the success of the summer school.

Naturally, a summer school is not only about science, but also about socializing and having fun together. Bottom-up and top-down approaches were combined in this area as the week included three organized events. A poster session and welcome reception on the Monday, a beach BBQ and volleyball contest on the Wednesday, and last but not least the closing dinner on Friday evening. The scientific closure took place on Friday afternoon when each team summarized their work, presenting the problem they addressed, the approach they followed, and the results they produced. The tutors and the organizers were very pleased with the amount and quality of work the teams did in just one week. It was pleasing to see the enthusiasm and the good intentions to continue the collaboration with a joint paper as a future target.

Three people played an instrumental role in organizing everything for and around the Summer School: **Marina Bitsaki** from the University of Crete, the local organizer, **Nivea Ferreira** (VU University Amsterdam), the summer school coordinator, and **Giorgos Karafotias** (VU University Amsterdam, former grad student of the University of Crete) who acted as a 'special liaison officer' and pseudo-local organizer for the FOCAS CA Training Committee. On behalf of the management of the FOCAS CA, I want to thank them, the invited speakers, and the tutors for the great summer school.

2nd FOCAS Workshop on Fundamentals of Collective Adaptive Systems

Monday, 8th September 2014 - co-located with SASO 2014, London, UK
Full details at: www.focas.eu/saso-2014

Invited talk and discussion by Franco Zambonelli

Engineering Collective Behaviors in Future Smart Cities

In this talk, Franco sketches a future vision of urban superorganisms and identifies the key challenges in engineering innovative services that seemingly involve ICT devices and humans, harnessing the power of pervasive social intelligence to improve the quality and sustainability of urban environments. In particular, he discusses how the lessons of bio-inspired computing can be a promising starting point for engineering urban superorganisms, but also highlights the requirement of synthesizing lessons from socially-inspired computing models. He presents his recent experience in the context of the SAPERE ("Self-aware Pervasive Service Ecosystems") European project, and sketches directions for future research.

Accepted Papers

Fundamentals of Collective Adaptive Systems

- *Building blocks for aggregate programming of self- organising applications*
  Jacob Beal and Mirko Viroli
- *Enabling Self-expression: the Use of Roles to Dynamically Change Adaptation Patterns*
  Mariachiara Puviani, Giacomo Cabri and Letizia Leonardi
- *A Goal Model for Collective Adaptive Systems*
  Antonio Bucchiarone, Claudio Antares Mezzina and Heorhi Raik
- *A Perspective on Defining the Collective Adaptive Systems Problem*
  Niranjan Suri and Andrew Scott

Applications of Collective Adaptive Systems

- *Data verification for collective adaptive systems: spatial model-checking of vehicle location data*
  Vincenzo Ciancia, Stephen Gilmore, Diego Latella, Michele Loreti and Mieke Massink
- *On Intention Propagation Based Prediction in Autonomously Self-adapting Navigation*
  Laszlo Z. Varga
- *Towards a Real World Simulator for Collaborative Distributed Learning in The Scenario of Urban Mobility*
  Andreas Poxrucker, Gernot Bahle and Paul Lukowicz
- *Modelling residential smart energy schemes*
  Vashti Galpin

Nature-Inspired Techniques for Collective Adaptive Systems

- *Social Adaptation of Robots for Modulating Self- Organization in Animal Societies*
  Payam Zahadat, Michael Bodi, Ziad Salem, Frank Bonnet, Marcelo Elias de Oliveira, Francesco Mondada, Karlo Griparic, Tomislav Haus, Stjepan Bogdan, Rob Mills,Pedro Mariano, Luis Correia, Olga Kernbach, Serge Kernbach and Thomas Schmickl
- *On the 'Local-to-Global' Issue in Self-Organisation: Chemical Reactions with Custom Kinetic Rates*
  Stefano Mariani
- *Scalability Issues of Firefly-based Self- Synchronization in Collective Adaptive Systems*
  Iva Bojic, Tomislav Lipic and Mario Kusek

FoCAS Workshop on The Superorganism of Massive Collective Wearables

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

Alois Ferscha (Johannes Kepler University of Linz, Austria), **Paul Lukowicz** (Technical University of Kaiserslautern in Germany) and **Franco Zambonelli** (University of Modena and Reggio Emilia) have organized a topical research workshop on the emerging issue of considering personal wearable technologies like watches, glasses or smartphones as collective adaptive systems.

Personalized wearable ICT systems presented in fashionable and appealing lifestyle-designs have gained critical user acceptance, and comprise momentum to bring wearable computing to a socio-technical mass phenomenon within the next few years. Early indicators for this expected wearable systems 'tsunami' are the 'spring tide' of 5.3 billion mobile phone platforms (i.e. mobile subscribers) as of the end of 2013, an assessed market potential for 300 million smart watches in 2014, and a possible market for more than 200 million smart eyewear systems in 2015 [1].

This workshop asks questions on the potentials and opportunities of turning these massively deployed wearable systems to a globe spanning superorganism of socially interactive personal digital assistants. While the individual wearables are of heterogeneous provenance and typically act autonomously, we can assume that they can (and will) self-organize into large scale cooperative collectives, with humans being mostly out-of-the-loop. We may not assume a common objective or central controller, but rather volatile network topologies, co-dependence and internal competition, non-linear and non-continuous dynamics, and sub-ideal, failure prone operation. We could refer to these emerging massive collectives of wearables as a "**super-organism**", since it exhibits properties of a living organism (like e.g. 'collective intelligence') on its own. In order to properly exploit such superorganisms, we need to develop a deeper scientific understanding of the foundational principles by which they operate.

Todays trends and observable indications for a near future mass deployment of wearable computing technologies will lead to modes of use that go way beyond a pure individual, personalized assistive technology. Taking todays computational, sensory, actuation and wireless communication capacities of such platforms, it is not just considered possible, but already a reality that these are programmed to operate cooperatively as very large scale ensembles of wearable appliances.

The workshop hypothesizes, that the foreseeable mass deployment of wearable computing technologies like smart phones, smart watches or smart eyewear will lead to the emergence of a dense digital substrate to externalize and enhance our physical and social intelligence, and make it a pervasive aspect of our individual and social lives.

The workshop attempts to address the following foundational research concerns:

- Understanding the trade-offs between the power of top-down (by design) adaptation means and bottom-up (by emergence) ones
- Understanding the "power of the masses" principle as far as participatory wearable ICT processes are involved
- Understanding the issue of diversity and of diversity increase in complex systems and in service/data systems
- Laying down new foundations for the modelling of large-scale Human-ICT organisms and their adaptive behaviors
- Identifying models and tools by which individual organs of the systems can influence and direct "by design" the emergent adaptive behavior of the whole system

The workshop also attempts to address the following systems research concerns:

- Opportunistic information collection
- Collaborative reasoning and emergent effects
- Social awareness

Full details at: www.pervasive.jku.at/ubicomp14

FoCAS Summer School: short report on a great adventure! by Lucia Pannese

I had the pleasure to be one of the tutors at the Focas summer school in Heraklion during the last week of June 2014: it was a great experience both from the professional and the human point of view: good work was done in an amazing team spirit and good atmosphere full of enthusiasm

The SmartSociety dream team involved 3 students, **Luca**, an Italian PhD from Trento, **Remus**, a Rumanian PhD from Luxemburg and and **Ayham**, a Syrian student who was even taking his final exam during this week and who will do his PhD in Holland.

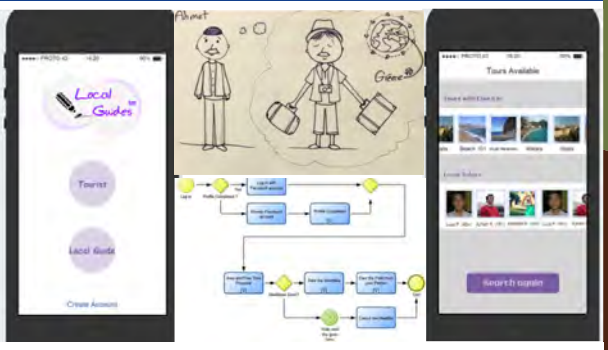
First the group learnt about SmartSociety project concepts like collectives, user and task profiling, social computation and incentivisation. Then the group used the gamified environment that is being designed to showcase the whole complexity of underlying studies and modules of the project. The three guys did a fantastic job in producing a flow for gamification aspects through different tourism apps. Using this they went on to produce two mock-ups of apps that Imaginary srl (my company!!) will include in the user engagement exercises that are being conducted as part of the SmartSociety project.

The pictures show a graph describing gamification dynamics, a sketch to describe a touristic scenario that students defined and 2 screens of a mock-up app for tourism that was developed.

Aside the very full working days, some evenings were organized: one to see some football matches from the World Cup, a beach party with football and volleyball tournament and a final dinner with a view!

Next steps will foresee the inclusion of these results in user engagement activities to collect some useful data and ideally the plan would be to prepare a paper for the FoCAS magazine together with the 3 students to conclude this work. **END**

www.smart-society-project.eu



Other SmartSociety News

SmartSociety's **Michael Rovatsos** was part of the scientific committee for the **16th European Agent Systems Summer School** (EASSS 2014), giving the opening lecture on Multi-agent systems (MAS) and MAS research. EASSS 2014 was held at the Technical University of Crete, Chania, Greece , in the week of 14-18th July. Primarily focussed on single and multi-agent systems, this year's school featured additional courses covering topics related to social intelligence. It was co-organised by the European Network for Social Intelligence, serving as their official Summer School.

EASSS featured lectures on Human-Agent Collectives, Preference Handling, Agent-Oriented programming, Dynamic Mechanism Design, Logic for MAS , Cooperative Games, Voting, Auctions and Norm Synthesis among others. Many talks had a hands-on approach and guest speakers made a point of nurturing interaction with the students.

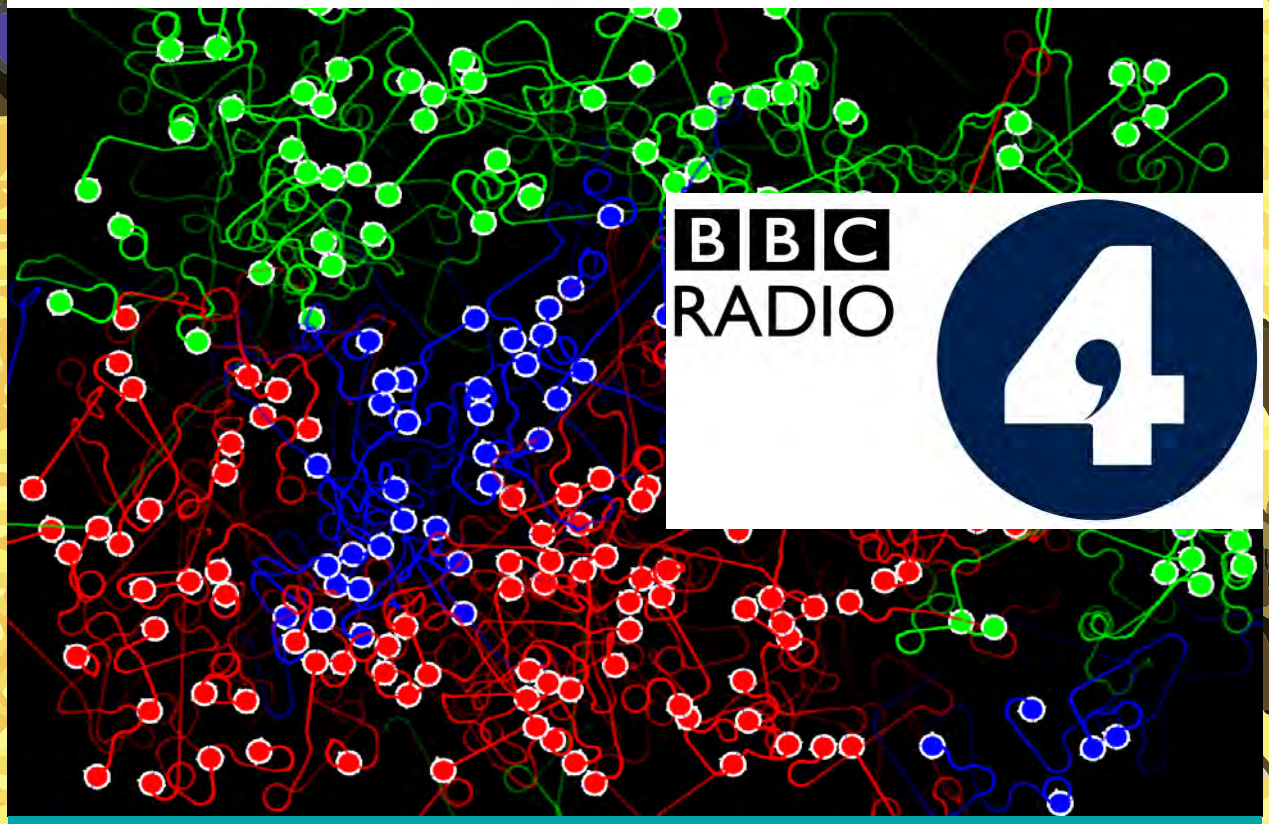
BOOK

The SmartSociety project, in collaboration with FP7 **Social-IST** and **EPSRC SOCIAM** projects, has edited a new book on "**Social Collective Intelligence - Combining the Powers of Humans and Machines to Build a Smarter Society**". The book, published by Springer, can be purchased online at www.springer.com/computer/hci/book/978-3-319-08680-4

Swarm-Organ on BBC Radio 4

www.swarm-organ.eu

The Project Leaders of the two UK partners of the SWARM-ORGAN project team, **Dr. Veronica Grieneisen**, from the Computational and Systems Biology Department of the John Innes Centre, and **Prof. Yaochu Jin**, from the Department of Computing of the University of Surrey, appeared on BBC Radio 4's weekly science show Frontiers. They discussed how understanding genetic regulatory networks of cells and biological development influences research into developing swarm robots, as well as the challenges and aims of working with actual robots.



Snapshot of simulated swarm dynamics showing bot-trajectories and their current individual states;
This robot simulator is developed by the SwarmOrgan Consortium
(acknowledgements: Dr. Matthew Hartley working with Grieneisen Lab, John Innes Centre).

Listen to the full episode *Swarming Robots* here: www.bbc.co.uk/programmes/b047zrlc

Visit JIC's website to read a summary of the interview:
www.jic.ac.uk/news/2014/07/bbc-radio-4-frontiers-swarming-robots

Specifying and Verifying Properties of Space

www.quanticol.eu

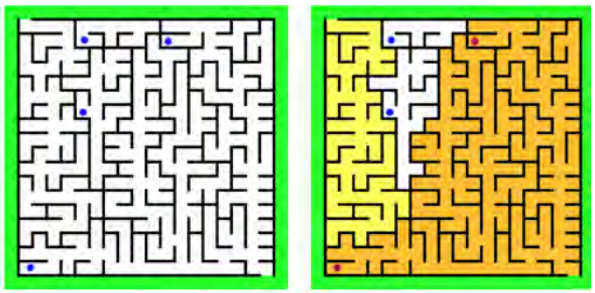
Spatial aspects of position, location and adjacency play a strong role in collective adaptive systems in shaping the behaviour which can emerge from a system.

The QUANTICOL project has implemented a model checker that operates on space in the sense of a model described by topological means, or, more precisely, by closure spaces. Closure spaces encompass topological spaces and graph-like structures.

The work is supported by a model-checker tool, implemented using the functional language OCaml, which contains a generic implementation of a global model checker using closure spaces, parametrised by the type of models. The model-checker is available from: https://github.com/vincenzoml/slcs

An example of the tool usage is to approximately identify regions of interest on a digital picture (e.g., a map, or a medical image), using spatial formulae. In this case, digital pictures are treated as quasi-discrete models in the integer cartesian plane. The language of propositions is extended to formulae dealing with colour ranges, in order to cope with images where there are different shades of certain colours.

Applications of the model-checker include finding your way out of a maze, when given a picture of the maze. In another example, the model-checker was given a portion of the map of Pisa, featuring a red circle which denotes a train station. Streets of different importance are painted with different colours in the map. The model checker is used to identify the area surrounding the station which is delimited by main streets, and the delimiting main streets.



The spatial model-checker has also been used to identify errors in GPS data reporting the location of buses in the Edinburgh bus fleet. Collective adaptive systems depend strongly on good-quality data, which they use in deciding whether or not to take adaptive action. The QUANTICOL project mapped GPS data points onto an Open Street Map in order to be able to use spatial model-checking to classify GPS position reports as being plausible (the bus is on its route) or implausible (the bus is in the middle of a field). GPS data is inherently noisy and by using their spatial model-checker the QUANTICOL project is able to detect poor-quality data.

More information is available at: http://blog.inf.ed.ac.uk/quanticol/technical-reports

Authors: **Vincenzo Ciancia**, **Stephen Gilmore**, **Diego Latella**, **Michele Loreti**, **Mieke Massink**

EXPLORING SOFTWARE MONOCULTURE

Internet applications are formed from reusable components all over the software stack. Both on the client and the server side, web-specific libraries and frameworks enable creative developers to wrap up rich applications within very short time. Massive re-use happens both on the client side (on the browser) and on the server side (in the data-center). For instance, jQuery is a popular client-side JavaScript library, which drastically improves the development of responsive web applications. Spring is an example of a server-side technology, which is used on millions of servers. The open-source philosophy and ecosystem is one of the backbones of this massive re-use in Internet applications

Re-use and modularity are key for liberating creativity and entrepreneurship in the Internet world. However, this bright world has a darker side. The problem is that they participate in creating a massive monoculture, in a way that has never been encountered before. The DIVERSIFY project recently explored two technological monocultures found on the web: content management and dynamic pages.

WordPress

In the top 500.000 web sites (1), we found 106.412 sites running WordPress. Among these sites, 65.558 (64%) use the Akismet plugin, which checks potential spam in WordPress comments. 21.849 web sites (22,6%) use the Jetpack plugin, which has a known SQL injection vulnerability, even in the latest version. Figure 1 shows the distribution of the 400 most popular plugins (2) among the web sites that we analyzed.

This data provides evidence for two levels of applicative monoculture. First, at the level of the application: with more than 20% of the top web sites using WordPress, we see emerging a technological monoculture for content management. While the vibrant community who keeps producing large quantities of diverse plugins could compensate this monoculture, we observe the opposite effect. The second level of monoculture is in the distribution of plugins, largely skewed towards a very small number of plugins. Consequently, a single attack on a zero-day flaw on WordPress is able to compromise thousands of Internet web sites.

JavaScript

We did a similar study for JavaScript libraries, based on the top 110.000 web sites. We focused on 94 libraries, starting from the list of notable libraries established by Wikipedia (3) that we enriched with libraries found while crawling the sites. Among the visited sites, 97.000 (88%) use JavaScript, which, in itself, constitutes a massive monoculture. Figure 2 displays the distribution of libraries among the sites that use JavaScript. It appears that a single library holds the largest share of the sites: jQuery is used by 37% of the sites. Then, the distribution drops drastically: Sizzle and jQuery UI are used by 13% and 12% of the sites respectively. The other libraries are used by less than 10% of the sites, including 78 plugins that are used in less than 1% of the cases.

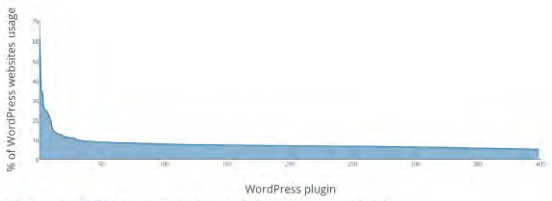


Figure 1 - The monoculture of WordPress plugins

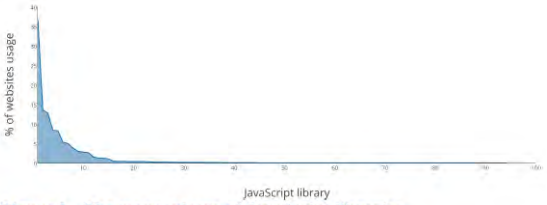


Figure 2 - The monoculture of JavaScript libraries

1 According to www.alexa.com
2 According to www.wordpress.org/plugins/browse/popular
3 www.en.wikipedia.org/wiki/List_of_JavaScript_libraries

www.diversify-project.eu

Organic Computing — A Paradigm Shift for Complex Systems
Müller-Schloer, Christian, Schmeck, Hartmut, Ungerer, Theo (Eds.)
2011, XXX, 627p. 100 illus., 10 illus. in color.

A product of Birkhäuser Basel
www.springer.com/birkhauser/computer+science/book/978-3-0348-0129-4

Clarissa: Cloud Adaptation & Application (Re-)Distribution: Bridging the two Perspectives.
Gómez Sáez, Santiago; Andrikopoulos, Vasilios; Wessling, Florian; Cassales Marquezan. In: Proceedings of the First International Workshop on Engineering Cloud Applications & Services (EnCASE 2014)

Performance-aware Application Distribution in the Cloud.
Gómez Sáez, Santiago; Andrikopoulos, Vasilios; Leymann, Frank.
In: Proceedings of the Workshop on Enterprise Architekturen mit Big Data & Cloud (EABDC 2014)

Are two heads better than one?
On the success of collective decision-making

Blog post available at:

www.assisi-project.eu/index.php/blog/two-heads-better-one-success-collective-decision-making

Quantified CTL: Expressiveness and Complexity.
François Laroussinie, Nicolas Markey.
In Logical Methods in Computer Science. 2014. (To appear)

Synthesizing structured reactive programs via deterministic tree automata.
Benedikt Brütsch.
In Information & Computation. Elsevier, 2014. (To appear)

Programming Social Collective Intelligence. Daniele Miorandi and Lorenzo Maggi.
To appear in IEEE Technology and Society, special issue on Technology for Collective Action (2014). www.smart.inf.ed.ac.uk/programming-social-collective-intelligence

On the Elasticity of Social Compute Units. Mirela Riveni, Hong-Linh Truong, Schahram Dustdar. Springer-Verlag, 26th International Conference on Advanced Information Systems Engineering (CAiSE 2014), 16-20 June 2014, Thessaloniki, Greece. Accepted.
www.smart.inf.ed.ac.uk/on-the-elasticity-of-social-compute-units

UPCOMING RELATED EVENTS

SASO See, SASO Do: From Computational Awareness to Collective Adaptation a FoCAS Science Cafe at SASO 2014 - Monday 8th September, Imperial College London

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

Workshop on The Superorganism of Massive Collective Wearables
at UBICOMP2014, 13th September, Seattle, USA - www.focas.eu/ubicomp-2014

NIR 2014 at PPSN (13th Int. Conf. on Parallel Problem Solving from Nature) Workshop on Nature-inspired techniques for robotics, September 13th, Ljubljana, Slovenia - www.focas.eu/nir-2014

FoCAS App Sprint: 24-26th September, Barcelona, Spain

ASCENS Spring School: Spring School on Engineering Collective Autonomic Systems
March 23-27, 2015 | Lucca, Italy - www.ascens-ist.eu/springschool2015

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.

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FLOSS MANUALS

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SEVENTH FRAMEWORK PROGRAMME

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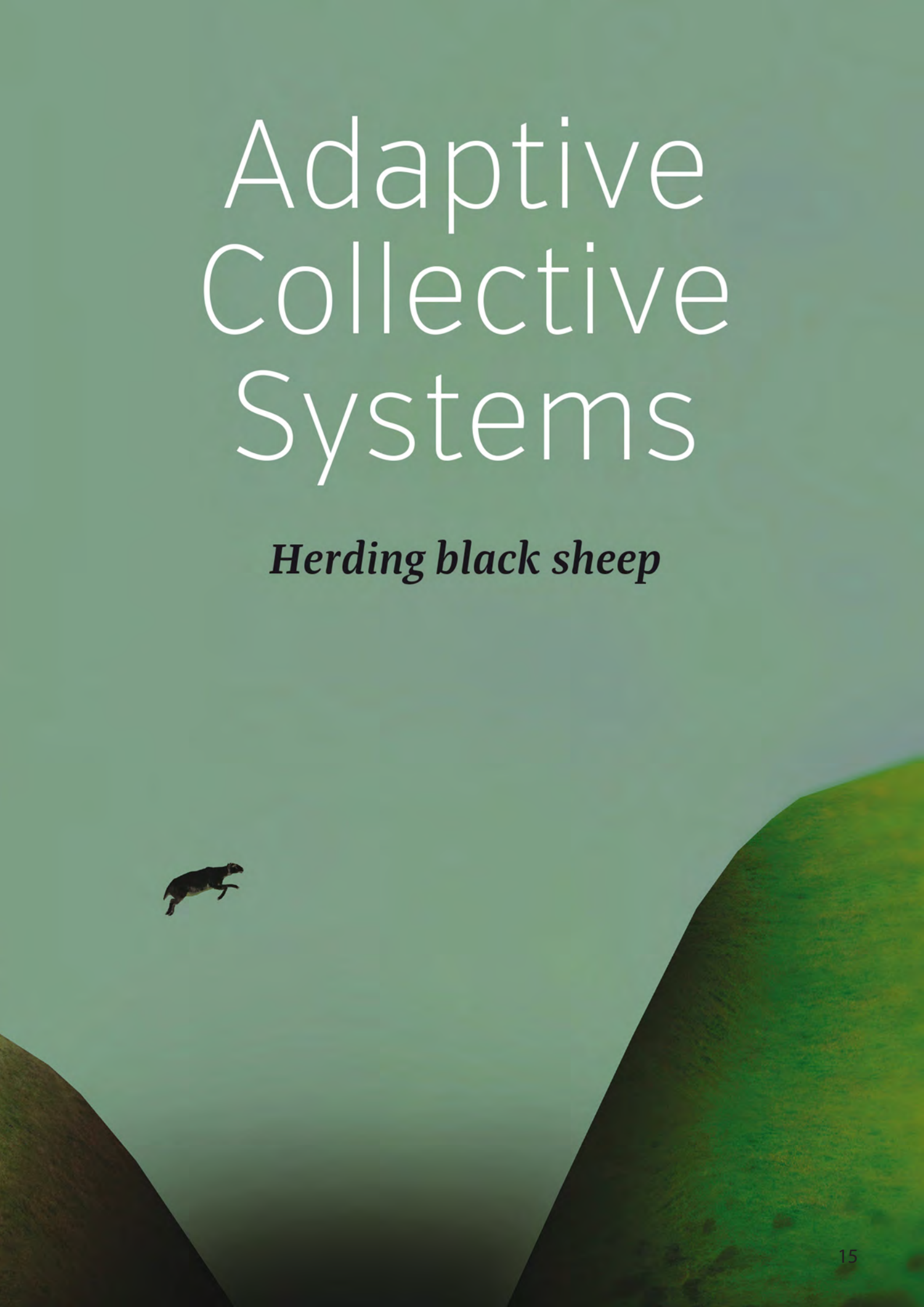
Adaptive Collective Systems

Herding black sheep



FUNDAMENTALS OF COLLECTIVE ADAPTIVE SYSTEMS

FoCAS

FoCAS supported projects:

ALLOW ENSEMBLES www.allow-ensembles.eu
New design principles for large-scale collective systems

ASCENS www.ascens-ist.eu
Autonomic service-component ensembles

ASSISI | BF www.assisi-project.eu
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

DIVERSIFY www.diversify-project.eu
Ecology-inspired software diversity for distributed adaptation in CAS

ORGANIC COMPUTING
www.organic-computing.de
Organic computer systems consist of autonomous and cooperating subsystems

QUANTICOL - blog.inf.ed.ac.uk/quanticol
A Quantitative Approach to Management and Design of Collective and Adaptive Behaviours

SMARTSOCIETY www.smart-society-project.eu
Hybrid and Diversity-Aware Collective Adaptive Systems

SWARM-ORGAN www.swarm-organ.eu
A theoretical framework for swarms of GRN-controlled agents which display adaptive tissue-like organisation

COOPERATION

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

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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