e-Kickoff

ICCSA'14 – Le Havre
June 23-26th 2014

Booklet

The Complex Systems Digital Campus (CS-DC, http://unitwin-cs.org) is an international network of institutions and individuals sharing research and education resources for dealing with the difficult scientific challenges of complex systems science and its applications as defined by its living roadmap.

UNESCO and CS-DC have just signed a multi-annual cooperation programme to promote the development of integrated knowledge and integrated models of complex systems in order:

- to bridge the gap between science and engineering in an increasingly interconnected world,
- to contribute to the aims of global development while being respectful of environmental constraints,
- to develop a lifelong personalized education for all in the science of complex systems as well as in integrative and predictive sciences.

With this signature, the CS-DC is becoming a UNESCO UniTwin, weaving a rapidly increasing network of more than a hundred high education and research institutions.

The CS-DC will be organized through transdisciplinary research and education e-departments. Each e-department is federating the e-laboratories dealing with the challenges of its evolving roadmap chapter. Each transdisciplinary research and education e-laboratory is federating the e-community addressing its evolving chapter challenge. The CS-DC will contribute to develop an open science towards ubiquitous observing, learning and computing.

A permanent call for e-laboratories and e-department is now the most important issue for CS-DC success stories.

The first CS-DC kickoff meeting at ICCSA'14 in Le Havre has sessions giving an insight on such e-departments with their e-laboratories. The second CS-DC kickoff meeting will take place at ECCS'14 in Lucca: it is still radically emphasizing this strategic line with a special call for e-departments and e-laboratories. The two kickoffs will use videoconference so that everyone in CS-DC can participate at distance.

A CS-DC international e-conference will be organized each year for appreciating our CS-DC success stories with respect to the Cooperation Programme with UNESCO. The track of the conference will be managed by the e-departments and its sessions by the e-laboratories. The international conference will also be a remote conference allowing the participation of every CS-DC member.

The kickoff organizational committee:

Paul Bourgine,
Cyrille Bertelle, Pierre Collet, Carlos Gershenson, Laura Hernandez, Jeffrey Johnson
Jorge Louça, Yasmin Merali, Carla Taramasco

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MONDAY June 23rd

Integrative science of education

Jeffrey Johnson: ***The educational challenge for the UNESCO UniTwin CS-DC: its scalability by Étoile Peer Marking***
(Open University, UK; *Étoile*, NESS & TOPDRIM European FP7 Projects)

Abstract:
The science of complex systems is transdisciplinary, horizontally cutting across the traditional silo domains of knowledge. These are studied vertically in great depth by specialists, who often know little of other disciplines. We need these specialists but we also need scientists who can work horizontally across disciplines, with enough knowledge to communicate with specialists in many fields (Figure 1). The problem we face as complex systems scientists is that almost all of us know almost nothing about almost everything. We have a massive educational challenge, not just for our students but for ourselves.

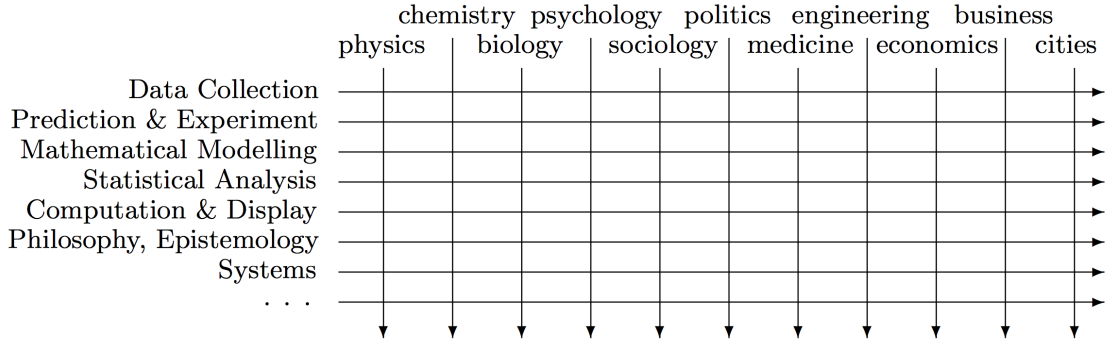

Figure 1. Complex systems science works horizontally across the individual scientific domains

Conventional education has the problem that it is very expensive and not very effective. It has been suggested that a major challenge in education is to make it an order of magnitude less expensive and an order of magnitude more effective. The European *Étoile* project is our first attempt to provide *scalable* education where the cost of educating each additional student is negligible, opening up the possibility of hundreds of thousands or even millions of students at no cost to the student. *In particular, this easy-to-use Peer Marking architecture provides scalable education that will make the system very attractive to members of the Complex Systems Digital Campus wanting to set up their own courses, or wanting their students to study other courses. We will provide support for those wanting to use the platform.*

José Aguilar: ***Proposal of an educational model for careers in the area of Computer Sciences***
(Universidad de Los Andes, Venezuela)

Abstract:
The CS-DC working group in Universidad de Los Andes (Venezuela) works on different Complex Systems domain. Our group tries to model complex systems and to study the emergent properties present in them. We use concepts from the multiagents systems (interactions, confidence, etc.) and the biology (homeostasis, self-organizing) to propose tools to study real complex systems.

Particularly, we have proposed an educational model for university courses in the area of computer science, based on conceptual aspects as active learning, learning objects, and learning by doing. The proposal presented is aimed at training professionals to respond to several issues, including: ICT needs of the country, the profiles defined by the IEEE/ACM, etc. To this end, this new career combines scientific, reflective and development of technologies activities. The research groups are one of its key pillars, because in them gravitate the activities of the career.

Particularly, under a scheme of knowledge management and technological development of products based on the paradigm of teaching "learning by doing". On the other hand, based on the fact that in the last decade more than 50% of all learning is disseminated electronically, is proposed to incorporate the strategies of distance education, computer-assisted, among others, as one of its pillars. Regarding the definition of career, it considers the needs of today's students, offering flexible, adaptable to emerging needs, based on a process of self-training in a curriculum graph (several possible formation paths to follow). Finally, the organization of the career is conceived to support all the above aspects, and to do that is proposed an organizational structure based on the metaphor of "clouds¨; specifically, the effect of clouds, thinking more about the density and internal dynamics, so that will be flexibly moving with the wind, meaning as wind the world, the industry, and the challenges facing the next higher education in our country. The proposed model is composed of three sub models: Curriculum Model, Teaching Model and the Evaluation Model. Additionally, it is composed of three clouds: the self-formation cloud, the learning object cloud and the cloud of educational paradigms.

Keywords: educational models, learning paradigms, learning by doing, blended learning

Chun-Yen Chang: ***NTNU research and teaching programme related to complex systems***
(NTNU, Taiwan)

Abstract:
National Taiwan Normal University (NTNU) provides a diversified learning and academic research environment integrating science, education, fine arts, and cultures to engage in knowledge innovation and holistic education. It consists of 10 colleges that include 59 departments and 54 graduate institutes. The teachers and educators prepared by NTNU has been the backbone force for the development of secondary school education in Taiwan. For

decades, NTNU has devoted to the research and development of educational policy and teaching practice. According to the recent World University Rankings conducted by the QS Intelligence Unit, NTNU is ranked one of the top 500 world's elite universities and ranked 42th in the education field.

Science education is a major field at NTNU with world's top level research capacity as over the past 10 years, Taiwan has been ranked 7th in number of publication in science education. Moreover, the Science Education Center (SEC) of NTNU has made remarkable contributions to the national development of science education and educational assessment, including: (a) hosting Trends in International Mathematics and Science Study (TIMMS) in Taiwan, in which Taiwan's achievement in science education was demonstrated internationally; (b) hosting International Science Olympiads (ISO) and training students to participate in Olympiads to educate future science elites; and (c) executing national standardized tests such as the high school entrance Basic Competence Test (BCTEST) and developing a unique system of testing and examination affairs.

As the director of SEC, Dr. Chang has lead numerous nationally funded projects, sponsored by the Taiwanese Ministry of Scence and Technology and the Ministry of Education, such as: building "The e-Learning Research Teams for Excellence", "The Center for excellence in e-Learning Sciences (CeeLS): i4 future learning environment" as well as the ongoing "Aim for the Top University Project" of establishing the "Center for Research Excellence in Science Education" (CRESE). With these nationally funded projects, Dr. Chang has established and incorporated several innovative Smart Classroom technologies into CloudClassRoom system to facilitate science teaching and learning. Another major research activity conducted by CRESE is the integration of multiple disciplines (Education, Cognitive psychology, Neuroscience, and Genetic or molecular biology studies), which is an interdisciplinary research framework. The ultimate goal is to integrate different research fields with aims of not only exploring the mechanism of learning and behavior, but more importantly, providing instructional approaches and learning strategies to best fit with students' aptitudes or characteristics based on the interactional effects of ECNG (Education, Cognition, Neuroscience, and Gene).

Klaus Jaffe: ***International Interdisciplinary Collaboratorium in Complex Systems (CSColl)***
(Universidad Simon Bolivar, Venezuela)

Abstract:
Only with interdisciplinary knowledge will we be able to tackle complex problems. This knowledge is beyond the realm of a single specialist or a single institution. This poses a challenge for educational programs aiming at forming a generation of researchers, better prepared to tackle complex problems. Computational aids to allow several researchers in different parts of the world to discuss, support, interview, teach, tutor, advice and interact with students of different countries and from different disciplines will certainly be required to successfully implement any improved advanced educational platform appropriate for complex system research. CSColl aims is to enable international communal tutoring of students by creating a virtual educational atmosphere analog to that found in advanced research groups where interactions among senior scientists, novel researchers, post doc´s, PHD students and undergraduate students favors the transmission and creation of

knowledge that fuels advanced scientific research. The first years of the Doctoral Program on Interdisciplinary Science shows examples of how interdisciplinary research and advanced education in complex systems is expanding our pool of knowledge. Three examples are presented: Insights into the interfaces of literature, arts and thermodynamics; finding the roots of the evolutionary dynamics of cooperation; and understanding Friedrich Hayeck's Economic Calculus and Adam Smith's Invisible Hand in Free Markets.

Keywords: evolution, networks, economy, sex, ants, sociodynamics, bioeconomy

Pierre Collet: ***POEM, Personalised Open Education for the Masses: using complex systems in MOOCs***

(UNISTRA, Campus Numérique des Systèmes Complexes de Strasbourg, France)

Abstract:
The objective of POEM is to develop Participative, Predictive, Preventive and Personalised (4P) education on complex systems by complex systems. Ant Colony Optimisation algorithms are used to extract optimal pedagogic paths from massive participation thanks to a man-hill system. The paths can then serve for predicting what are the best pedagogic items to be presented to a particular student but also to prevent failure. Finally, automatic evaluation schemes based on ELO notation allow to assess the level of both students and pedagogic items, allowing the system to make personalised suggestions as to what to do next.
Keywords: MOOC, pMOOC, Learning Management System, man-hill, POEM, 4P education

Integrative social science

Béatrice Galinon-Melenec: ***The "Human-Trace", a Substantial Societal Challenge***

(Le Havre University, France ; Human Trace-DC e-lab)

Abstract:
Having observed that the notion of trace is used in disciplines whose subjects and methods often stand far apart, the author has put forward some definitions from French anthroposemiotic research (signe-trace, signe-signal, "echoing of traces" etc.). The propositions result from her own findings in professional situations of communication. In this article, B. Galinon-Mélénec explains that confusing the sign and the trace is an anthropocentric view and that "if any sign is, in fact, a "signe-trace", a trace is not necessarily a sign". The latest scientific discoveries have led the author to propose a new anthropological definition spanning time: the *Human-Trace*. Revealed by both anthropology and astrophysics, traces of the distant past make it possible
to question the trace in terms of processes, interactions (human or nonhuman), systems and complexity. This paper serves as a basis for debate within the international and interdisciplinary e.laboratory "Human-Trace-Complex-Systems", with the aim of developing a collective intelligence of the notion of *Trace.* All disciplines are invited to respond to this

substantial societal challenge.

Keywords: *Human-Trace*, *Traces Processuelles*, *Signe-Trace*, *Signe-Signal*, *Construit de traces, Milieu, Habitus,* Embodied Traces, Relationship, Interpretation, Interactions, Process, Relation, Milieu, Environment, System, Complexity, Anthroposemiotics.

Flavia Mori Sarti: ***Opportunities to the consolidation of Complex Systems in Brazil: The Center for Interdisciplinary Research in Complex Systems and the Graduate Program in Complex Systems Modelling at University of Sao Paulo***
(USP, Brazil)

Abstract:
In Brazil, the research in Complex Systems has been a domain within the natural sciences until the last decade. The successful creation of graduate programs that deal with complexity modeling applied to environmental and social subjects in the last few years in Brazil indicates the existence of an interdisciplinary research field in Complex Systems that offers with high innovative potential to several areas of knowledge. Nowadays, there are five Brazilian graduate programs explicitly defined to be directed towards computational modeling of environmental and social problems, amidst 16 graduate programs that indicate "computational modeling" as research scope. Nevertheless, there is only one program that directly mentions the subject of Complex Systems in its denomination and offers the possibility to join both environmental and social modeling to computational modeling and physics, the Graduate Program in Complex Systems Modelling at University of Sao Paulo. In its core, the program proposes to apply tools from computation and physics for Complex Systems Modeling in economics, management, politics, biology, environmental sciences and theoretical physics, among other. During the last few years since its creation in 2010, there were 15 graduate students who presented Master thesis successfully, and other 11 graduate students are expected to present thesis in 2014, including various themes from analysis of social networks to agent based modeling applied to economics, environmental sustainability, and health systems management. In 2012, the program extended activities to the creation of the Center for Interdisciplinary Research in Complex Systems. The presentation includes the main achievements and research themes of the Complex Systems group from the University of Sao Paulo, in order to seek for potential research collaborations and partnerships.

Keywords: complex systems, social sciences modeling, environmental modeling, networks, agent based modeling.

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Tuesday June 24th

Integrative ecology

Salima Taïbi: ***Statistical approach for soil monitoring, risk assessment and soil characterization***
(ETSIPA, France)

Abstract:
Soil is a complex system and an essential resource for human society and ecosystems. Soil protection and preservation are crucial to continuing sustainable development of our societies. In this context, a French Program "Biondicators" has been set up to assess numerous indicators of soil quality.
The volume of data, and the large number of biological variables to be tested (one hundred) require analytical techniques, such as Random Forests, which can overcome the problem of multicollinearity, heterogeneity for the selection of indicators, sensitive to various factors.
Random Forests methodology is appropriate for the selection of the most discriminant variables in order to develop a predictive model. So, we searched for the best way to select them, by bringing together all the biological variables, representing the Microflora.
The strategy of Agri'Terr research team is to manage high numbers of experimental data in a database and to develop a data mining process from collected data during several years.
These research work need to develop decision support tools for multi-criteria evaluation of sustainable practices within the territories (agricultural practices, logistics, short supply chain, life cycle assessment).

Keywords: Random Forests, Discriminant Analysis, indicators, micoroflora, pollutants , index, agricultural practices.

Zahira Souidi: ***Sustainable forest management and remote sensing***
(University Mascara, Algeria)

Abstract:
"Sustainable forest management and remote sensing" is a thinking for the sustainable forest management of any region or country that need a clear status of the resource base. The forest is a complex ecosystem and effective management of forest resources, both public and private, requires reliable and timely information about their status and trends. Yet, the efforts monitoring existing are failing to meet increasingly complex and large-scale forest management needs. New technologies may be able to satisfy the nation's forest information needs. An important development over the past quarter-century has been the deployment of Earth observing satellites and rapid improvements in computing power and algorithms to interpret space-based imagery. Remote sensing along with GIS and direct field measurements have shown the potential to facilitate the mapping, monitoring, and modeling of the forest resources.

Now that these technologies have been available for a significant period of time, how have they been integrated into forest monitoring practice and, importantly, exploited by decision makers?
Together with these questions, we bring part our contribution to i) show the different application of remote sensing in forest ii) formally specify protocols from the forest observation for spatial data analysis and interpretation, ii) annotate and comment different software available for spatial data treatment, iii) define, obtain and validate data observation, iv) contribute to mapping, monitoring, and modeling of the forest resources.

Masa Funabashi: ***Research and Education Program of CS-DC e-laboratory "Open System Exploration for Ecosystems Leveraging"***
(Sony CSL, Japan)

Abstract:
One of the most important global agenda the world is facing today is the sustainability of social and ecological systems.
The global source of environmental load lies in agriculture, and the majority of the world food production is owned by smallholders making up 1/3 of the world population.
Promotion of small-scale distributed farming system is considered as a crucial international incentive for sustainable agriculture, addressing environmental problem, health issue, escape from famine and poverty, still prevailing in the majority of the world.
The enhancement of smallholders practice, promotion of biodiversity and vitalization of sane local economy is the matter of total optimization of social-ecological complex systems.
This objective clearly calls for a bottom-up citizen movement gathering multiple stakeholders, as well as the design of self-organization and multi-scale optimization with strong support of complex systems science and affordable technologies.
Our e-laboratory aims to provide a prototype of such boundary institution, which basically create and provide information related to sustainable primary industry, and function as a hub to connect citizen and scientific communities towards the realization of open-source, distributed food production systems and the augmentation of other ecological capital.
6 initial field laboratories ranging over 3 countries and institutions will be presented in this kick-off meeting, as well as the primary list of our research and education program.
Keywords: Food production, sustainability, agriculture, ecology, citizen science, One Health, nutrition,metabolome,taste,food quality & safety, big data, statistical analysis, machine learning, Open systems modeling, Model fusion, Agent-based simulation

Multi-level Modelling of Complex Systems

Jörg Lehnert: ***Mathematics in the sciences***
(MPI-MiS, Germany)

Abstract:
The mission statement of the MPI for Mathematics in the Sciences reads as follows: “Our aim is not only to apply existing mathematical methods and techniques to the sciences but also to transmit the conceptual and structural approach of mathematics into new areas of research and, vice versa, to translate scientific questions and problems into mathematical challenges.” Obviously, Complex Systems are a big part of this game.
At the MPI we study a broad variety of mathematical aspects of complex systems science including multilevel systems, complexity measures, information theory, information geometry, complex time-delay-systems, computational neuroscience, machine learning, and autonomous learning. We will give a short insight into the driving questions for our research program.
Also, MPI jointly with the University of Leipzig runs a graduate school, the IMPRS Mathematics in the Sciences. At this school several lectures about mathematical tools important for complex systems sciences are offered, some of them are online available. We will also give a short introduction about the IMPRS.

Keywords:
- Education program: Graduate courses, mathematical aspects of complex systems, video-recorded, online available, dynamical systems, probability theory, discrete structures
- Research program: Mathematical Foundations of Complex Systems, Mulitlevel Systems, Complexity Measures, Information Theory, Complex Time-Delay Systems, Computational Neuroscience, machine learning

Hector Zenil: ***The Online Algorithmic Complexity Calculator (OACC): From Sequence Complexity to Graph Complexity***
(Algorithmic Nature Group, LABORES, France/UK/Spain/Sweden)

Abstract:
The Online Algorithmic Complexity Calculator (OACC) is an on-going long-term project of the Algorithmic Nature Group to develop an online tool implementing semi-computable measures of complexity through various numerical methods and algorithms for potential applications in a very wide range of disciplines, from bioinformatics to psychometrics, from linguistics to economics.
It currently retrieves numerical approximations (upper bounds) of Kolmogorv complexity for binary strings of short length by means of algorithmic probability (notably by using the algorithmic Coding theorem relating frequency and complexity), for string length which lossless compression algorithms fail to deal with, hence providing an alternative/complementary method to compression algorithms (in the future the calculator will smoothly make the transition between the algorithmic probability and the lossless compression methods using a technique that the group has developed called the Block Decomposition Method.
More algorithmic information measures, more data and more techniques will be incorporated gradually in the future, covering a wider range of objects such as longer binary strings, non-binary strings and n-dimensional objects, such as images and networks.

Additional material can be found at the Algorithmic Nature Group website at http://www.algorithmicnature.org. An Online Algorithmic Complexity Calculator implementing this technique and making the data available to the research community is accessible at http://www.complexitycalculator.com.

Keywords:
Kolmogorov complexity, Solomonoff Algorithmic Probability, alternative to lossless compression.

Oscar Cordon: ***«University of Granada interdisciplinary Education Program on Complex Systems»***
(University Granada, Spain)

Abstract:
The training programme on Complex Systems offered by the University of Granada to the CS-DC is not viewed as a single, integrated programme but as an interdisciplinary combination of different subjects at different levels (degree and master courses). The backbone is composed of two semester courses entitled "*Redes y Sistemas Complejos*", taught in the fourth course of the Computer Science degree, and "*Física de Sistemas Complejos*", taught in the fourth course of the Physics degree, which provide a complete introduction to the area.
The remaining courses are considered as specialization courses, taught in different degrees and masters, in both specific and complementary topics such as scientific networks, biological networks, information visualization, agent-based modelling, evolutionary computation and metaheuristics, and neural networks.
The programme also includes several tutorials and open source resources as well as a biannual international seminar. Overall, it is participated by lecturers and researchers from three different Faculties (Computer Sciences, Sciences, and Librarianship and Information Sciences), thus resulting in a high level of interdisciplinarity in both the lecturers' expertise, the taught concepts and the research problems tackled.

Keywords:
complex systems and networks, complexity, chaos theory, social networks, scientific networks, information visualization, biological networks, agent-based modelling, evolutionary computation and metaheuristics, and neural networks.

Territorial intelligence

Sylvie Occelli and Magda Fontana: ***E-Lab for Situated Collective Intelligence***
(IRES, Research Centre on Behavioural, Complexity and Experimental Economics at the University of Turin)

Abstract:
Over the last decade a number of Piedmont institutions have been progressively involved in ICT large scale applications and complexity oriented studies. Several experiences have been carried out and ICT based expertise accumulated which link scientific, policy and lay knowledge.
Taking advantage of these activities the E-Lab for Situated Collective Intelligence has been launched as part of an e-community of The Complex Systems Digital Campus (CS-DS). Within the roadmap of the CS-DC, the main focus of the E-Lab for Situated Collective Intelligence is the enhancement of a system capability to devise projective actions in order to shape more socially, environmentally, economic and institutionally viable developmental paths(http://unitwin-cs.org).
The e-Lab is geared towards supporting policy processes. As for IRES, it has absorbed the LabSIMQ activities which have been carried out in the Institute since the late nineties.
The e-Lab main objectives are three-fold, Fig.1:
a. developing an approach meant to yield the knowledge of what is desirable for a certain community, thus making modelling activity a main source of innovation in organizing the whole policy process (e.g., among other issues, better alignment between governmental departments, raising ICT education levels among civil servants, developing model-based service portfolios);
b. making the modelling tools alive in real policy context, thus providing an environment where these tools can be learnt and tested, thus involving the policy recipients as well;
c. building the socio-technical system for leveraging valued knowledge to support urban and regional policies in situated contexts.

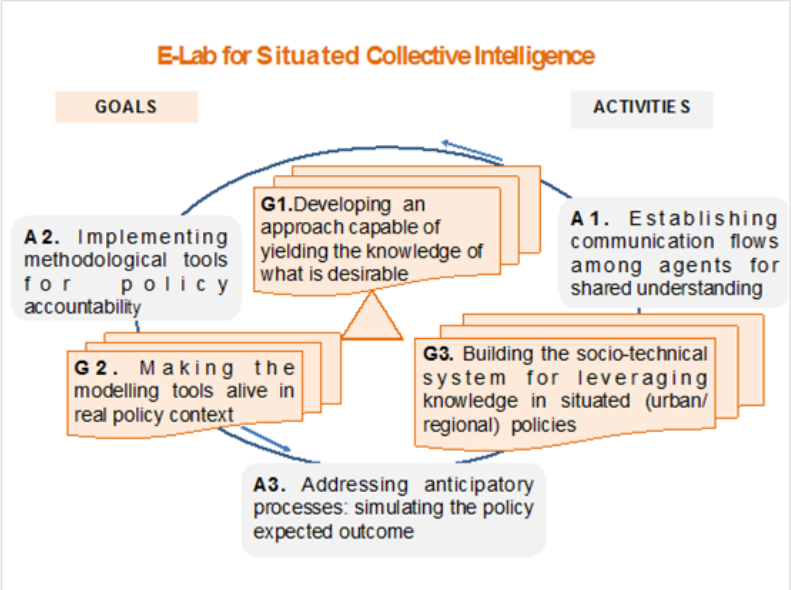

Figure 1. Main goals and activities of the e-Lab

The e-Lab includes research centres, university departments and consortia of international relevance, displaying a relatively wide set of competences, dealing with ICT infrastructures and tools, large scale data management, computer science and social systems (http://www.elabpiemonte.org).

CPM - Centre for Policy Modelling, Manchester Metropolitan University

CSI-Piemonte - Piedmont Consortium for Information System

CSP - Innovazione nelle ICT - Centre for Excellence for ICT Research and Development;IRES Piemonte - Socio Economic Research Institute of Piedmont

ISI Foundation - Institute for Scientific Interchange Foundation

TOP-IX - Torino Piemonte Internet Exchange

UNITO-Be.Compl.Ex@Unito - Research Centre on Behavioural, Complexity and Experimental Economics at the University of Turin.

The activities of these institutions cover facets of human organizations which have an increasingly important role in the upgrading of existing socio-technical systems and/or in the establishment of new ones. Enhancing their collaboration in an e-Laboratory, therefore, will contribute significantly to the innovation of the Piedmont regional system, while reinforcing the links with the international community. For the larger CS-DC community, the Piedmont e-Laboratory can represent an in-vivo open platform for testing ICT and complexity based applications in situated contexts.

The presentation will focus on two main topics:

a) the activities of e-Lab since its establishment by Sylvie Occelli;

b) the presentation of the education program on Behavioural, Complexity and Experimental Economics at the University of Turin by Magda Fontana.

Céline Rozenblat: ***Master Geographical Modelling - MGM***
(Lausanne Univ., Switzerland http://www.unil.ch/mastergeographie/page95141.html)

Abstract:
It is organized by 9 Universities from 5 countries and supported by Erasmus (Intensive Program - IP until now and we hope Erasmus + next year, we are waiting the agreement). It was coordinated by the Lausanne University for the two first years, but it was not possible for next year because of the Swiss rejection from the Erasmus programs as coordinators: then the University of Besançon now coordinates it for next year and we remain partners. This program consists in 2 weeks of training in the same place for students and professors from the 9 universities. The program is a common module integrated in the of the respective masters of the different universities. There's a moodle platform managing material and exercises. But we would like to extent the tools supporting this program,

Thierry Saint-Gérand: ***Road Risk/Road Safety duality, a territorial complex system issue***
(Remgarev-DC e-lab)

Abstract:
Here is an example of REMGAREV-DC work groups field of research and action (Europe, Maghreb, MENA). This paper highlights some CS aspects of a challenge focusing one of the main world wide public health problematics: road mortality (1 200 000 deaths in the world per year). Road Risk/Road Safety problematics, when considered from a dynamic and societal point of view, reveals typical features of complex systems. Thus, it happens from a huge set of permanently evolutive interactions between factors and actors (users, stakeholders) involved in various domains (land use, networks, urban functionalities, road environments, culture, technologies, social categories, public politics….). It works like a multiple real world-space-time scales melting pot: from functional urban area until the most accurate zebra-crossing, from long time land planning until immediate event's process, all in a set of spatial ergonomic constraints. This REMGAREV-DC work group aims to involve and integrate in a cooperative and sharing spirit, the largest panel of scientists and field actors of this problematic, contributing to generate a renewed and operational thinking way upon this hard issue.

Keywords: Road Risk and Road Safety, spatial complex system, interactions loops, GIS

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Wednesday June 25th

Integrative governance of complex systems

Pierre Parrend: ***Complex systems for industry***
(ECAM Strasbourg Europe, France)

The research program of ECAM Strasbourg-Europe in the domain of complex systems targets following issues:

- *Modelling human organization as complex systems:* Human organizations, in particular enterprises, are more and more considered as holistic emergent systems. Based on empirical observations, concepts from complex systems are extracted to characterize the organization, and formal models are defined. The dynamics of emergence, as well as solutions for capitalization of experiences, are elicited. Study object in this context are the organization itself, and the behaviour of projects.
- *Optimisation through evolutionary algorithms for industrial problems:* Evolutionary algorithms enable to search for global optima in complex functions. Recent advances on 'Industry of the future' issues underline the need for on-the-fly management of complex problems such as pattern recognition in images or the design of logistics flow for mass-market, small series products, on the one side, and advanced simulation for the design of complex systems such as magneto-thermic refrigeration systems, on the other side. The objective in the domain of production lines is to be able to design reactive, product-driven platforms. The objective in the domain of system design is to explore radical system improvement through simulation, whereas current processes are heavily relying on trial and error prototype development.
- *Security risk and anomaly identification through cognitive solutions:* The IT infrastructures of industries are become ever more connected: not only organisations know a dramatic increase in interconnections with third parties (Cloud providers, partner organizations), but they also increasingly bind the heart of their productive systems to the network for remote monitoring and maintenance. This matter of fact introduces high stakes for the cyber-defence of these organizations on two complementary aspects: the management of security risks in complex infrastructures, and the detection of ongoing security threats in these infrastructures. Risk involves a complex system analysis at the level of the organization both for infrastructure as well as for web applications such a specialized medical social networks. Threat detection involves applying the complex systems algorithms such as meta-heuristics or evolutionary algorithms to the analysis of huge amount of system logs from heterogeneous systems.

Keywords: industry, evolutionary algorithms, risk management, security, simulation, multi-physical systems, organisation management

Zhangang Han: ***Systems Science @ BNU***
(Beijing Normal University, China)

Charles S. Tapiero: ***The extreme risk initiative***
(NYU, USA)

Abstract: Extreme risks are distinguished by their impact and the severity of its consequences. These risks may be environmental, industrial, physical, social, financial/economic or arising from complex interactions across domains. These tend to be silent and not easily revealed in past data, which makes their detection elusive. Unlike common and recurrent risks, they may be difficult to assess using the standard models and conventional evidentiary approaches: they belong to a class on their own.
The "Extreme Risks Initiative", ERI, is an NYU-School of Engineering interdisciplinary open research agenda, based on axes defined by its members and global research collaborations. The approaches are both technical and practical, aiming at broad distribution across interdisciplinary lines including financial-economic, urban systems, transportation-networks, bio-systems, as well as global and environmental problems. A selected series of research axes as well as publications drawing on the Initiative's members are included in this statement.
In addition to research, the Extreme Risk initiative will also pursue an educational agenda, through lecture series, workshops and a publication program in the Initiative Working Papers, Journals (such as Risk and Decision Analysis), and other means to inform and contribute to a greater understanding and appreciation of Extreme Risks, their complexity and characteristics and how to confront and recover from their consequences.

Pierre Collet: ***E-lab on Complex Computational Ecosystems (ECCE)***
(UNISTRA, Campus Numérique des Systèmes Complexes de Strasbourg, France)

Abstract:
The objective of the CS-DC UNESCO UniTwin is to create a North-South-South and East-West network of scientists from all disciplines and institutions for embodying socially intelligent strategies in research and education on complex systems science. Within the new science of Complex Systems, the objective of ECCE is to study and develop computational ecosystems made of many possibly heterogeneous machines, possibly running heterogeneous pieces of software in order to solve a single problem that could be either related to complex systems (reconstruction of multi-scale dynamics, simulation of a complex system, ...) or not. The e-laboratory will organize the creation, sharing and integration of all resources for these strategies. The sharing of necessary resources will be done in the closest possible way with the other institutions having the same sharing goal.

Because some large complex systems will require the combined power of several computers, one of the more advanced challenges of ECCE will be to put together computing ecosystems consisting of heterogeneous computers possibly executing different pieces of software, all working in a cooperative way towards the single aim of modelling a particular complex system. Because a set of different autonomous interconnected machines can itself be considered as a complex system, the ultimate aim of ECCE is to create Computational Ecosystems working together as a autonomic and efficient Complex System. All in all, the challenge for ECCE is to designing efficient large scale computing ecosystems as complex systems that could also be used reflexively to solve complex systems. For this to happen, many different elements need to be put together, involving data storage, communication, parallelization, security and robustness of both data and software, results visualisation, etc. All these elements can be the object of research projects of ECCE.

Keywords: Computational ecosystems, distributed computing, massive parallelism, exascale computing

NOTES

Thursday June 26th

Integrative Biology

Karol Mikula: ***Mathematical methods for multiscale 3D+t imaging in integrative biology***
(STUBA, Slovakia)

Andres Santos: ***Computational methods for multiscale 3D+t imaging in integrative biology***
(Universidad Politecnica Madrid, Spain)

Abstract:
The understanding of the processes underlying embryo development from a single cell into a multicellular organism is a long-term goal of Developmental Biology that is recently being feasible thanks to the availability of massive 3D+t complex multiscale data acquired with new microscopy technologies. But these large quantities of data require automated or semiautomated image processing methods to be possible. Current developments and challenges in biological image processing include algorithms for microscopy multiview fusion, cell nucleus tracking for lineage reconstruction, cell segmentation, multidimensional image registration and gene expression atlases. These tools are to eventually produce in toto reconstruction of the embryo development combining the cell lineage tree with quantitative gene expression data in its spatio-temporal context.
In this work several processing tools developed by our group will be presented. A wavelet multiview image fusion for Light-Sheet Fluorescence Microscopy is able to combine information from all available views into a single volume with improved overall contrast. Cell lineage reconstruction workflow for early stages of embryo development has been possible thanks to advanced microscopy and dedicated tracking and segmentation tools. Finally on-going work on the construction of a gene expression atlas of early embryogenesis is based on image registration algorithms to combine information from different individuals.

Keywords: Multi-scale 3D+t image processing, cell lineage reconstruction, gene expression atlas, 3D+t data analysis

Nadine Peyriéras: ***The Embryome challenge***
(Embryome-DC e-lab)

Abstract:
The embryome is defined as the embryonic physiome, i.e. the multi-scale dynamics of the organism from the egg cell through its embryogenesis and organogenesis, with reference to the Physiome as define by Jim Bassingthwaighte. The concept of physiome encompasses the goals of a novel integrative and predictive biology. It seems the most appropriate to characterize the paradigm underlying the objectives of a growing interdisciplinary community gathering biologists, physicists, chemists, mathematicians and computer

scientists, tackling the understanding of biological processes through their phenomenological and theoretical reconstruction from their in vivo observation. This general framework requires designing and implementing technologies, methodologies and tools for acquiring 3D+time data at all levels of living systems and extracting the relevant quantitative information further used in multi-scale analyses. This path is expected to provide in depth understanding of living systems and of their underlying processes unattained so far. We indeed are still far from understanding the basis for living systems morphogenesis, autopoiesis, ageing, homeostasis and resilience. These systemic properties cannot be understood through the mere observation and measurement of local markers and indicators. They must at some point be tackled at the level of the whole systems multi-scale dynamics. Understanding organisms' systemic properties is a necessary condition for sustainable progress in health sciences through improved diagnosis and personalized therapies towards personalized health.

Keywords: Physiome, multi-scale 3D+t imaging in vivo, multi-level phenomenological reconstruction, multi-level theoretical reconstruction, 3D+t scientific visualization, digital embryo

Integrative cognitive science

Jean-Marc Meunier: ***Creativity as a way to understand complexity: from Arts to Science***
(University Paris 8, France)

Abstract:
Complex systems are difficult to understand for human cognition because they involve a set of phenomena that are impossible to study in isolation and involve forms of thinking that are often far from those used in everyday life. Their study and teaching require a change of perspective and the development of new forms of mediation.
"To understand is to invent and to explain stop to understand if it stop to search". (J. Piaget, 1948). This citation exemplifies the link between creation, understanding and education that must be conceived as a release capacity thinking about the world.
Both Arts and Social Sciences, for research, education and innovation, are the challenge that University Paris 8 try to raise in particular two major projects: Labex Arts H2H (http://www.labex-arts-h2h.fr/) and Idefi CREATIC (http://idefi-creatic.net) Both projects may irrigate practices research and education in complex systems digital campus

References:
Piaget, J. (1948). Où va l'education? (Structural Foundation for Tomorrow's Education. First published in "Prospects," quarterly review of education (Unesco) 1948, 1972, found on web at : http://unesdoc.unesco.org/images/0000/000061/006133eo.pdf

Keywords: Arts, creativity, Complexity in Humanities, Digital and Cognitive Technologies, Capturing, modelling and producing Humanities

Annamaria Lammel & Jean-Marc Meunier: ***Interaction between climate and human systems: how to teach about it?***
(Paris 8 University)

Abstract:
Climate is a complex system involving many parameters and phenomena that occurs often on longer time scale than can directly perceive the human being. Human societies are also complex systems where the actions of individuals interacting environment. For the first time in the history of mankind, human activities alter irreversibly the climate and the gap between the knowledge of the scientific community and civil society are growing more and more. Our work has highlighted the limited capacities of human cognition to understand these systemic events mainly because of limited experiences, social and emotional factors and a propensity in some cultures to favor analytical thinking rather than holistic thinking.
The project we present today is to develop structured knowledge through networking of scientists and citizens acquire, develop cognitive mediations including through virtual experiences and creativity to enable the symbolic, artistic and emotional processes and thereby develop modes of systemic thinking necessary for the understanding of climate phenomena and changes they undergo.

Charles Tijus & Reza Ebrahimi: ***Presentation of the proposal for a new e-Laboratory on Cognition Science for the UNESCO UniTwin Complex Systems Digital Campus***
(Paris 8 University, Universcience)

Abstract:
The e-Laboratory on Cognition Science for the UNESCO UniTwin Complex Systems Digital Campus is in line with the international research and research & development of cognitive computing and of cognitive technologies that are technologies that model humans in order to process data collected from humans.

The e-Lab international cooperation groups a number of partners (*China with Taiwan, France, Spain, South Korea, Switzerland, United Kingdom, Vietnam ...*) and the scientific and technological projects are based on the longstanding experience of partners in modelling ongoing behaviour (*body, hands, eyes*), understanding processes through knowledge activation (*semantic text mining algorithms*) and decision-making for acting, tasking and problem solving.

This cooperative research is also to apply cognitive computing of user's behaviour in the context of open data for launching innovative and ambitious Programs. The cognitive computing systems we intend to develop are based on induction of user's goals and on the computation of possible alternative goals according to the context delivered by both, knowledge (*Big data crawling and text mining on unstructured content*), real-time context and open data. Systems outputs are hypothesis generations, suggestions of alternative subgoaling for an improvement of human-artificial interactions and open dialogs.

The generic Cognitive methods will be used to develop methods for assessing user's behaviours and providing personalized interactions in real time, enhancing Next-Best-Action scenarios. Semantic, behavioural analysis and categorization algorithms for unstructured content and Smart push-based inference techniques will be used for Deep Learning methods and for hypothesis generation algorithms, for instance for developing Virtual Assistant applications. Furthermore, innovative tracking techniques (*eyes, hands, body…*) will be used to enhance visual and multimedia analytics capabilities to evaluate user's behaviours for use cases such as Self-Directed Learning, e-Learning and MOOC assessments.

Integrative Social Science

Maria-Eunice Gonzales: ***Complexity, ecological information and social affordances: a study of contemporary Ethical problems***
(UNESP, UFABC, Brazil ; Social self-organization e-lab)

Maria Eunice Q. Gonzalez (UNESP - Brazil), Mariana Claudia Broens (UNESP - Brazil), Guiou Kobayashi (UFABC - Brazil), Vivian Urquidi (USP - Brazil), José Artur Quilici-Gonzalez (UFABC - Brazil), Alexander Gerner (Universidade de Lisboa – Portugal) [Social Self-Organization E-Lab]: « Complexity, ubiquitous computing, and ecological information: a study of contemporary ethical problems »

Abstract:
In this E-Lab, we investigate, from the complex systems perspective, possible ethical consequences of the uses of ubiquitous computing in everyday life, involving social and technological *affordances*. Specifically, the dynamics of *social organization* is studied, with emphasis on the *process of social identity and integration of cultural diversity*. The main question that interests us is: How can cultural identity be analyzed in light of the increasing presence of information technologies in individuals' daily lives? This problem arises from the fact that the relation between individuals and globalized information is generating new possibilities of action that could affect the delimitation and preservation of cultural diversity. Our attempt to analyze this problem is grounded upon the concepts of **complex systems, self-organization,** and **social** and **technological *affordances*.** *Social affordances* can be understood as dispositional collective properties of organism-environment

interactions, which indicate possibilities of social action. These properties include transformational invariants of social actions that allow social perception of the organism's dynamics during activities such as nurturing, friendship, and response to threats (Gibson, 1986; McArthur & Baron, 1983). In the case of human social *affordances*, in addition to basic manifestations of emotion such as fear, happiness, surprise, anger, and dignity, there are culture-specific patterns of interactions. *Technological affordances,* in turn, can be defined as functional, second order, emergent informational properties of human organization, mediated by computer and communication systems. These properties offer opportunities for activities such as browsing and social / individual remote communication and interaction.

We believe that the concepts of social and technological *affordances* may help us to understand the notion of social identity that encompasses fundamental aspects of human culture while preserving its diversity and autonomy. The complex systems perspective provides an appropriate method for the investigation of inter-transdisciplinary reflections on problems that arise in the contemporary scenario of digital technologies. Emphasis is given to Weaver's (1948/2004, p. 539) method of analysis that takes into consideration a great number of variables, but focuses on the *qualitative* ways that these variables can be *self-organized.* Problems such as "Why is one chemical substance a poison when another, whose molecules have just the same atoms but assembled into a mirror-image pattern, is completely harmless?" illustrate an important concept that Weaver calls *organized complexity*. According to him, problems of organized complexity can be found in "the biological, medical, psychological, economic, and political sciences", amongst others.

In synthesis, the main objective of the E-Lab is to analyze ethical questions concerning possible positive and negative impacts of ubiquitous computing upon self-organized social identity and the sustainment of cultural diversity.

On the negative side, we discuss: (1) possible ethical consequences of the use of ubiquitous computing in everyday life, involving *affordances* for trust, surveillance, and spontaneity; (2) aspects of authoritarian self-organized behavior using ubiquitous computing at multi-scale levels of control.

On the positive side, we investigate: (1) the informational possibilities of communication among people that allows identification of the diversity of knowledge of cultures, reconsidering this diversity from the perspective of *Ecology of Knowledge* (B. de Sousa Santos, 2007), according to which all knowledge and all cultures are incomplete; (2) a complex systems approach to individual and collective habits, with emphasis on relational aspects of alterity: a multicultural perspective.

Keywords: Ubiquitous computing, technological and social *affordances*, problems of organized complexity, cultural incompleteness.

Annex 1: Preamble of the Charter of the Complex Systems Digital Campus (CS-DC)

Preamble

The Complex Systems Digital Campus is an international network of individuals and institutions working together and sharing resources to promote research and education in complex systems science and its applications. This large scale collaborative work will embody social intelligent strategies towards new scientific and educational practices, dealing with the difficult societal and environmental challenges of an increasingly interconnected world.

The new science of complex systems will be at the heart of the future of the Worldwide Knowledge Society. It is providing radical new ways of understanding the physical, biological, ecological, and techno-social universe. Complex Systems are open, value-laden multi-level multi-component reconfigurable systems of systems, situated in turbulent, unstable, and changing environments. They evolve, adapt and transform through internal and external dynamic interactions. They are the source of very difficult scientific challenges for observing, understanding, reconstructing and predicting their multi-scale dynamics. The challenges posed by the multi-scale modelling of both natural and artificial adaptive complex systems can only be met with radically new collective strategies for research and teaching.

Complex systems science bridges the gap between the individual and the collective: from genes to organisms to ecosystems, from atoms to materials to products, from digital media to the Internet, from citizens to society. It cuts across all disciplines. It enables new and shorter paths between scientists and integrates the flow of scientific knowledge. It reduces the gap between pure and applied science, establishing new foundations for the design, control and management of systems with unprecedented levels of complexity, which exceed the capacity of current approaches. It will benefit the environment and industry, the health and education sector and all public and social actors. Understanding complex systems will be the basis of *worldwide wealth and socio-economic wellbeing* in the 21st century.

The *Complex Systems Digital Campus* will federate the Research and Education Institutions all around the world wishing to deal with the challenges of complex systems science. It will coordinate an evolving social network involved in identifying the scientific challenges through living complex systems roadmaps, and facilitate sharing all the research and educative resources for overcoming them. The Digital Campus will be structured through interdisciplinary education and research e-departments, each federating the e-laboratories of a roadmap chapter. Each interdisciplinary education and research e-laboratory is federating the e-community addressing each chapter challenge. The Digital Campus will contribute to develop open science by involving citizens with their sensing, computing and thinking resources towards ubiquitous observing, learning and computing.

Environmental, societal, technical and economic benefits stem from complex systems engineering. These benefits come from predictive, adaptive and robust integrated models that allow us to live with and protect the complex systems within and around us. The most noteworthy results will be improved understanding of complex systems, increasingly personalized health and education, the prevention of, and resilience to epidemics and more generally, extreme events. Reducing uncertainty regarding the impact of our actions on complex systems will lead to a transformation in the relationship between science and society, engineering, economics, politics and ethics.

Annex 2: Articles I and II of the Cooperation Programme between UNESCO and CS-DC

AGREEMENT BETWEEN

THE UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION

AND

THE NETWORK "COMPLEX SYSTEMS DIGITAL CAMPUS"

CONCERNING THE ESTABLISHMENT OF A UNITWIN COOPERATION PROGRAMME

Article I Purpose

UNESCO and the Network will create a Cooperation Programme in complex systems science and engineering (hereinafter referred to as "the Cooperation Programme") in the framework of UNESCO's UNITWIN Programme.

Article II Main objectives

The main objectives of this Cooperation Programme are to:

- promote an integrated system of research, education and training, information and documentation in the domain of the science and engineering of complex systems,
- contribute to the aims of global development by taking into account its social, economic and cultural dimensions and to this end, make the science and engineering of complex systems accessible to all, in order to get the relations between science, engineering, politics and ethics to evolve towards a sustainable development,
- contribute to a research and education of the highest quality in the domain of the science of complex systems,
- promote the development of integrated knowledge and integrated models of complex systens in order to bridge the gap between science and engineering,
- promote a lifelong personalised education for all in the science of complex systems as well as in integrative and predictive sciences — including the integrative and predictive science of personalised education for all — at all levels,
- contribute to an education and training in citizen cyber-science, open to all, independently of previously achieved academic levels, respectful of the diversity of social and cultural environments, genders, religions or ways of life.

In order to achieve these objectives, the object of the current agreement is to:

- launch a Complex Systems Digital Campus as a social intelligent ICT system in order to federate all resources and efforts on education, research and the applications of the science of complex systems,

- launch the CS-DC roadmap at all scales in order to identify the scientific, educational and societal challenges of CS-DC with its cloud-based computational ecosystem and educational ecosystem,

- launch the scientific cloud-based computational ecosystem of the CS-DC in order to construct complex systems of societal impact, by sharing partial multi-level models as well as software platforms and e-infrastructures of all kinds,

- launch the educational ecosystem of the CS-DC in order to construct a map of integrated knowledge, with the aim of creating and adapting educational contents as well as to develop a lifelong personalised education on complex systems.

Annex 3: Call for new CS-DC e-Laboratories and e-Departments (deadline July 18th 2014)

//Please redistribute to anyone who might be interested

UNESCO UniTwin Complex Systems Digital Campus: Science, Policy, and Applications

CS-DC Kickoff Meeting at ECCS'14 - September 25th, 2014
http://unitwin-cs.org/meeting_at_eccs14.html

Call for new CS-DC e-Laboratories and e-Departments
to be presented during the Lucca kickoff meeting

Deadline: July 18th, 2014.

The UNESCO UniTwin Complex Systems Digital Campus (http://unitwin-cs.org/) will organize a second kickoff as a Satellite Meeting of the European Conference on Complex Systems (ECCS'14 http://www.eccs14.eu/) that take place in Lucca, from Sept. 22nd to 26th 2014. This satellite meeting will bring together members of the CS-DC, from all over the world, to review progress and assess challenges related to the coordination and sharing of research and educational resources among more than a hundred universities and institutions worldwide. The sessions will combine physical and remote presentations to include members attending ECCS in Lucca and those unable to do so.

The meeting calls for proposals of new CS-DC e-laboratories and e-departments.

For a new e-laboratory: the proposals should include a description of the main e-laboratory challenge (an existing one in the roadmaps or a new one), the list of scientific teams involved (at least two countries or five teams), the list of scientists having accepted to be member of its Scientific Council, a mention to some of its specific projects, and what will be shared like data, software and computer resources.

For a new e-department: the proposal should include the list of existing and embryonic e-laboratories, the list of scientists having accepted to be member of its Scientific Council and at the global level of the e-department, a mention to some of its specific larger scale projects and sharing of multi-scale data, software and computer resources. For embryonic e-labs contained within the e-department, they have to sketch a preliminary proposal, as for new e-laboratories.

All proposals will of course remain confidential.

The CS-DC Board and the Satellite Workshop Committee will examine all proposals. Reserves will be transmitted to proposers, including the invitation to resubmit as quickly as possible when the reserves are solved.

The satellite meeting will first organize sessions for the accepted e-departments with their associated e-laboratories (accepted or expected). The last session will be devoted to the newly accepted e-laboratories that do not yet have a corresponding e-department. The representatives of accepted e-departments and e-laboratories will prepare an oral presentation about their proposals, even if they cannot attend ECCS'14. The oral contributions and debate will use a videoconference system for distant communication. At least, the remote communication might take the form of a video that will be projected in the Satellite Workshop.

Proposals should be submitted using the CS-DC template for respectively e-laboratories and e-departments (http://unitwin.csregistry.org) by July 18th 2014. The templates are available on the Permanent Call for new CS-DC Entities page of the Complex Systems Digital Campus wikiversity portal:

https://en.wikiversity.org/wiki/Portal:Complex_Systems_Digital_Campus

Please send proposals by e-mail to Laura Hernandez <laura.hernandez@u-cergy.fr>

Hope to see you in Lucca, including in remote way,
CS-DC@ECCS14 Committee