FET
through the keyhole

Future and Emerging Technologies in Europe
January 2012

"If everything seems under control, you're just not going fast enough"
Mario Andretti, 1978 Formula One World Champion, now retired.

In this issue

Welcome

In 2011, FET focused on strengthening and extending its unique position within European research, as a collaborative research programme targeting technological breakthroughs grounded in science.

In addition to its well known Open and Proactive modalities, FET continued to develop and strengthen its newer activities in the areas of FET-Flagships, Young Explorers and High-Tech Research Intensive SMEs.

Towards the end of 2011, FET was rewarded for its efforts by being proposed an exciting new home and strengthened budget under the Science Pillar of the new Horizon 2020 research programme.

FET would not be what it is today without the dedication and efforts of the many hundreds of scientists and researchers who rely on FET support to research some of the big ideas of tomorrow. As we start this New Year 2012, let's take a moment to celebrate all the great ideas and great people that continue to make FET what it is - a unique and valuable asset for Europe.

Happy New Year!

The FET Team

Towards Horizon 2020

On 30 November 2011, the Commission formally adopted its proposal for Horizon 2020, the follow-up of FP7. The proposal itself tells quite a lot about what the next framework programme for research and innovation will look like – although of course we will have to wait to see what the European Parliament and Council have to say about this. But what was put forward is definitely a good starting point. In 2010, FET organised a successful exhibition at the European Parliament in Strasbourg. The feedback of the parliamentarians at the time was very positive, so now let's see how the story continues.

The Commission's proposal signals a series of new opportunities for FET. First of all it provides FET with a brand new home. Everything that happens in the ICT (and other thematic) programmes today will be distributed over three pillars in Horizon2020 - Excellent Science, Industrial Leadership and Societal Challenges. FET will be in the Excellent Science pillar, together with the European Research Council, Marie Curie and Research Infrastructures. That's great news as this positioning will allow FET to continue to fund science-driven research focusing on new technologies, and the Excellent Science pillar is where it naturally fits.

Second, it is likely that the overall FET budget will be strengthened, something that is crucial

considering the enlarged mandate for FET (beyond ICT) and the new FET-Flagship initiatives.

Finally, FET will consist of three schemes: FET Open, FET Proactive and FET-Flagships. These three schemes will sound familiar, but we are looking hard about what we can do to improve the way we do things – simpler, faster and creating more leverage. The exact way of running the three schemes is still actively being discussed. If you have ideas, be sure to let us know.

CSFRI/Horizon 2020 home page
http://ec.europa.eu/research/horizon2020/index_en.cfm

fet[11] Conference Proceedings now available

The *fet[11]* Conference Proceedings are now available.

The *"Procedia Computer Science, Volume 7, 2011, Proceedings of the 2nd European Future Technologies Conference and Exhibition 2011 (FET 11)"* can be cited (or linked to) through their permanent Digital Object Identifiers (DOI), or through the more traditional title/volume/page formats in any common academic citation style.

The proceedings are edited by conference co-chairs Elisabeth Giacobino and Rolf Pfeifer, and feature articles and videos of the plenary sessions, presentations and keynotes, the multi-disciplinary scientific sessions as well as the posters, giving a 360° view on Future and Emerging Technologies.

fet[11] took place in Budapest from 4-6 May 2011. The conference was co-organised by the FET Programme, ERCIM (the European Research Consortium for Informatics and Mathematics) and the Hungarian Academy of Sciences, and was held under the auspices of the Hungarian Presidency of the European Union.

The European Future Technologies Conference and Exhibition is a unique European forum on visionary, high-risk and long-term research in information science and technology. The 2011 event featured an exceptionally broad range of scientific fields and sowed the seeds for new ideas across disciplines.

Further information:

http://www.sciencedirect.com/science/journal/18770509
http://www.fet11.eu

Boosting Open Research

In 2011, FET-Open commissioned a study to look at ways to boost the exploratory power of open research in future and emerging technologies in Europe.

Within the study framework, a survey of some 300 FET-Open participants (successful and unsuccessful) was conducted, desk research and interviews took place with some 40 international research funding agencies to collect input on strategic and operational aspects of open research programming and funding, and more than 50 participants from national and international funding agencies and research centres convened at 2 workshops in Brussels (in July and September) to discuss key opportunities ahead. At a final December workshop, some first study conclusions were teased out.

The study found that prevailing models of research have several benefits in terms of rationalising research, but can create undesirable path-dependencies of various sorts, including organisational rigidity and compartmentalisation, risk-averse behaviour, and lack of support for visionary ideas that are incompatible with dominant scientific knowledge.

Truly path-breaking technological innovation with major economic potential is often the result of non-conventional but at the same time purpose-oriented thinking, and thus escapes the rationality of the dominant research and research funding models. This is a key challenge for research funding agencies.

The study also concluded that open research in future and emerging technologies is expected to become more relevant in the future mainly due to the general collapsing of time and increasing access to information inherent in our current techno-socio-economic model. We are moving ever more quickly from scientific discovery to technological research and development.

Interestingly, the study also found some currently unexploited value in the flow of proposals and projects to the FET-Open scheme. FET-Open is in a unique position to provide a very useful observatory and strategic watch function. An open research project and proposal portfolio at any particular time constitutes a laboratory of unconventional ideas which can test and highlight new inroads for technological and thematic research programmes, and provide insights for broader social competitiveness and welfare. This strategic watch function is thought to be currently under-developed.

The study found that the value of open research in future and emerging technologies lies in the fact that it tends to fall in a gap between thematically prescriptive research (not open enough), bottom-up curiosity-driven research (not purpose-oriented enough), and broad-based innovation (not visionary enough).

The final report and executive study will be available in the coming weeks.

FET-Flagship Pilots Midterm Conference
24-25 November 2011 - Warsaw, Poland

On 24-25 November, the FET Flagship Pilots Midterm Conference took place in Warsaw, under the auspices of the Polish EU Presidency, with the title "Building FET Flagships: A world-class scientific endeavour". Over 250 participants attended the full-house event, where the Flagship Pilots presented their midterm progress in the coordination of their communities, their updated visions and goals, and the expected impact of their research. To tackle grand scientific challenges and to achieve world-class results, a large-scale federated effort needs to be put in place by the Flagships by aligning programmes and resources from the EU, Member States, and leading research institutions. This complex planning task was promoted at the event by extensive plenary and bilateral talks between Flagship Pilots and funding agency representatives from EU and national programmes. While discussions will continue to determine fundamental issues such as implementation mechanisms and contribution forms, it is already clear that the extent and various forms of national participation, and the efficiency of coordinating them, will be key competitive elements.

The political session of the first day delivered the firm message that there is solid support behind the FET Flagships vision, which the scientific community can safely count on. However, to succeed in the competitive process, the Flagship Pilots will have to deliver a case that is both well-founded and broadly appealing. By now already a step change in progress can be seen, as the Flagship candidates have matured from "inspiring", as presented at their *fet[11]* launch in Budapest, to "credible", as seen at their midterm – suggesting that the implementation of the FET Flagships has, in a way, already commenced.

Follow the FET-Flagships

For further information and photos from the conference, as well as for earlier communications and the latest news on FET Flagships via twitter and facebook, follow the featured links at:

 http://cordis.europa.eu/fp7/ict/programme/fet/flagship

 http://twitter.com/FETFlagships

 https://www.facebook.com/FETFlagships

Work Programme 2013

A number of consultation meetings were held in Brussels in November 2011, with a view to eliciting themes for future FET-Proactives under the 2013 ICT Work Programme. A short summary of each workshop is provided below.

Consultation reports will be available soon on the FET Proactive website.

http://cordis.europa.eu/fp7/ict/fet-proactive/shapefetip-wp2013_en.html

Reports from Consultation Meetings

Evolving Living Technologies

Modern ICT technology works through speed and processing power, yet remains primitive in comparison to the joint computational and self-adapting properties of living organisms. All natural living systems are composed of physically and chemically embodied agents which are relatively autonomous, self-constructing, evolvable and self-organizing. They show a long list of desired features. They are scalable with local communication, reactive, adaptive and robust against disturbances of many kinds. Learning to build our own ICT along these lines appears to offer the most promising way to solve a host of seemingly insurmountable problems, including ease of creation and use, energy supply, difficulty of manufacturing, etc. Hence, the challenge is to create controllable yet evolving living technologies in collective systems of physical entities. These systems will include an integration of self-assembly and self-reproduction, and have an ability to balance fully open-ended evolution with more constrained and directed evolution, so as to maintain control over outcomes. This will allow us to learn how to exert flexible and useful control over evolving living technologies.

Human Computer Confluence

A meeting on "Human Computer Confluence" held in Brussels on 11 November 2011 brought together key scientists with diverse expertise to brainstorm and elaborate novel research topics as candidates for FET proactive initiatives. The consultation targeted radically new ways of communication between humans and machines, aiming at bringing together relevant research in psychology and information technology. Three key challenges were identified: (1) Emotional signals play a fundamental role in human communication and need to be used by computers to adjust their actions for more efficient user support. Advanced sensing systems, a clear understanding of the difference of human affective states as well as non-rational behaviour and decision-making are needed to address this. (2) ICT systems should serve as empathic cognitive extensions of their users, being active and instrumental in driving interactions with computers as well as with other humans, hereby learning and adapting with the user. This includes overcoming natural limitations of human attention, enhancing learning and developing an artificial representation of time matching with human temporal cognition. (3) An understanding of how the confluence with ICT affects human development, brain plasticity and behaviour is needed in order to

channel the long term trajectories of human computer confluence. The challenges identified aim to develop radically new methodologies going 10-20 years beyond the current state of the art in diverse areas including psychology, behavioural sciences, computer science, sensor technology, and philosophy.

Atomic Scale Devices and Systems

This topic builds on seminal and promising exploratory work initiated by FET-Proactive and FET-Open projects at the end of FP6 and developing into FP7. This collaborative and multidisciplinary research is unparalleled in Europe and constitutes a necessary step towards examining alternative routes to the anticipated physical limitations of today's semiconductor industry and the slowdown of "Moore's law".

Today, supported by the FET-Proactive 'Molecular Scale Devices and Systems' and a community of complementary FET-Open projects in metrology, light-matter interaction and opto-mechanical systems, and novel molecular substrates (iSENSE, SCOPE, MINOS, QNEMS, TAILPHOX, BION, ARTIST, Moldynlogic, iChem,…), this research topic has gained wide recognition and early results that need to be sustained over time in order to pave the way for future European-based atomic and molecular information technologies, systems and devices and keep Europe at the forefront of the worldwide state-of-the-art in this area.

Can Computers be Creative?

Can creativity be studied scientifically? Is creativity something particular to people, or can computers also be creative? How would one measure creativity? And should one look at individual creativity or at group creativity? These and other questions were the topic of a consultation organised by FET. About 15 scientists came together to discuss progress so far, and what the main challenges are for the future.

The sort of people that are able to bring forward this topic are from a variety of disciplines – including AI, human computer interaction, cognitive science, neuroscience, but also performative science (deploying science and technology through performing arts).

Some of the main challenges that were identified are mathematical modelling of creativity, measuring human creative performance, implementing creativity in ICT and collaborative human-computer creation. The participants also identified some methodological needs, such as benchmarking, building real-world testbeds and the need for multiple evaluation frameworks. There was also a hot debate around the question if there should be a generalised theory of creativity – right up to the time when participants had to run off to the airport.

FET in Numbers

FET Budget in FP7:
Total budget €617m, of which:
- FET-Open: €219m
- FET-Proactive: €359.5m
- FET-Flagship: €10m

FP7 Projects Launched
- FET-Open - 86 CPs, 9 CSAs
- FET-Proactive - 65 CPs, 20 CSA
- FET-Flagship: 7 CSAs

[CP = Collaborative Research Project]
[CSA = Coordination and Support Project]

FET-Open Continuous Scheme
Proposals received so far in FP7: 2019

FET eStatistics
http://twitter.com/#!/fetopen - 122 tweets, 181 followers
http://twitter.com/FETFlagships - 196 tweets, 81 followers

https://www.facebook.com/fetopen - 248 likes
http://www.facebook.com/#!/pages/FET-Flagships/141589582520429 - 256 likes
http://cafeteria.ning.com - 647 members

FET Conferences & Workshops

Zero Power Workshop
26-27 Oct 2011, Cork, Ireland

The ZEROPOWER Coordination and Support Action aims to create a coordination activity among consortia involved in "Toward Zero-Power ICT" research projects (FET proactive call FP7-ICT-2009-5, Objective 8.6) and communities of scientists interested in energy harvesting and low power, energy efficient ICT.

The project organised a workshop in Cork from 26-27 Oct 2011, to help to build the emerging ICT-Energy related community by networking existing national, regional or international activities and programmes in "energy efficiency" with a view to exploiting synergies, maximizing impact and contributing to the definition of international cooperation strategies and/or the development of research collaboration.

Workshop Website
http://www.zero-power.eu/node/36
ZEROPOWER home page:
http://www.zero-power.eu/

FOME'11: Future of Middleware at Middleware'2011
Lisbon, 13 December 2011

The CONNECT project organized FOME'11 - Future of Middleware at Middleware'2011. FOME'11 brought together a number of invited leading researchers to offer a comprehensive coverage of key issues that middleware needs to face. The aims of the event were to take stock of the current situation, to establish an agenda for the next wave of middleware research and, most importantly, to stimulate researchers and build a community to address the significant challenges ahead. In a nutshell, what should middleware look like in 2020?

Conference:
http://2011.middleware-conference.org/fome/fome2011

CONNECT home page:
http://connect-forever.eu/

FET Funding Opportunities

FET-Open in 2012

The FET-Open Scheme remains open through 2012 for research proposals targeting fundamental breakthroughs and paradigm shifting ideas in any area of ICT. Why not take a look at the open tracks on challenging current thinking, international cooperation, or our dedicated tracks for young explorers and high tech research intensive SMEs? A special call on the Science of Global Systems closed on 17 January 2012.

- http://cordis.europa.eu/fp7/ict/fet-open/challenging-current-thinking_en.html
- http://cordis.europa.eu/fp7/ict/fet-open/ye_en.html
- http://cordis.europa.eu/fp7/ict/fet-open/high-tech-sme_en.html
- http://cordis.europa.eu/fp7/ict/fet-open/international-cooperation_en.html
- http://cordis.europa.eu/fp7/ict/fet-open/global-systems_en.html

FET-Proactive - Call 9

Call 9 of the FP7 2011-12 Work Programme (identifier FP7-ICT-2011-9) launched on 17 January 2012. **The deadline for proposal submission is 17 April 2012 (17h00 Brussels time)**. The call features three thematic R&D initiatives and a call for coordination and support actions. The indicative budget for all the objectives in call 9 is 70 M€

Quantum ICT (QICT) including ERA-NET+
The objective is to conceive theoretically and develop experimentally novel and powerful technological applications of quantum coherence and entanglement. In particular, projects should develop a conceptual platform for potentially disruptive technologies, advance their scope and breadth and speed up the process of bringing them from the lab to the real world.

http://cordis.europa.eu/fp7/ict/fet-proactive/qict_en.html

Information Day on Call 9
FET-Proactive has recently hosted an information day on Call 9, which took place on **18 January 2012 in Brussels**. The day provided first-hand information on the FET-Proactive initiatives in this call, as well as contractual, legal and administrative modalities.

In addition, the formation of consortia and synergies have been facilitated through an open exchange 'Proposers Forum'.

Presentations will be made available at:
http://cordis.europa.eu/fp7/ict/fet-proactive/ie-jan12_en.html

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Fundamentals of Collective Adaptive Systems (FOCAS)
A key feature of Collective Adaptive Systems (CASs) is that they comprise many units/nodes, which have their own individual properties, objectives and actions. Decision-making is distributed and possibly highly dispersed, and interaction between the units may lead to the emergence of unexpected phenomena. They are open, in that nodes may enter or leave the collective at any time, and boundaries between CASs are fluid. The units can be highly heterogeneous (computers, robots, agents, devices, biological entities, etc), each operating at different temporal and spatial scales, and having different (potentially conflicting) objectives and goals. The objective is to establish a foundational framework for CASs.

http://cordis.europa.eu/fp7/ict/fet-proactive/focas_en.html

Neuro-Bio-Inspired Systems (NBIS)
In particular, this objective addresses the need to:

- learn more about the relationship between structure, dynamics and function in neuronal circuits and assemblies, and how information is represented or "coded" in a brain;

- develop deeper and more comprehensive theories of neural processing, possibly building on results obtained in the domains of dynamic and complex systems;

- close the gap between neuroscience and engineering by motivating interdisciplinary work that ties data with theories and novel computing.

http://cordis.europa.eu/fp7/ict/fet-proactive/nbis_en.html

Coordination and Support Actions
This call objective targets:

a) Actions supporting the coordination and cooperation of targeted research communities, assessing the impact and proposing measures to increase the visibility of the initiative to the scientific community, to targeted industries and to the public at

large. These actions should also foster the consolidation of research agendas.

b) Actions supporting and promoting cooperation with non-EU research teams in foundational research on FET topics, with a balanced participation from partners in the EU and from target countries.

c) Short duration actions (typically 6-12 months) to organise consultations of multidisciplinary communities to formulate novel FET research topics, focussing on new emerging research areas. The main objective should be to identify and motivate one or more new research avenues from a global perspective, the associated fundamental challenges, and to analyse the expected impact on science, technology and society.

d) Actions to organise conferences and workshops which should foster dialogue between science, policy and society on the role and challenges of interdisciplinary ICT related long-term research, increasing Europe's creativity and innovation base and bridging diverse European research communities and disciplines.

Objective ICT-2011.9.12:

http://cordis.europa.eu/fp7/ict/fet-proactive/csa_en.html

La vie des projets

MATrix for CHemical IT

Biology is unique in integrating information processing with material production. Is it possible to create and program such integration using ICT?

The MATCHIT (MATrix for CHemical IT) project is a step in this direction. It is developing a hybrid programmable micro electro mechanical (MEMS) and biochemistry-based system that integrates information processing and chemical material production. The MATCHIT system can program the material production of simple biochemical objects from the nano to the micro scale, and has functionalities similar to a minimal artificial subcellular matrix.

The approach is based on DNA addressable chemical containers at multiple levels, which are interfaced with electronic computers via micro fluidics MEMS technology through regulatory feedback loops. With programmable DNA tags in the micro fluidics channels, the DNA tagged containers can be precisely addressed to a given MEMS position and/or be addressed to other containers. Just as in biology, the containers self-assemble, self-repair and enable production of new chemicals through internal, or through externally triggered, metabolic steps and the containers can undergo fission and fusion. At the same time these biochemical processes are energy efficient and the materials can be recycled.

For containers the project uses nanoscale cages, micron sized vesicles and up to 100 micrometer oil droplets in water or water droplets in ionic liquids. The DNA-based addresses as well as the containers can perform logical operations, enabling parallel chemical reaction programming in a new multilevel architecture through autonomous address modification and container content production resolution at the container-container, container-surface and container-molecule levels. This provides a novel concrete embedded application for combined DNA- and membrane computing. See figure below.
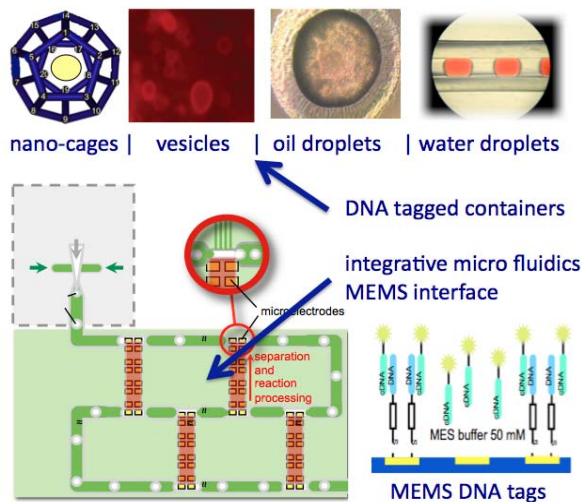

© MATCHIT. The DNA-based addresses as well as the containers can perform logical operations

The simplicity and programmability in MATCHIT promotes a deeper understanding of the computational power of coupled production and information processes, which we so far only know from biology. The consortia hope this can help develop a new platform for building smarter, more efficient and sustainable computer and production systems for the future.

The MATCHIT project integrates and disseminates multidisciplinary European activities in ChemBio-ICT area and provides an assessment of the likely long-term socio-technical impact of this new powerful enabling technology.

http://fp7-matchit.eu/

CYBERHAND – The Path to Innovation
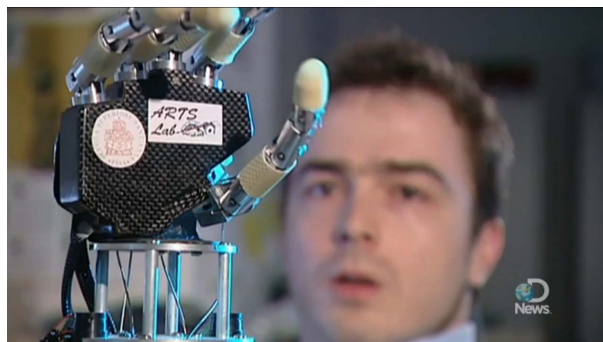
© Discovery Channel. For a month, Pierpaolo Petruzziello's amputated arm was connected to a robotic limb, allowing him to feel sensations and control the arm with his thoughts.

From 2001 to 2006, FET provided seed funding to the CYBERHAND and NEUROBOTICS projects, comprising a multidisciplinary group of researchers aiming to further develop the scientific and technological foundations of hand prosthetics.

Further technological development took place from 2007-2011 funded under the ICT Programme (TIME project) and by the Korean Institute of Technology (ACTIN project). Progress in clinical trials through the NEMESIS project (funded by the Italian Ministry of Health) recently led to the first connection in a human patient (LIFEHAND).

See video on Discovery Channel.
http://www.youtube.com/watch?v=ppILwXwsMng

## LAMPETRA: A Success Story in Neuroscience and Robotics

The LAMPETRA project (2008-2011) aimed at developing lamprey and salamander-like bio-inspired artefacts, with a twofold goal: to achieve new knowledge in neuroscience and to find new engineering solutions for high-performance artificial locomotion in terms of fast response, adaptability, reliability, energy efficiency and control. The main technological goal was to develop autonomous

> *LAMPETRA has lead to a breakthrough with respect to the state-of-the-art in the synergies between ICT and bio/neuro-sciences.*

artefacts that replicate living animal characteristics, from the neuronal level up to control and behavioural responses. Bio-inspired robots have been successfully developed, capable of controlling their locomotion in goal-directed task, moving like real animals in their natural environments. These systems have been used for conducting neuroscientific studies and for performing experiments on vertebrate mechanisms involved in the neural control of goal-directed locomotion.

The choice of the lamprey and the salamander as animal models was motivated by their agile locomotion skills, their great importance from an evolutionary point of view and by the fact that their neural centres controlling locomotion have been studied in detail.

LAMPETRA enabled advances both in neuroscience (better understanding of information processing and sensorimotor coordination in biological systems), and in robotic technologies. Bio-inspired artefacts have been developed by adopting original design solutions, consisting of a high number of active segments, of compliant body structures, muscle-like actuators, legs-like appendages, artificial stretch receptors, vestibular and vision (stereoscopic) sensors, electronic hardware combining digital and analogue circuitry. The control architecture takes inspiration from neurobiological studies and is based on the concept of central pattern generators and sensorimotor loops for robust and adaptive goal-directed locomotion.
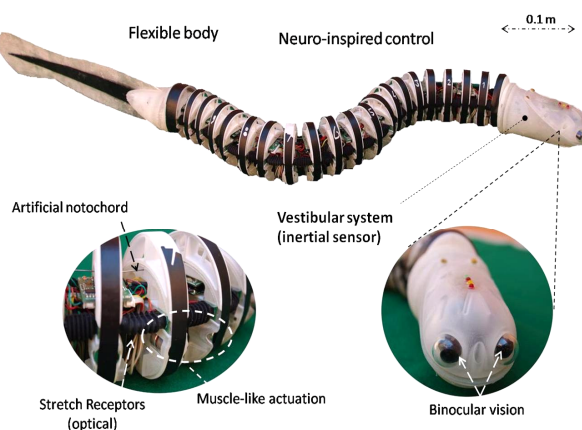
© *Lampetra. Overall architecture of the Lampetra artefact*

The results are expected to have a strong impact in both ICT and bio/neurosciences, and especially in providing a breakthrough with respect to the state-of-the-art in the synergies between ICT and bio/neurosciences. The new knowledge achieved in biology and neuroscience is expected to drive the development of new classes of high performance sensors and actuators, closer to the biological counterparts in what concerns function and information processing, as well as of new and efficient control techniques. Conversely it is possible to build artefacts so similar (from both morphological and neural aspects) to the corresponding living animals to allow neuroscientific experiments that would be nearly impossible to be performed on living animals. The revealed subtle neural mechanisms regulating sensory-motor coordination, non steady-state and goal-driven spatial locomotion in vertebrates, allow to rethink the notions of computation, information processing, control strategies that are implemented in brand new biomimetic devices.

More info:
http://www.lampetra.org

SCENIC – The Geometry of Acoustics and Participating Environments

SCENIC   The SCENIC Project (2009-2011) has succeeded in developing a geometrical theory of acoustics that promises to have a relevant impact on future generations of space-time audio processing algorithms. Similarly to what 3D vision has done in the area of image processing, it has developed new geometric methodology for the acoustic scene reconstruction. The approach consists of turning acoustic measurements into geometric constraints, which in projective geometry, take all the same mathematical form and can be combined to solve complex problems. Thanks to these solutions, the acoustic system is able to autonomously collect

information on the shape and reflectivity of walls and reflectors using natural sounds (finger snapping, hand claps, speaking voices). Another challenge that was undertaken and successfully overcome was the development of an acoustic beam (and ray) tracer that is able to geometrically model the sound field in a 3D environment in real time, in the presence of moving sources. The method is based on the evaluation of the mutual visibility between acoustic reflectors. Beams that are produced by a source can be swiftly traced as they split while interacting with the reflectors in real time, by looking up the data structure that contains the information on mutual visibility. This had been an open problem for a long time, which was successfully solved although it was just an area of tentative exploration for the project. With these powerful geometrical tools, the SCENIC methodology can turn the environment into a collection of acoustic mirrors that help in creating an augmented sensing/rendering system by virtually cloning the physical arrays multiple times.

> The SCENIC consortium generalized the visibility-based beam tracing problem to arbitrary 3D environments, a tough problem that had remained open for decades and was only initially an area of exploration in the project's technical annex.

Numerous innovative applications are becoming possible thanks to the above approaches. For example it is now possible to go beyond the environment geometry and focus on the reflection properties of its walls, in a completely acoustic and non-intrusive fashion. It is also possible to go beyond tracking and extracting sources in a reverberant environment: with the help of the surrounding walls we can estimate their radial pattern and orientation in real time. The proposed solutions can even enable the use of multiple independent (and unsynchronized) microphone arrays and perform data synchronisation, once again using principles of geometrical acoustics. Further progress relates to methods for geometric room compensation (a further unintended result), which can be combined with virtual environment rendering, thus solving the open problem of virtual acoustics (replacing a real environment with a virtual one).

The results concerning selective room compensation in the virtual surround application were showcased to industry at a special Industry Day, involving 20 companies and 65 participants, where participants were presented with a built space comprising a highly reverberating room within the demo room. In this environment, compensation was judged by those present to be quite impressive, given that it was demoed with a simple array of PC speakers.
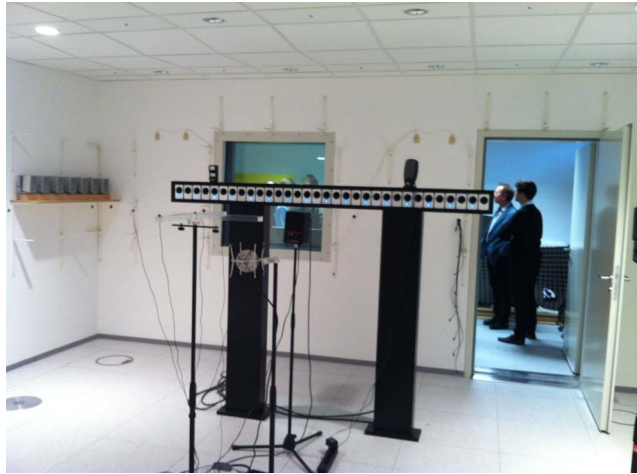
© SCENIC. The Virtual Surround Demonstration.

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The results pave the way for a new generation of radiometric rendering solutions that enable geometric wave-field extrapolation.

http://www.thescenicproject.eu

OPTONEURO – Changing world views

What if we could change our view of the world with the flick of a switch? A new short film, *'Song of the Machine'*, explores the possibilities of a new, modified – even enhanced – vision, where users can tune into streams of information and electromagnetic vistas currently outside of human vision.

© OPTONEURO project
Frame from "Song of the Machine", which is part of an ongoing collaboration between Superflux and neuroscientist Dr. Patrick Degenaar, whose pioneering work in optogenetic retinal prostheses aims to bring back sight to the blind. Dr Patrick Degenaar is Project Coordinator of the OPTONEURO project.

Unlike the implants and electrodes used to achieve bionic vision, this science modifies the human body genetically from within. First, a virus is used to infect the degenerate eye with a light-sensitive protein,

altering the biological capabilities of the subject. Then, the new biological capabilities are augmented with wearable (opto)electronics which, by mimicking the eye's neural song, establish a direct optical link to the brain. It's as if the virus gives the body ears to hear the song of the machine, allowing it to sing the world into being. *(Text adapted from the "Song of the Machine" on Vimeo.)*

Song of the Machine was on show as part of the HUMAN+ Exhibition at the Science Gallery, Trinity College Dublin until 24 June 2011.

The full project story can be found on the Superflux Blog
http://superflux.in/blog/song-of-the-machine-in-depth

HUMAN+ Exhibition, Science Gallery,Trinity College, Dublin
http://www.sciencegallery.com/humanplus/song-machine

The project was also featured in The Guardian Newspaper
http://www.guardian.co.uk/science/blog/2011/apr/21/retinal-prosthetics-human-plus-exhibition

Watch the movie on Vimeo:
http://vimeo.com/22616192

CONNECT - Emergent Connectors for Eternal Software Intensive Networked Systems

We are moving towards a world where everything is connected. Yet the deficiencies of today's system platforms in achieving a fundamental property of distributed systems, namely interoperability, are apparent. Faced with extreme heterogeneity of computational devices and networks, how can we ensure that any system can talk to any other?

Interoperability - the ability for two systems to exchange, understand and use each other's data - is a long-standing problem in distributed systems. However, the emergence of pervasive computing and the Internet of Things have brought about new challenges to achieving universal interoperability. Extreme heterogeneity and spontaneous interactions are characteristics of today's complex distributed systems. Computational devices ranging from embedded devices, sensors and smartphones through to cluster machines and the cloud use a wide range of communication networks and middleware protocols to communicate with one another. However, as soon as two systems adhere to heterogeneous protocols (from application down to network layers) to interact with each other, direct interaction is impossible. Standards are a well-established approach to rectifying these types of problems (e.g., Web Services standards from the W3C). Where two systems agree upon such a standard, interoperability can be guaranteed. However, systems may encounter one another spontaneously where no such agreement is possible.

The CONNECT project (Feb 2009 – Nov 2012) involves experts in middleware, software engineering, formal methods, machine learning, software synthesis and systems dependability, who are working together to overcome interaction protocol heterogeneity at all layers, on-the-fly. The project employs a revolutionary approach to generate dynamically the necessary interoperability solution to connect heterogeneous systems, and have coined a new term to refer to this: *emergent middleware.*
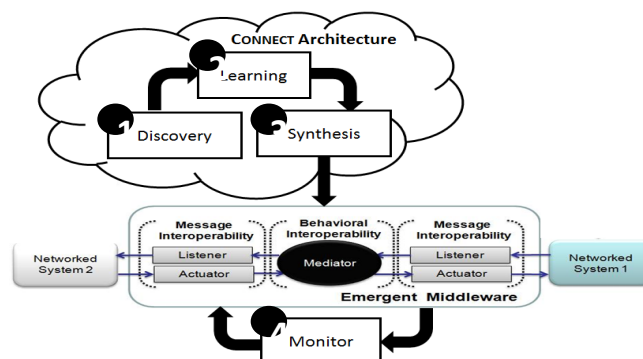
© CONNECT: On the fly generation of emergent middleware

The figure above illustrates an emergent middleware solution that performs two important functions:

- *Message interoperability* is dedicated to the interpretation of messages from/towards networked systems (listeners parse messages and actuators compose messages); by plugging in the correct listeners and actuators communicate is possible with any legacy protocol.

- *Behavioural interoperability* mediates the interaction protocols run by the communicating networked systems by translating messages from one protocol to the other.

In order to dynamically generate the above solution on-the-fly, CONNECT employs a runtime architecture that executes in four distinct phases:

- *Discovery.* Systems in the local environment are discovered and their information (e.g., an interface description) is used to build a model of the service provided and which middleware it utilises. Ontological information is then used to understand this provision and obtain better matching with other systems, i.e., does one system provide the behaviour another requires (irrespective of the heterogeneity)?

- *Learning.* Active learning algorithms explore given systems by means of test-based interaction in order to reveal how they provide their services, and thereby infer behavioural models that express how these services can be adequately invoked.

- *Synthesis.* The models of the two systems are used to calculate the necessary mediator that will ensure the translation between two systems. This is used to create an emergent middleware, aka CONNECTor.

- *Evolution.* The deployed CONNECTor is monitored to ensure it meets its non-functional requirements (e.g., performance). Where the requirement is not met, the architecture cycle is re-run to generate a new CONNECTor.

The above functionalities are supported by dedicated Enablers that are being developed as part of the project and released as open source from the project web site.

A number of challenges remain and are the subject of active research in the consortium. The inherent openness and probabilistic nature of such solutions raise important issues, especially when deployed at Internet scale. Here the system must be able to reliably produce correct mediators and also be secure against malicious threats.

http://www.connect-forever.eu

Further Project News Sources

Many FET projects publish news regularly in project newsletters and other online news sources. A selection of related URLs can be found below. Please contact the editors if you would like your project news source to be added to this list.

ASCENS (Autonomic Service-Component Ensembles)
http://www.ascens-ist.eu/press-reoeeases

ATMOL (Atomic Scale and Single Molecule Logic Gate Technologies)
http://www.atmol.eu/

CORNER (Correlated Noise Errors in Quantum Information Processing)
http://corner.fizyka.umk.pl/files/Newsletter2.pdf

CURVACE (Curved Artificial Compound Eyes)
http://www.curvace.net/index.php?option=com_content&view=article&id=71&Itemid=77

DATA SIM (Data Science for Simulating the Era of Electric Vehicles)
http://www.uhasselt.be/UH/datasim/Dissemination/Dissemenation-Press.html#tabsl

ECCELL (Electronic Chemical Cell)
http://homepage.ruhr-uni-bochum.de/john.mccaskill/ECCell/press/press_articles/

INBIOSA (Integral Biomathics Support Action)
http://www.inbiosa.eu/en/Press.html

MODAP (Privacy on the Move)
http://www.modap.org/content/newsletters

New Books

Integral Biomathics: Tracing the Road to Reality

This book describes a new approach to biology and is based on the first year activities of the INBIOSA project.

Hardcover, ISBN 978-3-642-28110-5

Due: February 27, 2012 – Springer Verlag

http://www.inbiosa.eu/en/Press-View.html?article=integral-biomathics-tracing-the-road-to-reality

LNCS7005: Similarity-based Pattern Recognition

Proceedings of the First International Workshop, SIMBAD 2011, Venice, Italy

This new book in the Springer Lecture Notes in Computer Science series explores two questions, based on the work of the SIMBAD project.

- How can one obtain suitable similarity information from data representations that are more powerful than, or simply different from, the vectorial?

- How can one use similarly information in order to perform learning and classification tasks?

http://www.springer.com/computer/image+processing/book/978-3-642-24470-4

Announcements

Valentino Braitenberg

The Italian Neuroscientist and Cyberneticist **Valentino Braitenberg** died on 9 September 2011. A former director at the Max Planck Institute for Biological Cybernetics in Tübingen, Germany, Valentino was most famous for the book **Vehicles: Experiments in Synthetic Psychology**, in which he described how hypothetical analog vehicles (a combination of sensors, actuators and their interconnections), though simple in design, can exhibit behaviours akin to aggression, love, foresight and optimism.

Text adapted from Wikipedia:
http://en.wikipedia.org/wiki/Valentino_Braitenberg

The Future of Computing

The New York Times is running an exciting web based interactive collaboration project to predict the future of computing. Why not take a look?

http://www.nytimes.com/interactive/2011/12/06/science/20111206-technology-timeline.html?ref=science

Forthcoming events

A selection of upcoming conferences and workshops is provided here.

7TH HIPEAC CONFERENCE, PARIS, FRANCE

A forum on computer architecture, programming models, compilers, and operating systems for embedded and general-purpose systems.
23-25 January 2012
http://www.hipeac.net/conference

CASTNESS'12, PARIS, FRANCE

Computing Architectures Software tools and nano-Technologies for Numerical Embedded and Scalable Systems
26 January 2012
http://teraflux.eu/castness

QIFT, MAINZ, GERMANY

2nd Cluster Review Meeting: involving 3 IPs and the Coordination Action QUIE2T.
16-18 April 2012

CAPO CACCIA, SARDINIA, ITALY

The 2012 CapoCaccia Cognitive Neuromorphic Engineering Workshop
29 April – 12 May 2012
http://capocaccia.ethz.ch/capo/wiki/2012

HPDC'12, DELFT, THE NETHERLANDS

21st International ACM Symposium on High-Performance Parallel and Distributed Computing
18-22 June 2012
http://www.hpdc.org/2012/

FUTURETECH 2012, VANCOUVER, CANADA

The 7th FTRA International Conference on Future IT
26-28 June 2012
http://www.ftrai.org/futuretech2012

ESOF 2012, DUBLIN, IRELAND

Euroscience Open Forum
11-15 July, 2012
http://www.dublinscience2012.ie/

KDD-2012, BEIJING, CHINA

The 18th ACM SIGKDD Conference on Knowledge Discovery and Data Mining
August 12-16, 2012
http://www.kdd.org/kdd2012/index.shtml

USIPCO, BUCHAREST, ROMANIA

20th European Signal Processing Conference
27-31 August 2012
http://www.eusipco2012.org/home.php

About this Newsletter

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Please contact the editors below if you would like to consider any FET or project related news for publication in this newsletter.

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