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Foreword

Art and science are usually thought to belong to two different worlds: one of beautiful pictures and sculptures in galleries and the other showing researchers in white coats conducting experiments in laboratories. In recent years, however, the boundaries between these two domains have become increasingly blurred. It seems that we are doing in the beginning of the 21st century what our ancestors did at the beginning of every new century: being pressed to find a new direction in visual art. And this time, science and technology are playing a significant role in influencing this new form of art. Moreover, every decade brings about new forms of art and technology.

Today, more and more artists are drawing inspiration from science and using the latest technology and new materials in their art, while scientists and researchers are realising the artistic elements of their work and finding ways to use art to communicate better. An exciting new discipline is rising – termed the ‘third culture’.

This publication *Art&Science: creative fusion* aims to explain the theory behind the art–science interface and illustrates this academic perspective using concrete examples, including projects, institutions and festivals. In addition, it seeks to strengthen the role of a new artistic–scientific community in producing knowledge, imagination and practice, as well as in intercultural exchange and cooperation. The section on the Western Balkan Countries (WBCs) elaborates this point: extending the ‘third culture’ to the WBCs is viewed as a way to facilitate their integration into the EU where cooperation can be much more than simply economic.

Both art and science are domains that can help to understand each other better, being constantly in motion and together offering exciting potential. Art & science, as a combined field, can work to bring together cultures, draw attention to topical issues like climate change and genetic modification, and serve as a tool for better understanding the world



around us. In this way, this publication can also serve as a bridge between the 2008 European Year of Intercultural Dialogue and the 2009 European Year of Creativity and Innovation.

Further exploration of the potential of the interface between these two fascinating domains seems merited. More research should lead to more interesting applications and further pushing of the boundaries. But more importantly it should bring people closer together and that is what art & science is all about.

Art&Science – creative fusion will show you what art & science has already been able to achieve so you can see what it can become in the future.

Janez Potočnik
European Commissioner
for Science and Research

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Reflection on art and science: creative fusion

Ever since Plato, a large part of Western civilisation has been convinced of the desirability of amalgamating the three pillars of intellectual life by trying to make Beauty, Truth and Goodness coincide. Each of these worlds has its own method. Professor Willem Elias of the Vrije Universiteit Brussel explores the common ground and divergence between art and science. We can compare the world of art with, on the hand, the world of value-based thought, as expressed in politics – the profane – and on the other hand, science.

While art and science have previously, and especially since the 19th century, been divided into two separate and wholly unrelated worlds, today the links between them are increasingly apparent and they are seen as complementary rather than competing. Further research on this area is needed and preferably at European level. Indeed, already in several corners of Europe and further afield, this “cross-performance” between art and science is bringing new and fascinating applications: creative fusion! But let us first touch on the comparison between art and science.

Science between certainty and doubt

Science is practised according to four standard rules. Firstly, data is sought through observation and supplemented through measurement. Secondly, patterns are sought, leading thirdly to a larger, cohesive whole, which is called a scientific theory. The cohesive scientific theory is arrived at by using a system of logic. If the science uses figures (quantitative), it is mathematics. If the science primarily uses words (qualitative), it concerns reasoning. Finally, the new theory has to be tested in some way, such that it can be confirmed, rejected or improved. Science is there to solve problems. Through science man hopes to be able to predict or explain what happens in the world.

Art

If we are to define science (in the world of truth), a method or rule can help; this appears next to impossible for art. Indeed, is there

anything more relative than the world of beauty? It is then also no surprise that one can conclude that in the 20th century, the classic definition of art failed and was substituted by an institutional theory: “A work of art is an artefact of a kind created to be presented to an ‘artworld’ public. It is realised that this definition too is very relativist, but for the moment the only one possible.”¹

Similarities and differences

It would be wrong to see too close a similarity between scientific and artistic work. Both disciplines give a means of knowing an individual, and thus the society in which they live in a specific time period. Both assume a curiosity about what happens in the world and the creativity and inventiveness that are necessary to make fascinating statements about it. Both presuppose a certain amount of curiosity about what’s going on in the world and enough creativity and ingenuity to report this in an interesting way.

Whoever wants to point out the similarities between science and art will inevitably use Leonardo da Vinci (1452–1519) as an example. He raised drawing as a part of anatomical research to a high level. He started from the conviction that the eye is our main sense for gaining knowledge of the world. And he often pointed out that an image, whether a drawing or painting, can show a lot more of what has been seen than can ever be described in words. The fact that during the Renaissance no distinction was made between the artist and the scientist is the proverbial quality typical of that time.

In the 20th century too, attempts have been made to minimise the difference between the artist and the scientist. None other than Claude Lévi-Strauss, the French ethnologist and philosopher, views art and science as two equal forms of ordering.² Myths – the stories through which a culture wishes to represent itself – are also important forms of organisation. Lévi-Strauss called this “wild thinking”. He considers art to be a form of “contemporary wild thought”,

somewhere between science and myth. One element in all this may be useful: the wildness. When looking again at the rules of science, similarities abound. Art, too, is about thinking while observing. Experiment is the basis of 20th-century avant-garde.

The search for patterns, though, is less evident. The artistic schools could be a parallel here. One could always say that no artist escapes a certain style, i.e. a broader category of design than the individual contribution. And each style has its theory of art. The need for verification is not really applicable and this is the big difference.

Scientists seek solutions, starting from their knowledge of any number of potential alternatives. The artist finds “their” solution. The former is concerned with problems, the latter with “their” problem. Science is better if it reaches the same findings; art gets better as it keeps finding something different. This is where the artist becomes very unscientific indeed. But fortunately so because if there were no difference, there would be no need for artists. Moreover, one of the downsides of the strict scientific method is that there is little room to go beyond the boundaries or rules. On the contrary, art does not have any limits. And it is precisely this artistic wildness that can be very fertile. This phenomenon is especially interesting in the case of artists who have chosen a branch of science as their subject matter.

Interface between art and science: towards a third culture

“The third culture” is a concept from John Brockman (1995³) that no doubt has its place here. The philosophy of science has seen major debate over the past two centuries between two forms of knowledge acquisition: the humanities, linked to qualitative research, versus natural sciences, linked to quantitative research. The concept of a “third culture” seeks to bridge this gap, and to reconcile these opposing viewpoints in order to transcend their differences with mutual enrichment.

1 Elias, W., *Signs of the time*, Rodopi, Amsterdam, 1997, pp.98–110.

2 Lévi-Strauss, C., *La pensée sauvage*, Plon, 1962.

3 Brockman, J., *The third culture: beyond the scientific revolution*, Simon & Schuster, N.Y. 1995.

Already in modernism, art was often interested in scientific work. Classifications and science-based technologies have particularly inspired many artists. The intention of this type of art was to be either critical or poetic. Critical because, for example, the basis for some classifications was questioned or because the significance of some technological discoveries was doubted. Poetic because the relationship between art and science was felt, but above all because one was interested in the form that science was taking.

With post-modernism, art took a completely different direction. When a post-modern artist gets inspiration from science, they no longer get inspiration on the basis of an unrealistic imagination, but rather on the basis of scientific knowledge that they themselves have, as an artist, or that they acquire through contact with scientists. The distinction is therefore very small, if not non-existent.

The point of departure is that the above-mentioned mutual fertilisation does not

remain within the ivory towers of science. Rather, the creative thoughts emerging from extraordinary gatherings in society must be made accessible to the public at large. This creative fusion between art and science can take many forms such as creating awareness on important societal issues as a result of technological progress. Or simply the use of information technology in art as demonstrated in digital art.

Thus far, there have only been demonstrations of what is possible rather than fully worked out in collaborative projects. It is therefore very important to study further the interface between art and science and to promote the potential of this cross-fertilisation or rather creative fusion.

Professor Willem Elias

*Vice-Dean Psychology
and Education Faculty*



What is the third culture?

Artistic research is an important element of both the art and the science worlds. Artists no longer feel the need to create solely for an object-centred art market. Instead, many artists are now exploring new creative forms where they find and invent projects that do not fit into the traditional art world. These people are reaching across cultural barriers and forging something new and unique.

Artists and researchers have taken elements from science and the humanities – two distinct and well-established cultures – and created a third. This third culture – arts & science – is a bridge between the two old ones. Artists are now able to use elements of science in new and exciting ways to generate creative results.

The concept of the third culture was first introduced by C.P. Snow in 1959 as he lamented the gap that had formed since the 19th century between humanities and natural science. This

gap, according to Snow, negatively impacted both fields. He predicted that a new generation of scientists would close the communication gap between these two cultures.

Today we can see Snow's predictions coming true. There is a growing and innovative field of art that has taken to using science and research to make thought-provoking pieces. Artistic research is becoming commonplace and not only artists and scientists appreciate it. The general public is becoming aware of this field and being brought into the third culture as well.

The third culture very much exists today. Look around and see any number of artists who take elements of science – biology, nanotechnology, cybernetics, information technology – and incorporate them into their work. The extreme gap that Snow observed between the humanities and natural science

in the 1950s has been overcome and arts & science, the third culture, has brought the two worlds together.

The ideal projects we are envisioning and presenting intend to strengthen the field of artistic research at the interface of art and science. Both cultures, art and science, have in common human curiosity, creativity and the desire to understand and represent the unknown. The initiators of these projects are of the opinion that the differing epistemics and forms of knowledge production can be used productively in the collaborative work of artists and scientists.

In the form of collaborative art-and-science research projects, reciprocal exchange and public presentations, these projects create an intercultural landscape of aesthetic and ethical knowledge production.

Contemporary research art

Jurij Krpan, Art Director of Kapelica Gallery & Cosinus brx Project, introduces us to the practical application of art & science.

The mission facing any progressive artist is to test the borders of accepted interpretations and questions governing public attitudes and values. With their heightened sensibility, artists are often among the first to sense social shifts and use their work to deal with topical themes and issues. Every era of human history is marked by exceptional individuals whose contributions have shifted the borders of understanding. We can say that the avant-garde has always played a role in changing conceptions of art and its role in society. Indeed we can claim that art has always been linked with the field of scientific investigation and development, and has, in parallel, transformed the world intellectually, emotionally and experientially. Science and technology have often united with art in one single entity, which, when answering the ultimate questions "Who are we? Where do we come from?" never limited itself through any investigative norms or practices of expression. Today, scientists and technologists rarely work in isolation. In the same way artists today often operate in groups with experts in particular fields.

Put away your paintbrushes

Contemporary themes imply contemporary materials and techniques. Instead of traditional painting and sculpting materials in their projects, artists use the objects, technology and software employed by science and technology. Computers, electronics, navigation systems, software, analogue and electronic telecommunications, information systems and so on are now available to almost anybody. The use of these

materials by artists is legitimate; they deal with themes of scientific paradigms and their applied aspects by using the means of expression that arise out of these paradigms.

In such forms of artistic expression we rarely come across a painter's canvas or a sculptor's materials. Instead, it is common for complex installations and systems to be used incorporating viewer participation and running from a few seconds to a few years. We rarely encounter decorative scenography or descriptive accounts of vistas. Instead, inductive processing of the theatrical environment and events outside the context of theatre buildings are common. Traditional music instruments are treated as equal to soundproof rooms, sophisticated audio-electronics and computer programs.

Given that such art projects use elements that we could easily encounter in scientific laboratories, uninformed visitors to exhibitions displaying these projects often offer critical commentary. They reproach artists for supposedly competing with scientists, claiming that since the latter inevitably do it better, their work is doomed to failure. But the eye of a viewer accustomed to appreciating complete, aesthetic works of art cannot see that the artwork no longer rests within the objectivity of the installation, text or sound, but within the direct experience, the process and more or less participatory constitution of the art.

New means of presentation

This brief introduction to the practical application of art & science

must also highlight the ways of presenting these works. Today, the inert practices of mounting and displaying objects in an exhibition space have been replaced to focus on establishing working systems, open processes, exhibitions within a space incorporating an interactive component similar to life itself, thus changing exhibition spaces into active platforms. Performance art is leaving behind the rigid confines of the "theatre box" where the relationship between the audience and the actors is fixed forever. Music has long since ceased to be confined to a monolithic recreational set of harmonies, but spans the spectrum from radical silence to newly invented sounds that have never before been heard... Just as artists are leaving behind the safe boxes of occupational and genre qualifications and visual artists engage with sound and performance aspects of their work, so too can interested consumers no longer rely on a hermetic cultural education.

A number of artists and artistic groups today work with scientists at institutes and universities on interdisciplinary projects. Progressive art faculties have since the mid-1990s been creating podia for intermedia arts, where students are also educated by scientists and technologists. The educational process at academies equips artists who work in an interdisciplinary fashion with international contacts and establishes institutes comparable with scientific laboratories in artists' studios. All of the above, parallel to the demands of whole new generations of art audiences, relegates the 500-year-old concept of belle arti to mere historical reference.

Jurij Krpan

Art Director of Kapelica Gallery & Cosinus brx Project

Biology beyond the lab

Polona Tratnik, PhD, an artist and academic, uses scientific tools and methods in the sphere of art to discuss topics related to biotechnology. She is able to create unique and interesting art that demonstrates the interface between art and science through the use of micro-organisms and cells related to the human body.



In her numerous projects Polona Tratnik explores the microbiology of the human body. With the support of biotechnology and the procedures of fragmentation and reconstruction of the body, the artist manipulates living material. Through this manipulation she encourages the re-examination of the notion of living and alters

the understanding of the human organism, which is undergoing profound change through tissue engineering and other microbiological procedures.

With the project *37°C* (2001) the limits of life and death through skin are explored. The observer experiences a warm, dark organism-installation space with growing skin cells, which is capable of maintaining and creating life. In the second realisation of the project (*L'Art Biotech*, Nantes, 2003) skin cells are held at 4°C, where their metabolic activities stop and therefore life is stopped, but could be revived again at 37°C.

Unique (2006), like some of her previous projects, continues to discuss the interweaving of the individual in the common microbiological flesh of the world and to question the boundaries of the individual's intimacy and privacy. It enables an insight into the micro world of the human body, and visualises the fauna and flora of it. Samples of micro-organisms of the observers are collected, cultivated and exhibited in windows under special conditions. The graveyard of the human remains becomes a fertile storehouse that enables life.

In Tratnik's work, science is tightly linked to art. Art here explores biotechnology, uses microbiological tools and insights within a field of contemporary research art. Thus it widens the field of art and discusses the actual social and political questions regarding biotech discourse.

SPOTLIGHT ON THE ARTIST

Name	Polona Tratnik
Location	Ljubljana, Slovenia
Specialisation	Biotechnological art
Website	http://www.ars-tratnik.si/

Art and science – evolving symbioticAlly

We investigate SymbioticA – the art and science collaborative research laboratory.

Somewhere in the University of Western Australia, a researcher is conducting an art project on interactions with bowerbirds using three conceptual approaches in green, grey and dull silver. Another researcher is exploring how retroviruses are being used in molecular and cellular microbiology, to provoke a rethinking of current practices of taxonomic and documentation strategies used in art and science. The place? SymbioticA – an artistic laboratory established in 2000 and dedicated to the research, learning and critique of life sciences, part of the University of Western Australia.

The first of its kind, SymbioticA enables artists to engage with science in a biological science department. Through their active use of scientific tools and laboratories, artists can explore science rather than simply comment on them. Resident researchers and students undertake projects that develop the links between the arts and a range of research areas such as plant biology, anatomy, tissue engineering, animal welfare and ethics. They can fully explore areas of interest free from the demands and constraints associated with the current culture of scientific research while still complying with regulations. In addition, it organises exhibitions, conferences, workshops and open afternoons to encourage awareness of biological art and provoke debate among the general public.

Model mice and patchwork coats

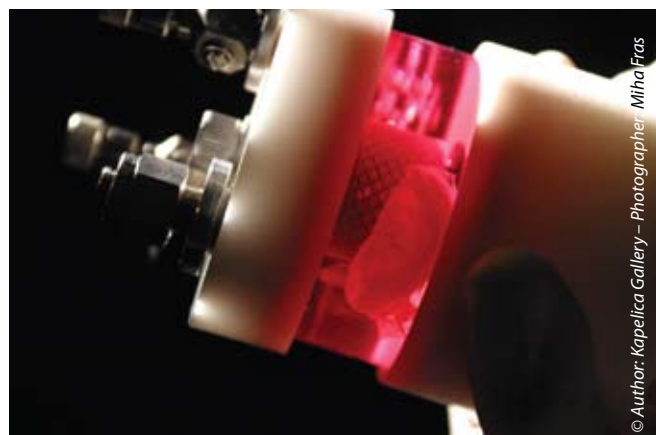
One example of a project is that by Verena Kaminiarz centring on mouse “animal/human models” used in medical research. “Disease model” mice can be ordered from

laboratories that guarantee them to develop various complications such as auto-immune diseases or cancer. Her aim was to attain an assortment of these creatures and provide them with a peaceful, restful area to live out their lives. However, instead of conducting “scientific” experiments in the traditional sense, she installed them as living portraits, in this case as portraits of artists whose work had inspired her. These artists all died from conditions for which there are mouse-model equivalents. In this way, the human disease model mice acted as representations of the artists.

For the 2007 *Still Living* exhibition, French artist ORLAN created the *Harlequin Coat* – a composite, organic coat, made from pieces of skin of different colours, ages and origins. This prototype of a biotechnological coat aimed to symbolise cultural cross-breeding and question whether a person owns their cells.

Encouraging art & science collaboration

SymbioticA gives both artists and scientific researchers the ability to explore their interests in both fields. Through the various projects and exhibitions it sponsors and takes part in, it is able to promote the idea of art & science to a wider audience while educating people about the life sciences in a unique and engaging manner.



© Author: Kapelica Gallery – Photographer: Miha Fras

SPOTLIGHT ON THE ORGANISATION

Name	SymbioticA
Location	School of Anatomy and Human Biology, University of Western Australia, Australia
Specialisation	Artistic research activities in the life sciences
Website	http://www.symbiotica.uwa.edu.au

The lab is now a studio

Portuguese Marta de Menezes explores the interaction of science and art through her work. Working in biology laboratories, she demonstrates how biological techniques can be used as a new artistic medium.

Humans have been trying to manipulate nature since the dawn of time. This has usually been for practical purposes, domesticating animals, for example. Marta de Menezes uses this concept, but modifies nature for artistic objectives.

Nature? is one such project. Menezes modified butterfly wings to create designs that have never before occurred in nature. Only one wing has been designed by the artist so the difference between the natural and the artificially designed can be fully appreciated. In altering the wings of the butterflies, Menezes does not modify the DNA, keeping the genetic line pure. The art has a lifespan, that of the butterfly.

Menezes has also used cell biology techniques and DNA to produce art. With *Nuclearart*, special DNA is used to paint the nuclei of human cells. By controlling what chromosomes or groups of chromosomes are painted, the artist is able to create a controlled image, one that is only able to be viewed with a laser scanning microscope. The images help researchers better understand the organisation of the human nucleus.

To paint brain activity, Menezes has employed MRI technology to photograph the brain. Functional portraits is an attempt to record the brain while a subject performs a specific task, like playing the piano. The brain produces complex activity patterns during different activities which can be recorded by MRI and “painted” by the artist.

Menezes’ work has been shown across the globe and her unique use of biotechnology has worked to bring art & science to the mainstream.



© Author: Kapelica Gallery – Photographer: Miha Fras

SPOTLIGHT ON THE ARTIST

Name	Marta de Menezes
Nationality	Portuguese
Specialisation	Biotechnological art
Website	http://www.martademenezes.com/

Communicating nanotechnology through art

How can the public be helped to better understand and engage with nanotechnology? How should nanotechnology be communicated? This European Commission project has some suggestions.

A relatively new science, nanotechnology is a popular topic in the media but the general public does not fully understand what it is and what it aims to achieve. At the same time, it shows promise for use in fields like medicine, energy and materials but more research and regulation is felt to be needed and stakeholders hold varying attitudes towards the field, from trust to concern and caution.

In this context, the European Commission wants to promote an integrated, safe, responsible and socially acceptable approach for the development and use of nanosciences and nanotechnology. To achieve this goal however it is crucial to find ways of informing the public about the results and implications of such studies. At the same time, it is necessary to learn more about public opinion on nanotechnology and to build mechanisms that will allow open and accessible channels of communication to be put in place in order to connect different groups of stakeholders, with a view to fostering engagement and dialogue in society.

The project

As such, the project "Communication outreach in nanotechnology: from recommendations to action" was organised by the Commission, including two workshops in February and October 2007 and an open consultation process. The first workshop brought together some 25 experts from

science centres and other science communication organisations, whose recommendations were then published online for public consultation, to which hundreds of comments were contributed.

A second workshop was then organised, with the help of experts from the fields of philosophy and sociology of science, science communication, science centre professionals, as well as artists and graphic designers, such as the BridA Art Collective (see box). The objective of the exercise was to detail appropriate actions in science communication and dialogue building with society. The project drew up a set of operative recommendations for future European funding on appropriate communication and innovative approaches to engage the European civil society into a dialogue on nanotechnology.

Art & science

Interestingly from an art & science perspective, one recommendation was to develop new models and tools for communication, dialogue and engagement, especially those could be considered "light", unconventional and emotion-based – e.g. theatre, art, fairs. The workshop identified various actions directed to the general public with the objective of stimulating curiosity, raising awareness and collecting feedback from people, which should best focus on leisure time activities. In particular, they found that art is

an instrument well suited to the task of catching people's attention. The aim is to reach people who are usually not involved and stimulate their curiosity, either by providing stimuli through perception, dance and art and adopt a user-oriented approach, answering the question "Why should I be interested?" The activities would provide basic information about nanotechnology, what it is and what implications it has, keeping it simple and realistic without oversimplifying. They would stress the fact that nanotechnology is not magic, it's a science that has methodologies and interdisciplinary work behind it, it is not static knowledge acquired once and for all but an evolving technology where new information is gained every day and new perspectives may emerge.

One proposed activity would be a virtual guided tour to a nano-environment, to give the idea of scale and nano-dimensions. A guide or mascot (sympathy figure) could be used to show the visitor around the virtual environment – e.g. "Captain Nano" or a user-generated avatar or a combination of the two. Edu-tainment tools can be made available. This kind of media can also be designed to work both for leisure and for professional/school time.

Contemporary nano-art festival

Another proposed activity would be festivals joining contemporary

art in various domains, where nanotechnology is interpreted using various arts and disciplines. This event should be modulated to target different audiences and include policy-makers to maximise impact and media coverage. Events should be planned by groups with mixed competencies, such as scientists, artists and designers

together. Interactivity with the public is a particularly important aspect of this kind of event and input from the public should also be welcome.

In addition to workshops, short films and connections to the "outside world" via the Internet, webcams, some possible components would

be an art exhibition with installations that introduce the public to the creative processes by offering the possibility of interacting with the artworks. These could change following actions carried out by users. Nanophysics laws could be introduced in the design of the artwork itself. A talk by a scientist could also be given, connected to an artistic means of expression interpreting the words and giving them perceptive depth, through visual aid or an artistic performance where dancers interpret what the scientist says through movement.

SPOTLIGHT ON THE PROJECT

Name	Communication outreach in nanotechnology: from recommendations to action
Specialisation	Workshops and consultation process run by the European Commission Directorate-General for Research (Directorate G – Unit G4: Nano- and Converging Sciences and Technologies), in February and October 2007, Brussels Recommendations on the best way to proceed with the communication of nanosciences and nanotechnologies
Website	http://cordis.europa.eu/nanotechnology/src/consultation.htm

The BridA Art Collective

One participant in the "Communication outreach in technology" project was the BridA Art Collective, specifically Tom Kersevan, Sendi Mango and Jurij Pavlica. Based in Slovenia, the Collective was formed during the artists' studies at the Academy of Fine Arts of Venice in 1996 and chose the name "BridA" as it cancels traces of individuality within the group and establishes a new body capable of existing and functioning autonomously. BridA is currently researching the transmission of information and application of nanotechnology research to the artistic process, placing it in an excellent position to participate in the Commission's project. One of its most recent works, *Information Accelerator*, unites and combines the processes of transmitting and receiving information, of directing and channelling it in an extensive system of tubes or pipes. The module spanned the entire gallery as some kind of conduit, making the flow and processing of all kinds of information possible. In BridA's words "such a structure can be

compared to a traditional drawing resembling a network of wires and channels. In such case, the drawing would be understood as a topographical grid for combining information in diverse ways, multiplying it, dividing it, adding it up and subtracting it, drawing the path to the final message in some sort of system of coordinates."

Another project, *MODUX*, comprised an analysis of the process of creating a work of art from the fundamental information, through processing and interpreting it, to the final product. BridA developed the project in stages, involving not only the development of the process but also of the project concept. A mural in Tarcento (2004) concerned transforming a digital image to such a low pixel density that the net of coloured squares became clearly recognisable and the original image was not discernible. This image record was subsequently converted to audio instructions for colouring in the square fields, to obtain an image trapped in the net. This experimental product was later developed by BridA into a project titled *Naredi sam/Do it*

yourself (2005), in which the audio instructions for creating a picture became the actual artistic product, while the actual final product (a net of squares representing a digitalised image) could be made by anyone following the audio instructions. In this project, BridA included the random visitors for the first time, giving them the opportunity to create an artistic product by themselves.

In *MODUX*, BridA addressed several dilemmas of the modern society, related to technology and art. The creative process of the paintings is linked to the empirical view of the world on which Western art is based. In this view, the measured value is the only true proof. A piece of measured information is something we all believe in and accept to be true. Even the modern media is supplying us with a multitude of truths, backed up with documentary materials. When creating a painting, BridA performs a subjective selection of a segment of a piece of single information and the "apparent scientific".

Website <http://www.brida-kud.si/>

Are you a zombie-cyborg? According to Stelarc, we all are.

We look at how Stelarc unites art with cybernetics by exploring the concept of the body and its relationship with technology through human-machine interfaces.

According to Australian artist Stelarc, the human body has always been involuntarily conditioned and prompted by external forces. At the same time, it is inextricably linked with technology, being augmented by machines. Thus, he says, all humans are zombie-cyborgs. The artist has highlighted this tenet through several striking performances, using medical instruments, prosthetics, robotics and virtual reality systems. For the *Net-connected* project, for example, he allowed his body to be controlled remotely by electronic muscle stimulators connected to the Internet.

The obsolete body

In other works, Stelarc stresses the inadequacy of the body: it is not very efficient, malfunctions and is ultimately doomed to fail. He believes that the body is now biologically obsolete and should be seen as a structure to be monitored and modified. His projects like *Virtual Arm* build on these concepts: this work was designed as a universal manipulator with functions not limited by either physiological structure or mechanical constraints. Rather than being simple mimicry, the extended capabilities of the *Virtual Arm* can be choreographed using a gesture recognition command language.

Communicating his concepts

These projects are key examples of the art & science field, bringing together modern technology with artistic expression. The concepts contained within Stelarc's work also unite all human beings – regardless of their nationality and culture. As people, all our



© Author: Kapelica gallery – Photographer: Igor Andjelic

bodies are equally frail and can be modified in same ways shown by his pieces.

In addition, he raises awareness of the use of technology and cybernetics through art that catches people's attention and provokes debate. His work has been performed around the world, including Europe, Japan and the USA. He was even able to reach a worldwide audience in the *Net-connected* project: anyone could participate by logging on to the exhibition and accessing the electrodes to which Stelarc was connected.

SPOTLIGHT ON THE ARTIST

Name	Stelarc
Nationality	Australian
Specialisation	Exploration of the body with technology
Website	http://www.stelarc.va.com.au/arcx.html

Speech and sound art – it's electrifying!

1930s dictators, gas flames and birdcages. "Forgotten" inventor Elisha Gray, a copper bath and music. We take a look at the work of electronic media artist Paul DeMarinis.

Working since 1971, Paul DeMarinis has created numerous performance works, sound and computer installations and interactive electronic inventions which have been shown all over the world. Emulating the artist as a meta-inventor, DeMarinis asserts that he has the freedom to explore and imagine because he is neither a scientist nor an historian. His research is experimental and he tries to see what works and what fails.

Following the inventor analogy, DeMarinis researches "forgotten" inventors such as Elisha Gray who was beaten by Alexander Graham Bell for the patent of the telephone. DeMarinis created his own version of Gray's other invention (the Musical Bathtub): *Gray Matter* – a series of electrified objects that produce sound and sensation when stroked with the hand – explores the interaction of body and electricity to make music. In another piece *Firebirds*, oracular flames kept captive within birdcages recite speeches of 1930 dictators – Hitler, Stalin, Mussolini. Gas flames, suitably modulated by electrical fields can be made to act as omnidirectional loudspeakers.

Much of DeMarinis' recent work deals with the overlap between human communication and technology. Inspired by 18th-century physician and naturalist Francesc Salva i Campillo's output device for his telegraph equipment, *The Messenger* examines the myths of electricity in communication. It



comprises three parallel telegraph systems based on incoming imaginary email messages. One system is made of 26 electrolytic jars with metal electrodes in the form of the letters A to Z that bubble when electricity is passed through them. The piece takes telegraphy as its point of departure for an examination of the interrelationship of electricity and democracy. It deals with how electronic communications technologies, in addition to enriching our lives and experiences, also contribute to our loneliness and isolation.

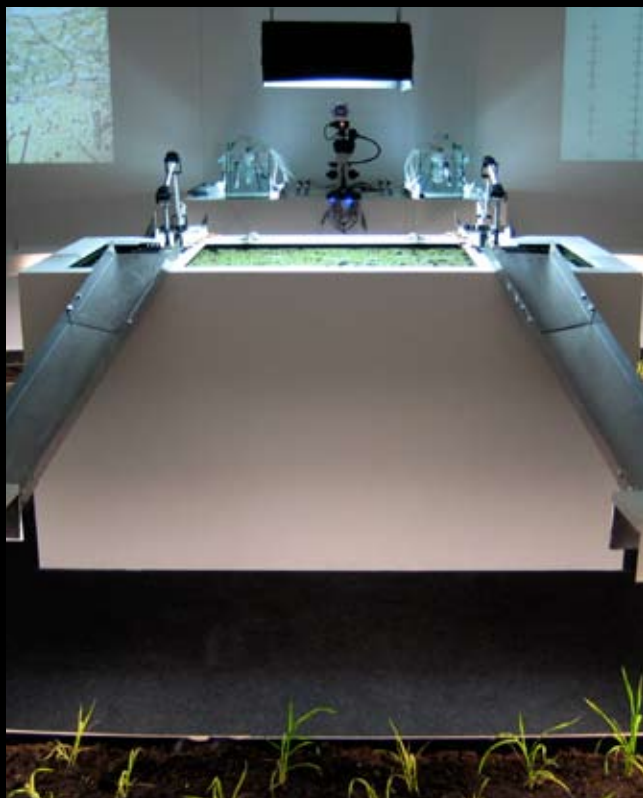
Through his work, DeMarinis seeks to highlight the interface between electronic media and society. Not only did electronic media reconfigure our culture's perception of the relationship between speech and sound in the 20th century, the transformation of speech into signal, signal into wave, to recording and playback make apparent that meaning is forever cast as sound, sound as signal, signal as noise, etc..

SPOTLIGHT ON THE ARTIST

Name	Paul DeMarinis
Nationality	American
Specialisation	Electronic media art
Website	http://www.well.com/~demarini/

Andy Gracie: Autoinducer_Ph-1

<http://www.hostprods.net/>



Autoinducer_Ph-1 reworks a traditional Asian rice cultivation technique which exploits a natural symbiosis between Azolla plants and Anabaena cyanobacteria. Here the relationship is forced into new parameters with an additional symbiosis between the Anabaena and a virtual bacteria colony.

An assemblage of pond-like structures, electronics, robotic arms, rice plants, and laboratory equipment probes into and interferes with symbiotic relationships. Data and information systems inherent in the relationships between organisms and how they may be augmented with artificial counterparts are brought into focus as outcomes of the complex relationships within the system determine the behaviours of the robotic arms and the growth of the rice.

Andy Gracie ©

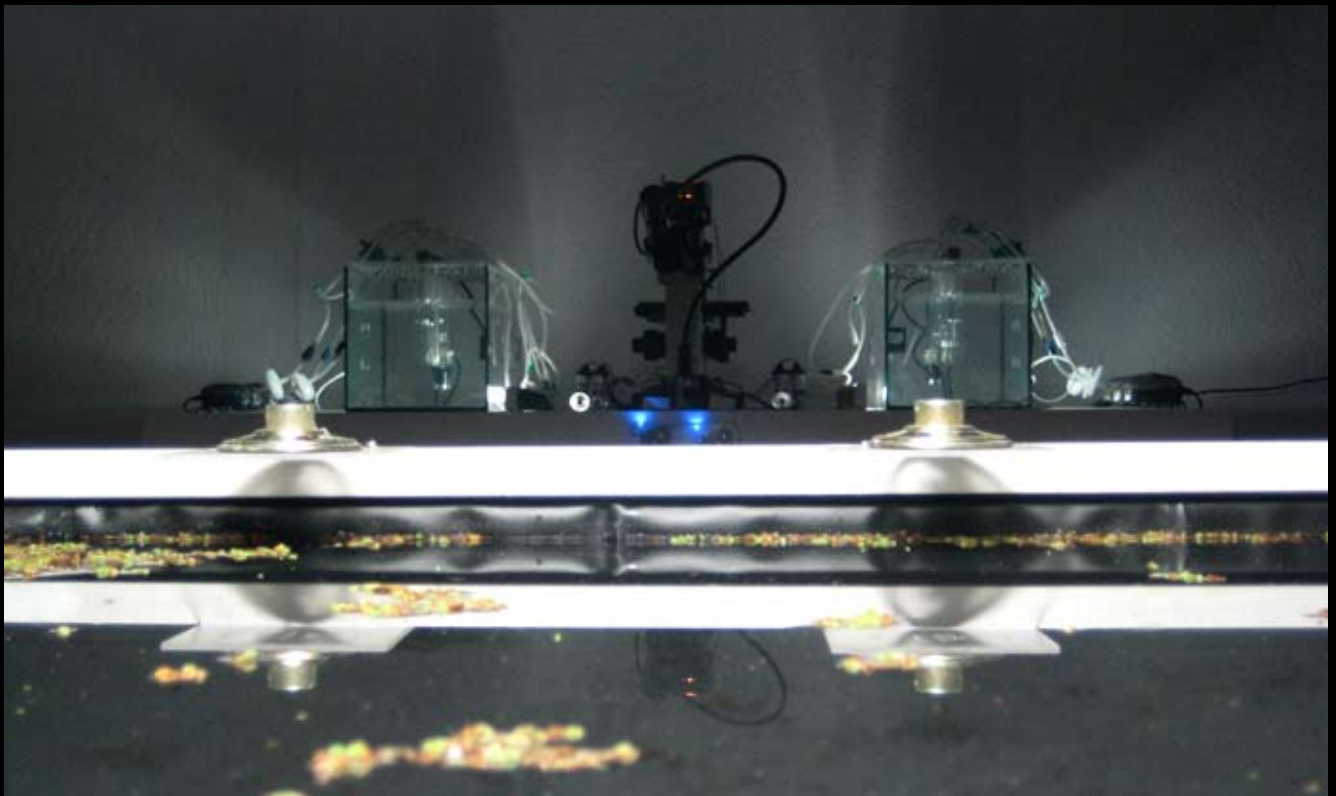
Artistic development and construction: Andy Gracie

Software development: Brian Lee Yung Rowe

Originally commissioned by Avfest for AV06

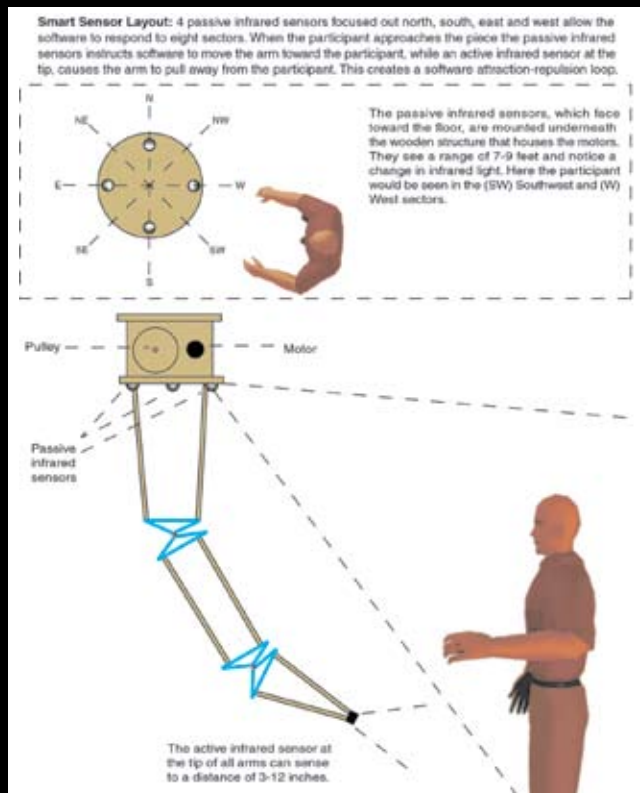
Completed with the aid of a grant from Arts Council of England

Developed during a studio residency at Comafosca, Alella, Barcelona



Ken Rinaldo: Autopoiesis

www.kenrinaldo.com



Autopoiesis is an artificial life robotic series of 15 musical and robotic sculptures that interact with the public and modify their behaviour based on the both the presences of the participants in the exhibition and the communication between each separate sculpture.

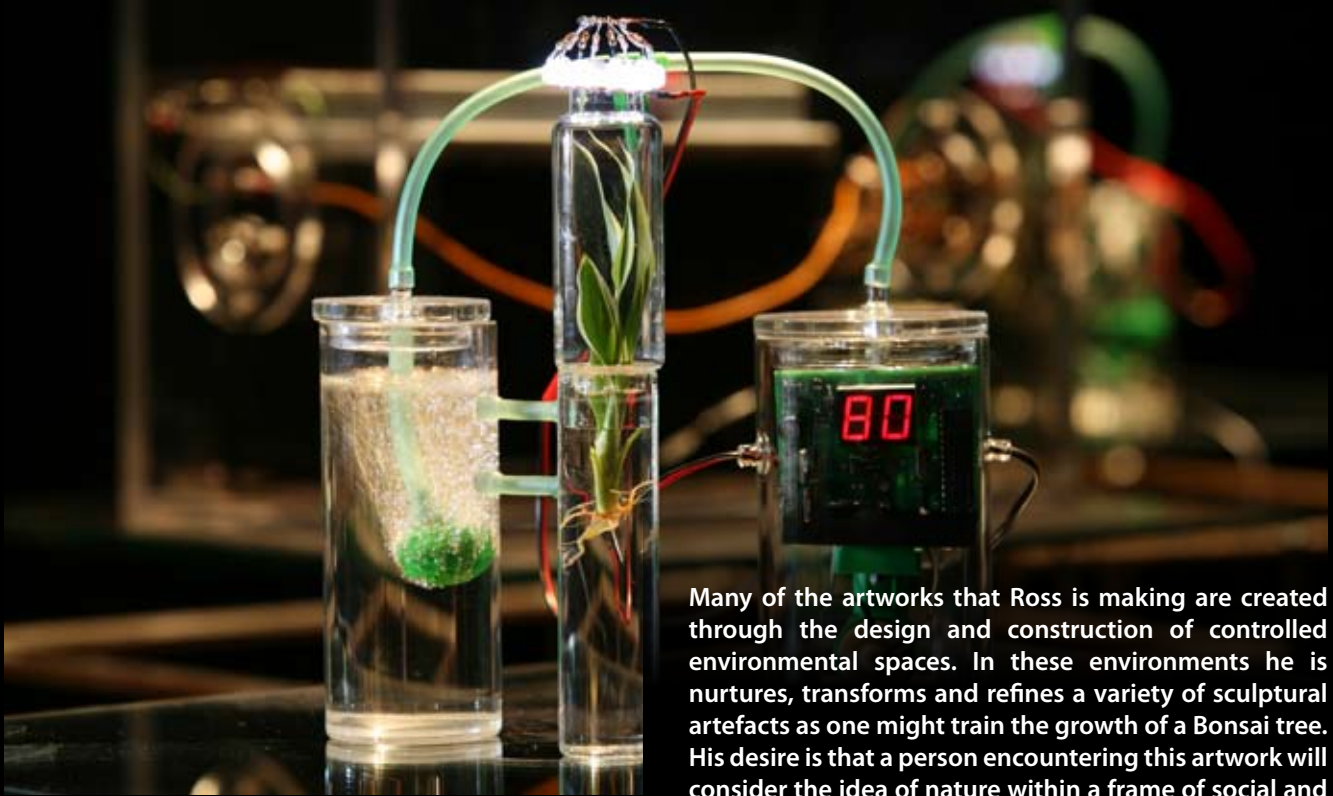
This series of robotic sculptures talks with each other through a hardwired network and audible telephone tones, which are a musical language for the group. Autopoiesis is "self making", a characteristic of all living systems. This characteristic of living systems was defined and refined by Francisco Varela and Humberto Maturana.

Ken Rinaldo ©
Photographer: Yehia Eweis
Photo: Kiasma Museum Central Art Archives/Yehia Eweis

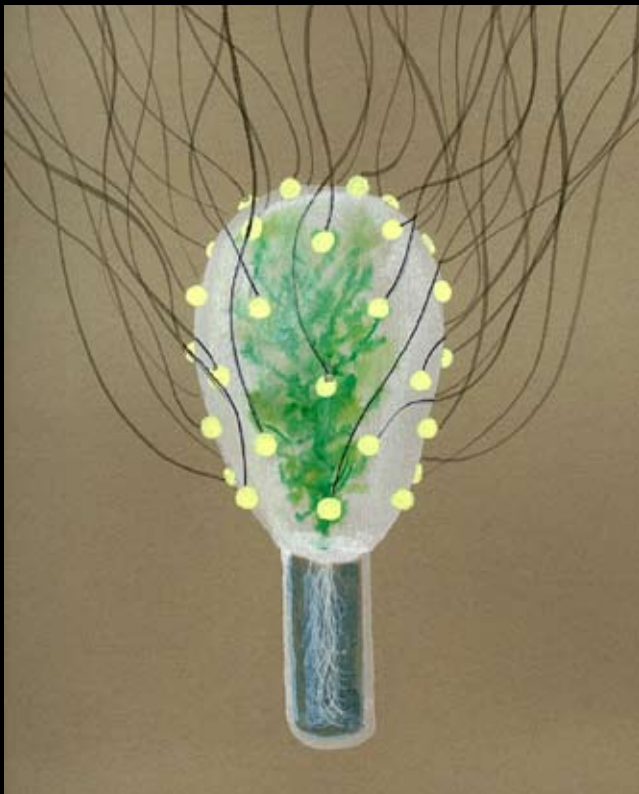


Phillip Ross: Junior return

<http://www.philross.org/>



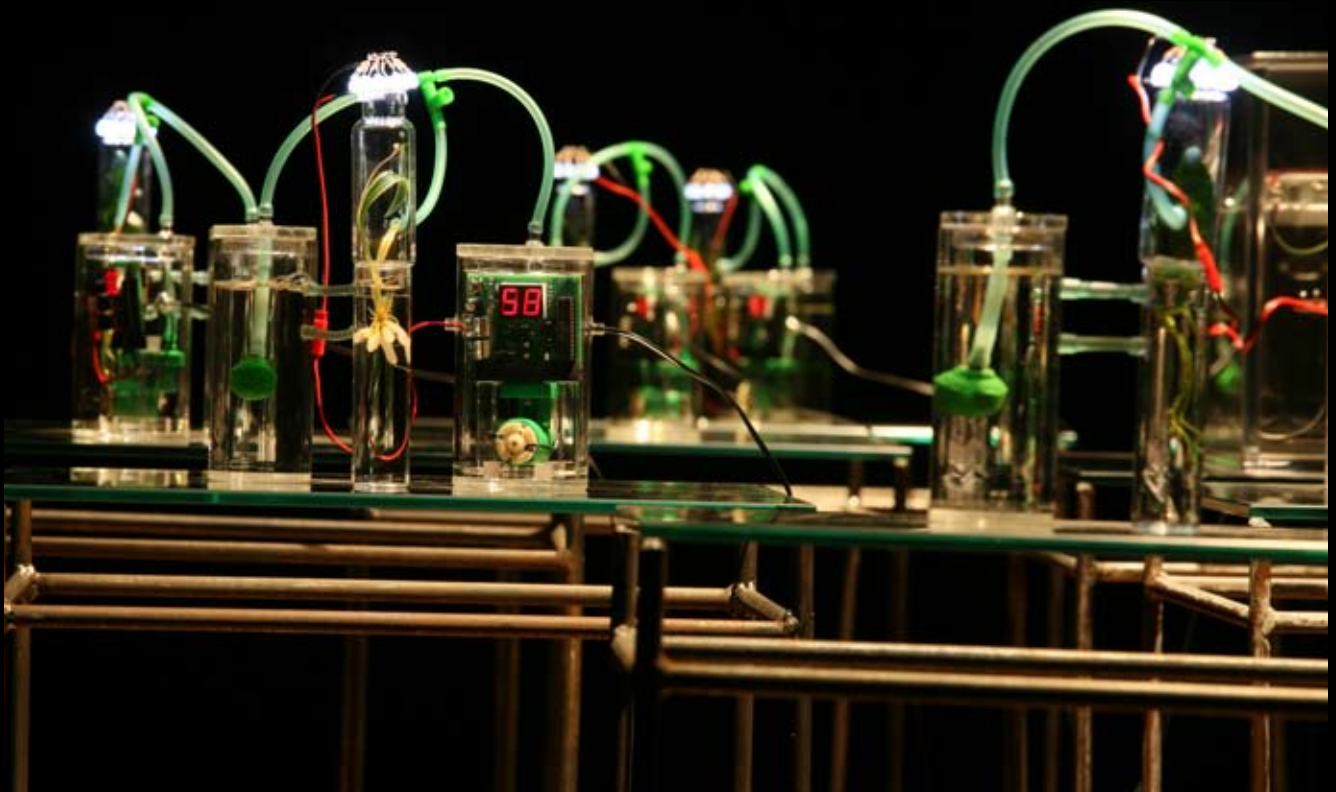
Many of the artworks that Ross is making are created through the design and construction of controlled environmental spaces. In these environments he nurtures, transforms and refines a variety of sculptural artefacts as one might train the growth of a Bonsai tree. His desire is that a person encountering this artwork will consider the idea of nature within a frame of social and historical contexts.



Junior Return is a set of glass capsules that provide a miniature, computer-controlled hydroponic environment; the plants' roots are submerged in nutrient-infused water, while LED lights supply the illumination required. These pods are tethered by electrical wire to a battery pack that supplies the energy for all of the plant's requirements. A digital timer counts the seconds that remain until a small pump is activated, briefly moving air to the plant and the water that bathes its roots. Then, with little notice, a few bubbles appear in the water, the only resolve of the anticipation.

The system keeps its enclosed plant in a dwarf state by supplying only enough resources to survive but not thrive. He kept a broccoli seedling alive for almost three years using this technique, and wanted to formalise this behaviour in a device. The plant in this container could flourish in the most meagre of environments, but would also be invisible to us in significance and aesthetic consideration.

Kapelica Gallery ©
Photographer: Miha Fras



Dragan Živadinov and Dunja Zupančič

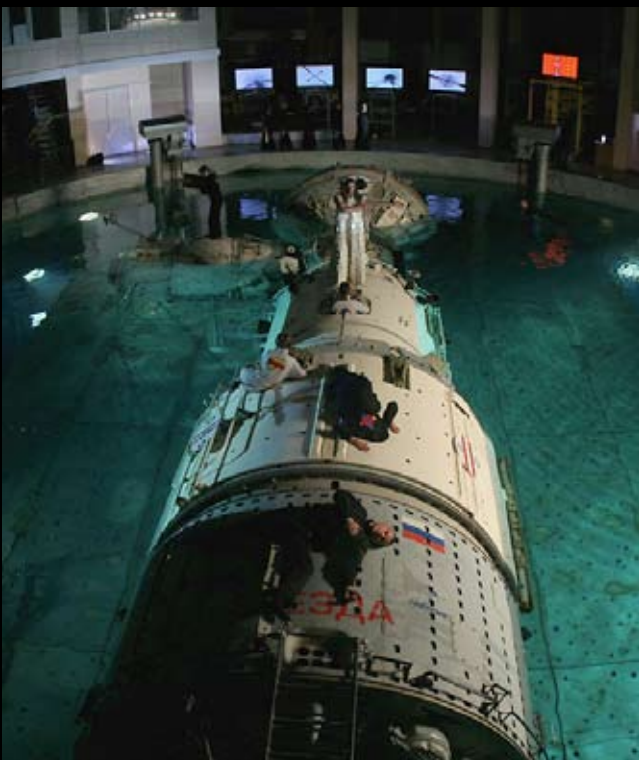
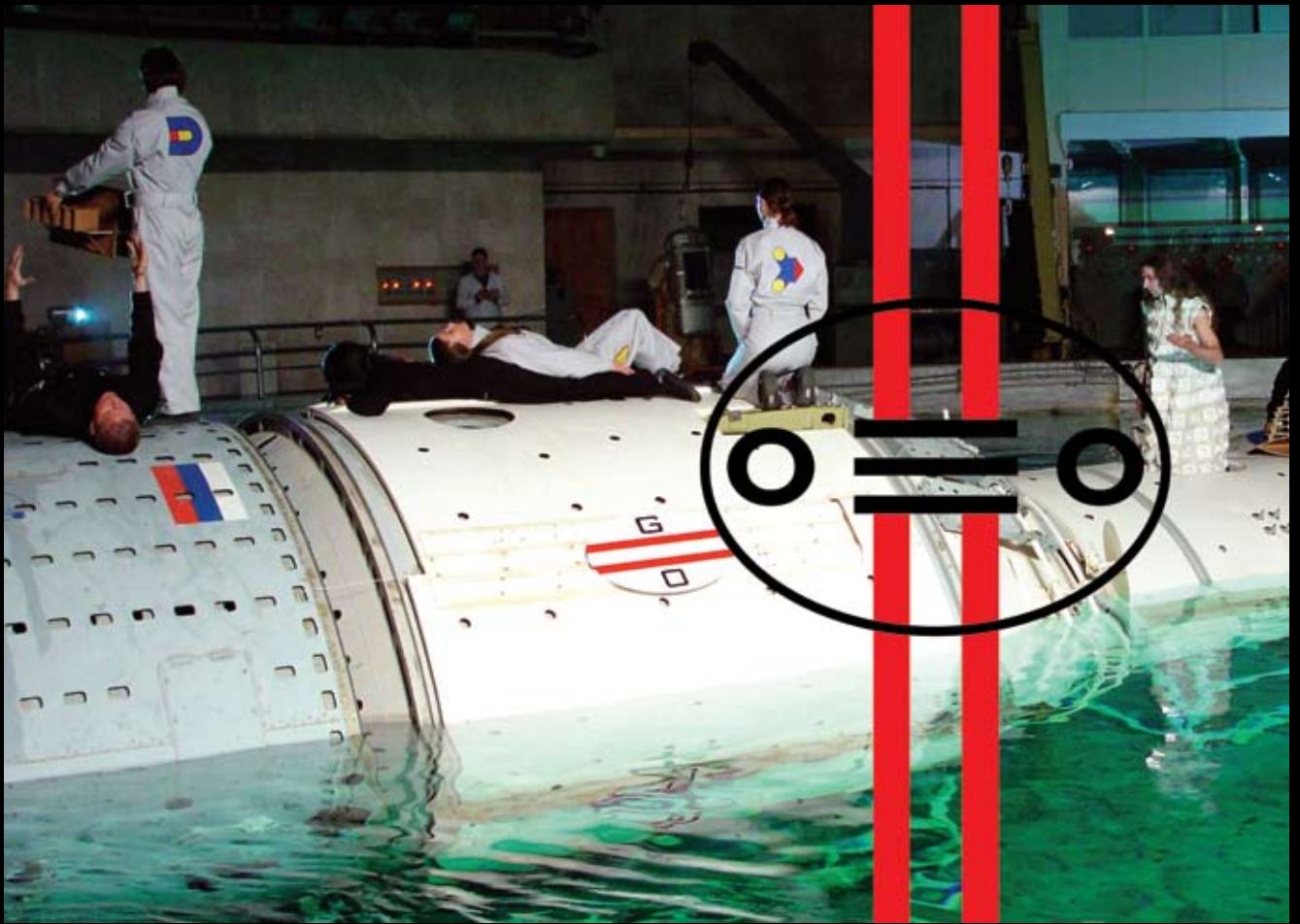
<http://www.noordung.net/> www.nskstate.com



If choreography is writing with bodies in space, he is the largest-scale choreographer ever. Dragan Živadinov from Ljubljana is the first artist in the history of space travel to be trained as a cosmonaut. In conditions of simulated zero-gravity – “parabolic flights” – he is working on dances to be performed in the cosmos. With *Praying Machine Noordung*, his earth-bound production for the Ljubljana Ballet, he is also proving himself to be a maximalist, temporally as well as spatially.

Živadinov plans to return to this piece every 10 years with exactly the same troupe, replacing each member they inevitably die over the decades with a recording of music, until one day only a concert remains on earth. The cremated bodies of the departed will continue the choreography by orbiting the earth as satellites in suprematist-style urns. He has chosen the infinite vastness of space as an arena because only weightlessness can ensure eternal movement. The dance of the space urns will go on forever. This must be the most glorious monument ever created by dance in honour of itself.

Dragan Živadinov ©
Photographer: Miha Fras



COASTOMIZE! and other MIXED REALITIES

www.hedendaagsekunstindevlaamseardennen.be

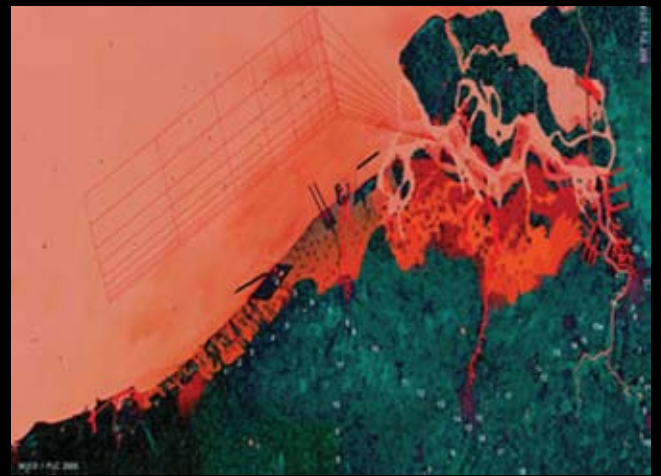


COASTOMIZE! and other MIXED REALITIES is an initiative by architect Marc Godts and art curator Sven Vanderstichelen. COASTOMIZE! is experiencing new space and time in a world where art, architecture, science and technology are no longer means but become context and environment. COASTOMIZE! and other MIXED REALITIES explores the notions and dynamics of private and public space. The changes in the coastline reflect the changes that happen everyday in our personal space.

COASTOMIZE! questions the roles design and planning have in limiting the space of the coast and their role in affecting everyday life. Artists explore these questions by playing with the boundaries of art, science, design and technology.

www.hedendaagsekunstindevlaamseardennen.be

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BridA Art Collective

<http://www.brida-kud.si/>



The BridA Art Collective comprises Tom Kersevan, Sendi Mango and Jurij Pavlica. Based in Slovenia, the Collective was formed during the artists' studies at the Academy of Fine Arts of Venice in 1996 and chose the name "BridA" as it cancels traces of individuality within the group and establishes a new body capable of existing and functioning autonomously.

BridA Art Collective ©
Photographer: BridA Art Collective

Photos of the audio-video installation *Modux 2004–06*,
exhibition – gallery offices of the EU Commissioner for Science
and Technology, Berlaymont Brussels February 2007



Printed circuit board
BridA Art Collective ©
Photographer: *BridA Art Collective*



Still image from video, *Karosta (Latvia)*
BridA Art Collective ©
Photographer: *BridA Art Collective*

Cybernetics – combining the human body and machines

Marcel·lí Antúnez Roca explores the interaction between the human body and machines through cybernetics by way of mechanotronic performances and robotic installations.

Antúnez's work unites human and mechanical elements to create art that looks at how human desire is expressed. In *Epizoo* the artist is connected to an electronic exoskeleton which is remotely controlled by the spectator. When it first debuted in 1994, *Epizoo* was one of the first applications of computer technology to the human body.

With the installation *JoAn, l'Home de Carn* Antúnez combines biological materials with a full-size figure. The figure, covered in pig and cowhide, is connected to a computer that detects sound and then sends electronic signals to move the figure. The spectator directly influences the movements of the piece, which in turn, elicits a further reaction from the spectators. *JoAn* is a manifesto about the integration of mechanics, computers and organic materials.

Another of Antúnez's performances, *Hipermembrana*, combines interactive visuals and sound, the "dreskeleton" and different interfaces. The performers control the sound and visuals through the dreskeleton, which helps express the narrative element of the performance. *Hipermembrana* explores the myth of the Minotaur through the layering of visual and literary storylines. This allows the conflict between rationality and animal nature in humans to be explored.

Antúnez has showcased his work across Europe and the world and has won numerous awards for his unique cybernetic performances and installations. His work, even though centred on cybernetics and the mechanical, still has a strong human element that brings the audience into the piece.



© Author: Marcel·lí Antúnez Roca – Photographer: Carles Rodríguez

SPOTLIGHT ON THE ARTIST

Name	Marcel·lí Antúnez Roca
Nationality	Spanish
Specialisation	Cybernetic art
Website	http://www.marceliantunez.com/

Technology with a side of social commentary

Knowbotic Research, a group of artists and researchers based in Zurich (Switzerland), makes strong social statements through their art projects and installations.

Knowbotic Research's projects make strong points about important social issues facing Europe and the world. *BlackBenz Race*, a semi-fictitious car race in 2007, traced the path made by Kosovo-Albanian migration through Europe. The metaphor of the illegal car race highlights the intersection of the public sphere and the migrant network. Furthermore, the black Mercedes Benz in itself is a paradox: it is a symbol of mobility, trading and trafficking that is part of migrant life while at the same time being a status symbol for the upper class of society.

At the 2008 Transmediale festival in Berlin, Knowbotic Research presented its project *Be prepared! Tiger!*. The project, in part, re-enacts a propaganda video of the Tamil Tigers where a stealth boat emerges from the water. Through extensive research, Knowbotic Research was able to recreate the boat. Although it appears to be unmanned, the craft is guided by a person inside. The artists explore the fine line between visibility and invisibility while drawing attention to the conflict in Sri Lanka.

Knowbotic Research also exhibited their project *Naked Bandit* at the 2008 Synthetic Times in Beijing, China. This project uses a flying robot, latex balloons and an audio system to examine the conditions and treatments of suspects or prisoners of war. A small zeppelin-like robot follows the spectator while a repetitive voice says, "Naked bandit. Here, not here." A computer monitor further urges the spectator to intervene and if enough people do the male voice stops. This project gives the spectator a sense of situation and the lack of rights that prisoners of war are given.

Combining technology and art installations, Knowbotic Research is able to inform the public about a wide variety of pressing social issues. These unique art installations show the power that art & science can have in regards to educating the general public.

SPOTLIGHT ON THE ORGANISATION

Name	Knowbotic Research
Location	Zurich, Switzerland
Established	1991
Specialisation	Exploring the interface of technology, information, knowledge, interface and networked agency
Website	http://www.krcf.org/krcfhome/

Junk or art?

Slovenian artist Sašo Sedlaček takes what most people would consider junk and combines it with new technologies to create unique art.

Using rubbish and other media that are not considered to be the most obvious for artistic pursuits, Sašo Sedlaček has created his own style of art. He explores technology and its impact on society through his work.

In 2006 Sedlaček launched the project *Space Junk Spotting*. Since space exploration began, debris has been collecting around Earth. What do we do with this “space junk”? With space polluters shirk their responsibility for polluting but claim ownership, preventing others from addressing the space junk issue. The project utilises mechanical and programming equipment to link to a space observatory allowing the artist to create the most comprehensive database possible, detailing the size, location and country of origin of each piece of junk. This database provides the possibility of finding a creative solution for reusing space junk preventing the creation of further junk.

Another Sedlaček project, *Beggar*, is a robot that begs for money in areas where such behaviour considered taboo. *Beggar 1.0* was built in 2006, made of old, discarded electronic devices – computers, dvd players, TVs, etc. – and begged for money in a Slovenian shopping centre while a second version, *Beggar 2.0*, begged for money in Tokyo. *Beggar* highlights the rise in poverty and shows that the wealthy are more comfortable interacting with the poor from a safe distance, though an intermediary, like a begging robot.



Sedlaček's art has been exhibited in Slovenia and across the globe making people think differently about waste. He shows that rubbish can be made into something useful through the help of technology.

SPOTLIGHT ON THE ARTIST

Name	Sašo Sedlaček
Nationality	Slovenian
Specialisation	Waste and recycling as artistic media
Website	http://www.sasosedlacek.com/anglesko/vstopnastraneng.html

Marko Peljhan: between art and science

The *Zaum* (transreason) of civilisation

By Mojca Kumerdej

(excerpt of the interview published in the *Delo Sobotna priloga* on 2 February 2008)

In spring 1994 on the Croatian island of Krk, Marko Peljhan was contemplating his next performance, while explosions could be heard from the mainland and the sky was filled with military air traffic. At that moment, he decided to transfer his artistic work from the stage to a wider area, which today spans from the North to the South Pole, from the Earth to outer space. Peljhan is a visionary whose artistic work incorporates knowledge from an extremely broad spectrum of areas, from art rooted in the avant-garde, to science, technology, military strategies, and social theories. His ethical creativity is aimed at liberating the subject, while in his utopian projections he exposes the neuralgic spots of this planet and civilization, where the system of values transforms into its destructive contrast.

After working on the Makrolab project for 10 years – an art–science living and research station, which was first presented in 1997 at the 10th Kassel Documenta and then set up at different locations in Europe, the USA and Australia – he now works in conjunction with the team of the Interpolar Transnational Art Science Constellation (I-TASC), which comprises artists and scientists from a number of countries (Canada, South Africa, Brazil, New Zealand, Iceland, Germany, Russia, Slovenia, Singapore, India, Belgium, the United Kingdom, Croatia, Bosnia and Herzegovina, Israel, Lebanon, Senegal, Swaziland, Zambia, Chile, the US, Norway, Denmark, Japan,

etc.), to develop life support, tactical media, communication and creation systems in the Arctic and Antarctic in the framework of the International Polar Year. He received the 2007 Prešeren Award and several international awards, one of these being the 2002 Golden Nica Award at the Ars Electronica Festival for Art, Technology, and Society in Linz for the work he created together with Carsten Nicolai entitled Polar. Since 2002, Peljhan has been a professor at the University of California in Santa Barbara and is one of the initiators for the establishment of the Slovenian Space Agency; at the end of 2007 he was named one of the ambassadors for the Year of Intercultural Dialogue.

When taking up your mandate as the Slovenian ambassador of the European Year of Intercultural Dialogue, you quoted a statement by architect and social visionary Buckminster Fuller: "The world is now too dangerous for anything less than Utopia!", which is a counterpoint to the cynicism implying that the world is going its own way and that nothing can be changed or influenced. What is your understanding of utopia, in which you refer to the avant-garde of the 20th century?

Fuller's position is a counterpoint to both cynicism and the foundation of the western Realpolitik from World War II onwards, which declares the values that are generally acceptable, on the one hand, and which functions

completely differently, on the other, by dismantling the concept of a social state and endangering, consciously or unconsciously, the fundamental democratic values. I think that utopia must always be seen from the perspective of the liberation of the subject; only a conscious and liberated subject is capable of utopic projection. This is a very complex social and psychical operation, which naturally has better chances of being realised in art – which, in my opinion, is primarily intended for the reflexion and projection of such liberty – than in politics, which since the enlightenment has been submitted to very pragmatic and functional goals, the purpose of which is to concentrate power and control, and some type of ultimate functionality. There is little space for utopia within the dialectics between an individual and the large systems of power. And even if ideologies destroyed the avant-gardes of the 20th century, their utopias live on in art.

In your work you most frequently refer to avant-garde Russian futurist Velemir Khlebnikov, who carried out language research and is the author of the term "star language"; he also dealt with zaum ("transreason" or "beyond-sense") and, almost a century ago, his social visions included visions of the Internet, global communication, radio, a utopic political system of world presidents, and mobile living systems, perhaps a form of predecessor of your Makrolab?

I discovered Khlebnikov at the beginning of my artistic career at the end of the 1980s, first through his poem *Ladomir*, written shortly before his death. *Ladomir* is a linguistically complex manifesto already in its title, as it consists of the concept of *lad*, denoting harmony, and *mir* signifying peace as well as the world and even the cosmos. Simultaneously, *Ladomir* speaks of war and destruction, which is a reflexion of World War I, and which implies totalitarianisms and forecasts World War II, which almost led to the destruction of the concept that proved constitutive of European civilization.

For Khlebnikov, language was the key element which had to be analysed first if the system of concepts on which it is based was to be understood. He created a very complex audio- and semantic topography of the language. One of Khlebnikov's key works, which is rather unknown, is his *Tables of Destiny*, logarithmic tables or mathematic models, by means of which he analysed key events in the

history of European civilisation. He believed that he had discovered laws that were beyond the currents of history and that the time dimension had a very specific rhythm.

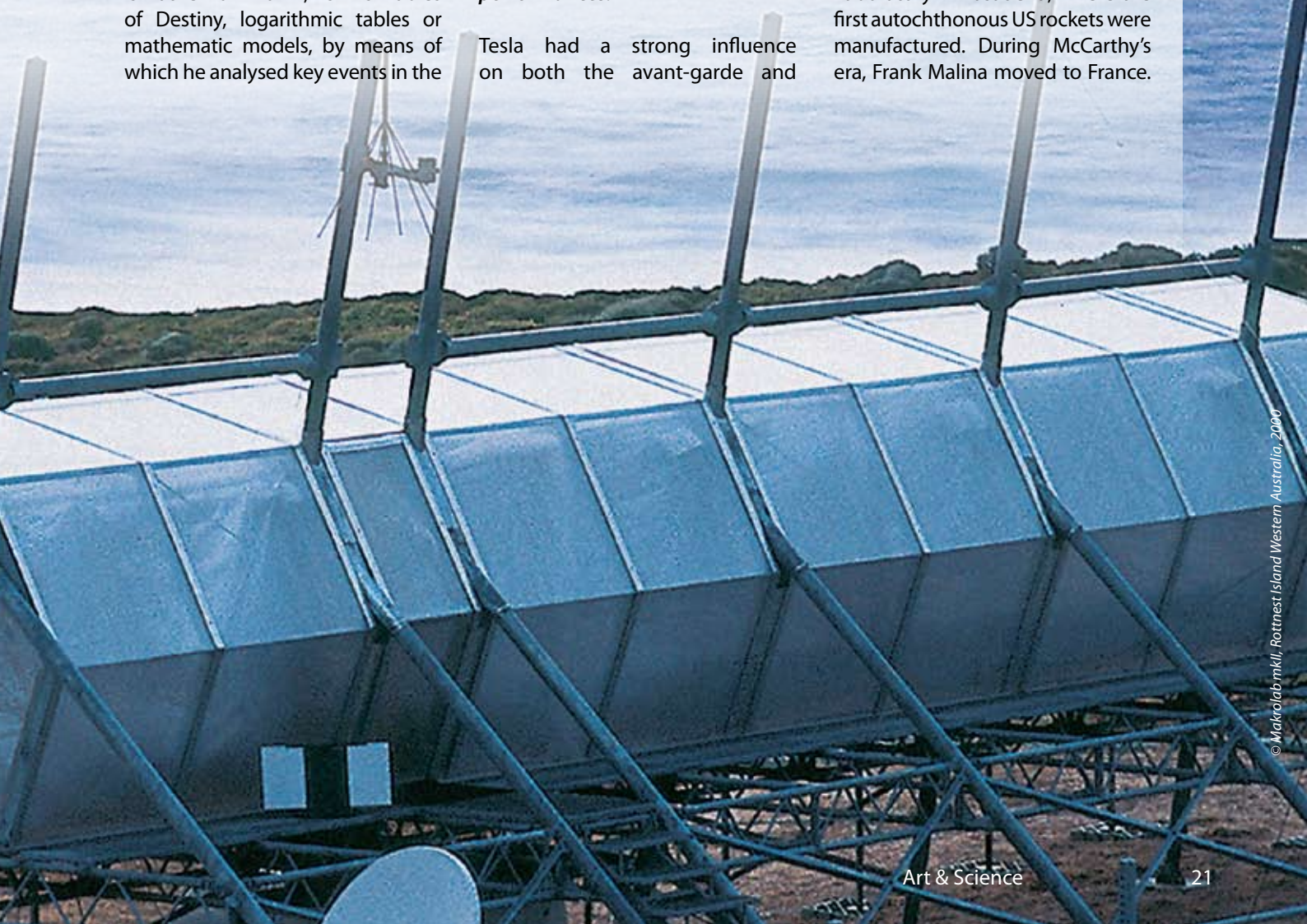
It is interesting that in the 1960s, without knowing Khlebnikov's work, Terence McKenna, coming from the circles surrounding Timothy Leary wrote the computer program *TimeWaveZero*, which is a digital equivalent of the *Tables of Destiny*. History can of course be considered to be a continuum; yet there is a fascinating field of research on the laws of time, which can only be dealt with by art and theoretical physics today, as it has no credibility elsewhere.

But still, although this endangered their scientific careers, in history some scientists walked on the edge of science, the edge of zaum, one of them being Nikola Tesla, to whom you have referred in your performances.

Tesla had a strong influence on both the avant-garde and

the military industrial complex. Interesting correlations exist between ideologies, science, and occultism. In *Salzkammergut*, in the framework of a very bizarre and occult correlation between the Nazis and the development of high technology, Walter Schaubinger manufactured water turbines by means of a system that interferes with the core of the theory of relativity and quantum mechanics. After World War II, a schism between the scientists who dealt with the US missile programme occurred; this small group was split into a very occult segment, which was headed by Jack Parsons and which moved away from the military industrial complex towards self-destruction, and an ultra humanistic segment, which was considered to be problematic in McCarthy's era.

Frank Malina belonged to the latter and was, like Parsons, one of the founders of the Jet Propulsion Laboratory in Pasadena, where the first autochthonous US rockets were manufactured. During McCarthy's era, Frank Malina moved to France.



He worked for UNESCO and at the same time dealt with kinetic art. In 1967, he established the journal *Leonardo*, which is a key publication linking art and science. At the first glance, these worlds are incompatible and people often roll their eyes or do not see a connection between the military industrial complex and art, but to me this is a highly organic whole and one of the key worlds I work in.

How about the establishment of the Slovenian Space Agency (SSA) initiated by you, together with Dragan Živadinov and Primož Pislak?

When we presented our idea about the SSA for the first time in 2001 at the Slovenian Academy of Sciences and Arts, namely at the first Noordung forum, the scientists there stared at us in amazement, saying "who are these lunatics,

why do we need such an agency, Slovenia is too small..." I responded: Is it not true that all scientific and engineering applied knowledge areas come together in aerospace? Are these not some of the most integrated systems enabling that one can work more and better, and be internationally connected? We, artists, however, wish to have our own department, since we have put everything on the table for you. I knew this was possible, as in 1998 with the assistance of the Russian space agency we established the first Slovenian video link with the Russian space station Mir, followed by Dragan Živadinov's performance and the show *Biomechanics Noordung* in a flying micro-gravity laboratory as well as the projects in the Yuri Gagarin Cosmonaut Training Centre in Star City.

As far as I know, the Slovenian government adopted the

resolution in 2007 that Slovenia should cooperate more closely with the European Space Agency (ESA), which was followed by the visit of a delegation from this agency to the Institute "Jožef Štefan" and the Chamber of Commerce and Industry of Slovenia. The agreement on cooperation between Slovenia and the ESA was prepared last autumn, and it was envisaged that it would be signed at the beginning of this year. Seven years later, things have finally started moving ...

In addition to space, you are interested in two territories, the Arctic and the Antarctic, where you intend to build living and working laboratories. At last year's Ars Electronica festival in Linz, you said that if one deals with both Poles, one deals with everything in between – no doubt particularly with geopolitics. ...

Climate change and art & science

As one of the most pressing issues facing the world today, climate change has become a popular source of inspiration and topic to be explored in art & science. We look at some projects here.

Makrolab

One such work is Marko Peljhan's *Makrolab* – a mobile laboratory built for the research and work of artists, scientists and the media. First set up in 1997, it has been displayed across the world. During 2007–08, the International Polar Year, the *Makrolab* project produced installations in Antarctica and Nunavut. Many projects have been carried out within the lab – from research on local ecology to telecommunications testing. The project ended in 2007, but it is being

continued within the consortium Interpolar Transnational Art Science Constellation, a network of individuals and organisations working across the fields of art, engineering, science and technology.

Polar

To boost awareness of climate change and address the broader cultural and policy-related themes, Arts Catalyst – a science art gallery in London (UK) – together with the Open University and the British Library ran a programme of talks called *Polar*. This project brought together artists, scientists, Inuit writers and experts from other disciplines. One talk focused on the iconography of climate change: ice cores, glaciers and field stations can be thought of as archives and spaces of knowledge that change how we imagine and

shape our futures. In this session the participants, which included Marko Peljhan, debated how these archives might well claim to hold the world's knowledge.

Noah's Ark

Given Europe's rich cultural heritage and the threats posed by climate change, *Noah's Ark* – funded by the European Commission – pinpointed a number of climate change factors that were likely to impact various building materials. It is the changing water cycle that may prove most critical, not rising temperatures. To present the project's results, the Vulnerability Atlas was created, outlining the prevalence of each risk factor across Europe. The maps indicate the dangers posed by climate change. The project also provided guidelines for addressing each threat and suggesting what should be done.



© Author: ??? – Photographer: ???

The initiative that follows *Makrolab* is called I-TASC (Interpolar Transnational Art Science Constellation) and was included in the International Polar Year Programme. The goal of our project is to establish mobile systems and communication infrastructure in the Arctic, in consensus with the local Inuit population, and in the Antarctic in cooperation with the scientific and military geopolitical complex, in accordance with the Antarctic Treaty. History in its rhythms is again working in favour of our project – and is endangering it at the same time. As was well publicised, a Russian flag made of titanium alloy was placed last year at the North Pole at the bottom of the Arctic Ocean; there is namely a desire that the Russian epicontinental belt expands to Canada, and also vice versa from Canada to Russia; the USA, Denmark, and Norway also have interests in the Arctic.

The Arctic is one of the most “neuralgic” points on the planet; nuclear submarines meet there; ballistic missiles between the US and Russia would fly above its surface; this is an area of massive

nature destruction, whale kills, the disposal of radioactive waste, submerged nuclear submarines, electromagnetic pollution with antiballistic radars etc. The Arctic is an area of sublime beauty and at the same time the theatre of Armageddon thrown open. Due to global warming it is becoming increasingly interesting, since it is easier to drill there and search for energy resources; due to the melting of ice, the so-called Northwest Passage between Europe and Asia has opened there. Indigenous people, the Inuit, victims of classical genocide in the 20th century, are not taken into consideration by anyone. Geopolitics has a short memory there.

What did you propose to the Inuit, what do they expect from you?

The Inuit have a destroyed social structure, as in the 1950s and 1960s Canada moved them into towns and killed their dog teams, which were a precondition for their nomadic way of life; when alcohol entered the picture, the result was an almost total destruction of their culture. That is why they are

very careful about what the white man, who is again destroying their environment, intends to do there. We have established contact with the media-aware group of the Inuit, who again wish to live as nomads, in a system of mobile isolation, on the land, at the same time they wish to be connected to their community and the world through networks, and to have the possibility to exchange experiences and open media production. This is where their and our interests coincide perfectly. Our initiative was presented in 2006 to the elders in Igloolik and was accepted after many questions and explanations.

The interests of the superpowers in the Antarctic are most probably the energy resources...

The Antarctic Treaty signed in 1961 was intended to ensure that the continent was entirely dedicated to peace and research. Territorial claims are frozen – frozen but not void! – by this Treaty until 2041, which was negotiated by the countries with territorial aspirations there. The Antarctic is an extraordinary archive of the atmosphere on our planet; by analysing its ice cores it is possible to view the geologic and atmospheric history of the planet. In the Antarctic last year, the I-TASC’s team built a self-maintaining weather system using solar energy which sends data to networks. At the moment, there are two I-TASC team members in the Antarctic, Siphwe Ngwenya and Ntsikelelo Ntsinghila; they are building and testing a larger energy system for our polar architecture. In addition, they as artists operate an open FM radio station, which was launched last year, and are making a film documentary. With our presence and sustainable approach we would like to change the logic of behaviour in the Antarctic.

Art & science in your neighbourhood

Ars Electronica

Where: Linz, Austria

When: Annually in September

Purpose: Since 1979, Ars Electronica has celebrated art, technology and society. It brings together experts and artists from around the world to discuss and create avant-garde art and installations merging art and technology.

Website: <http://www.aec.at/en/>

Transmediale

Where: Berlin, Germany

When: Annually in January–February

Purpose: Founded in 1988, Transmediale has developed into a festival for art and digital culture. Its artists and exhibitions explore and reflect the socio-cultural impact of new technologies.

Website: <http://www.transmediale.de/site/en/transmediale>

Dutch Electronic Arts Festival (DEAF)

Where: Rotterdam, the Netherlands

When: Biennially in April

Purpose: Organised by the Institute for Unstable Media since 1994, DEAF focuses on art, technology and society. Through art, concerts, seminars and performances, developments in art and technology are brought to a diverse audience.

Website: <http://www.deaf07.nl/>

International Festival of Computer Arts (IFCA)

Where: Maribor, Slovenia

When: Annually in May

Purpose: Launched in 1995 by the Video Section of the MKC Maribor Youth Culture Centre, the IFCA explores intermedia art, which connects art and new media technologies. Artists are encouraged to create with the Internet, robotics, virtual reality and other technology.

Website: <http://chp.uni-mb.si/mkc/>

Art + Communication

Where: Riga, Latvia

When: Annually each summer

Purpose: Since 1998, RIXC has been bringing together a large group of international artists. Each year the festival focuses on a different theme and the exhibitions explore how it relates to media, technology and culture.

Website: <http://rixc.lv/>

Break Festival

Where: Ljubljana, Slovenia

When: Biennially in November

Purpose: Starting in 1997, the Break Festival was originally a venue for new artists to showcase their work. Now it provides a way for artists from all over the world who combine art and technology to show their art to everyone - from established artists and scientists to the general public.

Website: <http://www.break-festival.org/>

COASTOMIZE!

Where: Velzeke, Belgium

When: Biannually

Purpose: Part of the Contemporary Art in East Flanders biannual event, COASTOMIZE! builds on previous reflective design experiments on how the Belgian coast could evolve. Artists blur the edges between art, science, design and technology, creating a new reality that mixes real and virtual.

Website: <http://www.hedendaagsekunstindevlaamseardennen.be>



Roger Malina and the *New Leonardos*

Dr Roger Malina, astrophysicist, is Chairman of the Leonardo organisation and the Executive Editor of the Leonardo publications dealing with art & science issues. He is also the former Director of NASA's EUVE observatory and of the CNRS and University de Provence Laboratoire d'Astrophysique de Marseille in France. He currently works in observational cosmology on the SNAP satellite. The following is an excerpt from an interview between him and Marko Peljhan.

Could you explain the history and the main visions behind the Leonardo organisation and its publications, such as the Leonardo Journal, now celebrating its 40th anniversary?

The Leonardo organisation was founded by a group of artists and researchers who were interested in promoting new kinds of contact between artists and scientists and engineers. At that time the public discussion was framed by C.P. Snow's concept of the two cultures.

The Leonardo organisation has articulated the idea that the artist could also be the researcher, in the model of Leonardo da Vinci; that some artists made technical inventions, as did scientists, even though technical invention was not the central objective of either scientific or artistic practice.

The Leonardo Organisation is now 40 years old and has published the work of some 5 500 "New Leonardos". Leonardo publishes a series of print and electronic journals and book through MIT Press. There are now over 30 Leonardo Books in print. Our websites can be found at www.olats.org (French) and www.leonardo.info (English).

In one of our conversations, you said that you couldn't subscribe fully to the notion of "third culture" as it has been advocated by a number of thinkers.

Could you explain what your thoughts on this are?

C.P. Snow had two major pre-occupations: one was the fact that the cultures of science and the cultures of the arts and humanities were in social communities that interacted little with each other and that this social segregation was harmful to creating art forms appropriate to our time. The second was a concern that in order to address the needs of economic and social development, science literacy was necessary and general public policy-makers were lacking it. Progress has been made in 50 years to address these issues and much remains to be done.

I don't see the problem as developing a third culture, which I think is not desirable, but rather creating within our institutions enough cross-bridging systems so that art/science interaction can be facilitated and enabled. The problem of course is that until you experiment, it is often hard to tell which art-science-technology interaction will be productive.

Artists have an important role to play in this cultural revolution that will need to take place. There is a need to create platforms for art-science and art-technology interaction within our strategies for mitigating anthropogenic climate change.

The cultures of art and the cultures of science are complex complementary landscapes. You, as a scientist, have had numerous interactions with artists, due to the nature of your work. How do you see this relationship developing in general and where would you like to see improvement? Do you think that the reflection of the art/science practices is adequate?

There is a growing professional community of "New Leonardos". By this I mean a variety of types of

professionals. In some cases individuals have first-rate linked careers both as research engineers or scientists, and also as professional artists or other cultural professions. There are teams which bring together artists, scientists and engineers for specific project purposes. There are also artists who through their research for art are making significant contributions to science or technology.

Because of the nature of art-science practice it is very much distributed rather than centralised. We need to find ways to make the community visible to itself but also to make the work accessible to a larger public both in civil society and government.

The main problem for art/science collaborative work and projects is funding, since the practices do not fit well within the art domain and of course also not in the science one. Due to your decades-long experience in working within the field, would you have any funding policy recommendations for this new and important field?

The Leonardo Education Forum is currently developing a White Paper with recommendations for education. We also held recently an online discussion called "To PhD or not to PhD" on the topic of whether art-science and art-technology practice requires more PhD-like training programmes. One goal is to develop different kinds of platforms that enable these practices.

It would be good to take stock again of the situation in Europe, identify best practices and examples, and establish a new road map to favour the appearance of "New Leonardos" in Europe that can contribute to the resolution of the burning issues facing us in the decades ahead. I think existing funding mechanisms can readily be adapted to address the work of "New Leonardos".

Art + science = understanding

Arts Catalyst – the science art agency – is devoted to bringing together the art world and the science world to foster understanding between the two through unique projects and commissions.

Arts Catalyst is an organisation that works to promote cooperation and understanding between art and science. By bringing together artists, scientists, researchers and the general public, Arts Catalyst is able to foster a wider discourse about art and science in society. The role and impact art and science have is largely overlooked and the idea of art & science, a single entity and a unique field in its own right, needs to be promoted to a wider audience.

Founded in 1993, Arts Catalyst is a London based organisation but collaborates with artists and scientists from all over the world. Its goal is to create a dialogue with the contemporary arts and to look at the relationship between science and everyday society. This is achieved through the organisation

of workshops, residencies, exhibitions, events, laboratories, conferences, research projects and educational and participatory projects which develop upon these ideas and exchanges.

Arts Catalyst presents its works in a variety of venues such as galleries, museums and public spaces in the UK, across Europe and all over the world. This allows the message of Arts Catalyst, the ability of art and science to work together to impact society, to reach the widest range of people possible.

A range of different projects analysing different intersections of art and technology have been undertaken by Arts Catalyst. The "Space Culture Symposium", for example, examined the intersection of space science, technology and

art from a cultural perspective. "Polar: the art and science of climate change" combines art and public discourse to draw attention to the effects of climate change. The "UK amphibians study" brought together the public and field researchers to investigate the declining number of certain species of amphibians in the UK. These projects, along with the other projects and commissions the Arts Catalyst has organised or produced, are intended to be provocative, playful and risk-taking, with the aim of sparking a wider interest in the topic explored and initiating a wider public discourse.

By working with international artists who focus on different elements of research and technology and who explore them through different media, Arts Catalyst is able to foster an extremely diverse network. Programmes and exhibitions organised by Arts Catalyst work to foster not only the understanding of art & science as force in society but also cultural understanding across borders.

SPOTLIGHT ON THE ORGANISATION

Name	Arts Catalyst
Country	United Kingdom
Established	1993
Specialisation	Fostering understanding and cooperation between art and science
Website	http://www.artscatalyst.org/

Pushing the boundaries of art & science

Are you looking for a place where artists push the boundaries of what is art, combining what might traditionally be confined to scientific fields with artistic expression? If so, the Kapelica Gallery in Ljubljana (Slovenia) may be the answer.

An institution for the promotion of contemporary investigative art, the Kapelica Gallery aims to present artistic practices and projects which topicalise every form of contemporary life. We perceive investigative art as a socially responsible production of values and meanings which, by

posing questions which do not lend themselves to simple answers, co-shapes the understanding and interpretation of the contemporary world. The gallery presents works of art that actively examine socially acknowledged values and invite visitors to reflect on them. The Kapelica Gallery is

thus not only a space into which finished artworks are exhibited, it is an active production platform which encourages, facilitates and showcases exploratory artistic production, and stimulates a critical understanding of the time we live in.

The gallery programme comprises exhibitions, performances concerts and lectures. The exhibitions are largely participatory installations or responsive environments in which the visitor is a part of the artistic process. Responsiveness, interactivity and indirect responsibility are concepts which visitors are faced with on a regular basis. In performances the artists address the public as directly as possible, transforming the visitors through participation into eyewitnesses. These live events are typically devoid of the stage logic that characterises traditional performing arts; instead the audience is instructed into the event with a visual language that excludes the spoken word. Visual intelligence is also stimulated by sound and music projects where forms of sonority may be experienced at the level of individual objects, texture, construction or soundscape. We nurture a better understanding

of contemporary art with critical and theoretical lectures by artists, experts and scientists from particular specialised fields.

In the 12 years since its inception, Kapelica Gallery under the leadership of Jurij Krpan has managed to form a distinct and influential production platform which was even entrusted with several projects of national importance. In 2003 we carried out the Slovenian presentation at the national pavilion of the 50th Venice Biennale, in 2006 we realised the 5th Triennial of Contemporary Slovene Art U3 at the Ljubljana Gallery of Modern and Contemporary Art, and in 2007 we launched the conceptual gallery Cosinus, which showcases Slovene artists at the European Commission building in Brussels. In the next three years we will tour major European galleries with the group exhibition *Ecology of a Techno Mind*, which will be launched in September 2008 at

the Ars Electronica festival in Linz, one of the most important festivals of media art in the world. We will present Slovenian intermedia art in relation to the international artistic scene, with emphasis on the exploration of changes injected into society by science, technology and novelty which drive contemporary society.

Through active cooperation with institutions that are involved in a similar enterprise (networking), ongoing activities to establish connections between art and science and art and the economy, as well as efforts in cultural policy, Kapelica strives to position contemporary investigative art among activities that crucially co-shape the values of modern society – a part of society which sees beyond purely commercial interests and is historically interested in contributing to the civilisation of different cultures.,

© Author: SKUC Gallery – Photographer: Dejan Habicht

SPOTLIGHT ON THE ORGANISATION

Name	Kapelica Gallery
Location	Ljubljana, Slovenia
Specialisation	Active reflection on science and technology through the arts
Website	http://www.kapelica.org/

LJU COSINUS BRX Gallery

In September 2006 the LJU COSINUS BRX Gallery was set up on the initiative of the Slovenian Ministry of Foreign Affairs. Located in the European Commission (Brussels), the programme is run by the Kapelica Gallery. Its goal is to feature artworks based on topical issues in science and technology,

thereby promoting the field of art & science. Since the opening project *Umbot Noordung* by Dunja Zupančič and Dragan Živadinov, the programme has featured *Modux 2004–2006* by the BridA Art Collective, *Recycling Strategies* by Sašo Sedlaček and from October 2007 to February 2008, *Situational Awareness* by Marko Peljhan. In addition, the gallery presented an

exhibition on the *Makrolab* project by Projekt Atol Institute. *Makrolab* is an ongoing mobile laboratory set-up for open and integral research and the common work of artists, scientists and tactical media workers in the fields of telecommunications, migrations research, weather and climate.

The intermedia centres of the Western Balkans

Many intermedia centres based in the Western Balkans emerged in the mid-1990s, thanks to an initiative by the Open Society Institute, which was founded by George Soros. This private initiative mobilised groups of intellectuals and socially conscious individuals. To overcome the state's control over the flow of information in Eastern Europe, multimedia platforms were established to provide access to the Internet, email and desktop publishing.

Today the centres are supported by public and private funds and enjoy a synergistic relationship with government. They have outgrown their basic activities and now act as spaces for analysis and reflection on newly emerging social paradigms that are accelerated by scientific and technological innovation.

Multimedia Centres Network of Slovenia (M3C)

www.m3c.si/dat/M3C/

M3C is an informal network of centres which connects digital technologies that are based on an open, knowledge society, culture & art, innovation and education. The network was established in the 1990s and expanded with support from the Slovenian government. In 2004 a network of nine Slovenian multimedia centres obtained funding from the European Regional Development Fund to further develop infrastructure and information that supports information technology and digital culture.

Ljubljana Digital Media Lab (LJUDMILA)

www.ljudmila.org

LJUDMILA is a not-for-profit digital media laboratory. It was founded in 1994 by a group of new media artists and has extensive experience in connecting new media technologies with artistic and activist projects. LJUDMILA is now a centre for media consulting, digital media production & archiving, as well as free software and hardware development and support. The lab hosts the Slovenian Creative Commons initiative and organises events dealing with free culture.

Multimedia Institute (mi2), Zagreb, Croatia

www.mi2.hr

mi2 is an NGO established in 1999 and opened its public space, net culture centre MaMa, which became a popular meeting spot in 2000. mi2's goal is to promote and educate the public on media culture, socially oriented approaches to new technologies and developments in social theory. The institute's activities include informal education and training in technology and digital media, free software development, promoting critical social theory and policy and advocacy work.

The Sarajevo Center for Contemporary Art (SCCA/pro.ba)

www.scca.ba

SCCA was founded by the Open Society Fund Bosnia and Herzegovina in 1996. It is a mobile art centre without its own gallery space. Most of its projects are realised in Sarajevo's open spaces. The shift from an art-oriented space to non-art-oriented places has created a new art scene. SCCA's multimedia production department, pro.ba, produces original work in new media, encourages students and others to realise their own projects using digital technology and provides assistance to artists in creating works in new media.

New Media Center_kuda.org, Novi Sad, Serbia

www.kuda.org

New Media Center_kuda.org founded in 2000 is an independent organisation bringing together artists, media activists, researchers and the wider public. Kuda.org supports cultural dialogue and alternative methods of education and research. It focuses on, among other things, the influence of electronic media on society, and the creative use of new communication technologies. It provides information via its library, mediatheque and digital archive; organises lectures, workshops and public presentations by artists, media activists, scientists and researchers; and supports not-for-profit artistic production as well as interdisciplinary research and experimentation.

The Visual and Cultural Research Centre (VCRC), Skopje, FYR of Macedonia

www.euba.org.mk/eng/index.asp

VCRC is part of the Euro-Balkan Institute. Since its creation in 2006, VCRC has been committed to interdisciplinary research in the field of visual culture and interpreting the social and political implications of art, culture and media. VCRC's projects deal not only with the ways in which art, culture and media reflect society's hidden patterns and mechanisms, but also explore new models of art-based social and cultural change. These projects address the urgent question of how to handle local and marginalised cultures during the transition to EU membership.

KONTEJNER | bureau of contemporary art praxis, Zagreb, Croatia

www.kontejner.org

KONTEJNER is an independent not-for-profit organisation that was founded in 2002. KONTEJNER supports the critical examination of the role and meaning of science, technology and the body in contemporary society. It is interested in multimedia and interdisciplinary projects at the junction of science, technology and art. KONTEJNER also started a production platform, DIY_ARTLAB, which stimulates collaboration between local artists and experts from various scientific and technological disciplines.

Tirana Institute of Contemporary Art (TICA), Tirana, Albania

www.tica-albania.org/index.html

TICA is the first permanent platform for contemporary art in Albania. It organises exhibitions, film screenings and performance events in addition to creating a forum for discussions and debates. TICA also offers an original artist-in-residence programme giving support to local artists and promoting cross-cultural exchange in the Balkans. Through its work, TICA aims to create an independent outlet for socio-politically engaged contemporary art.



© Markolab markilex Campalto Operations, Venice Biennale, Campalto Island, Venice, June to November 2003 – picture taken by the Quickbird satellite in July, 2003

Some conclusions

Where are we after having looked and read through this publication: in a visual art gallery? In an artistic laboratory? Lost in space? In the Antarctica, wondering what is going to happen to the human race and hoping that the cross-fertilisation between art & science will save us?

From this publication we have seen that artists no longer only use their paintbrushes but are making full use of the new materials and technology available in the beginning of this 21st century: new materials, recycling methods, electronics, cybernetics, software, telecommunications, information systems and so on. And it is not just a question of equipment – the actual mode of presenting art has altered, with performance art, for example, interacting with and involving the audience. This too has meant changes in the way that artists operate; many now work with scientists on interdisciplinary projects and in joint art–science spaces.

On one thing there seems to be consensus and this is confirmed by the Leonardo Education Forum: further research is necessary to explore the boundaries between art–science and/or science–art.

Some are calling for more study into the interface between art and science to discover new applications and argue that there should be more room for experimenting on the interaction which in turn can lead to further and other applications. Others are calling on the need to use more the mix of art and science to create public awareness.

From the above, some conclusions can be drawn.

First it seems that this new discipline – whether you call it ‘third culture’ or not – is a discipline worth analysing further. Some more academic analyses on the history, the current state of the art and best practices should help understanding the potential of the cross-fertilisation between art and science. A roadmap to stimulate development of art & science would be a useful tool.

Secondly, the idea of using art to communicate on science and technological progress and the role it can play in creating public awareness and communicating need to be considered more. As the articles already demonstrated,

their work can be used to tackle topical themes – climate change, poverty, waste management or genetic modification. The project “Communication outreach in nanotechnology”, funded by European Commission, is a solid step in the right direction. By looking at how best to communicate about nanotechnology, it concluded that art was well suited to the task of catching people’s attention. But more needs to be done.

In pursuit of the successful project, it seems that doing something similar to create awareness on climate change is the next topical issue in point. We will all be affected by the results of climate change. It is one of the greatest environmental, social and economic threats facing the planet. How therefore could art & science be used to boost the public’s awareness of climate change? In this, artists have an important role to play.

Thirdly, it seems that a new type of researcher/scientist is being born called artistic researcher who is involved in the applications of art & science and who needs, in order to pursue the thinking and the applications, to acquire more knowledge about science and technology. Dr Roger Malina, Chairman of the Leonardo organisation suggests a PhD-like training programme. Could next to the well-known Marie Curie grants under the EC research Framework Programme, grants be considered for the “New Leonardos”?

Fourthly, the idea of facilitating the integration of the Western Balkan Countries through intercultural dialogue and “cultural” in the broad sense – i.e. stretching it to art & science – needs also to be further examined as a means to provide better understanding and acceptance of a new region with EU perspective. As the title of this

publication Art & science: creative fusion suggests, art & science can help to bridge cultures; in particular the example of the Western Balkan Countries has been highlighted.

Finally, why not consolidate and expand on the knowledge on art & science by creating a platform enabling and facilitating artists and scientists and policy-makers to meet and exchange ideas, means and knowledge? Indeed, to develop this field further, there needs to be a place where the different teams can meet. Artists and scientists do not work in isolation. A major drive for coordination and information and exchange of data and knowledge would help establish a cutting-edge ‘third culture’ that combines the work of artists and scientists. And of course, such platform should be open to the world, as we have seen that this creative fusion is already shaping in different corners of Europe and the world.

European Commission

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This publication looks at art & science – an autonomous field uniting art and science which are typically thought to belong to two different worlds. However, these two domains have strong historical links, and if analysed in their totality, date back to the very beginning of human creativity, fuelled by curiosity and ingenuity. Today more and more artists are drawing inspiration from science and using the latest technology and research in their art, while scientists and researchers are realising the artistic elements of their work and finding ways to use art to communicate better with their stakeholders. Both striving to materialise the immaterial, art and science are constantly in motion and together they can lead to what is labelled the ‘third culture’.

This publication aims to explain the theory behind the arts–science interface and illustrates this academic perspective using concrete examples, including projects, institutions and festivals. In addition, it seeks to strengthen the role of a new artistic–scientific community in producing knowledge, imagination and practice, as well as in intercultural exchange and cooperation. Both art and science are domains that help to understand each other better. In this way, this publication can also serve as a link between the European Year of Intercultural Dialogue in 2008 and the European Year of Creativity and Innovation in 2009.

