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Transactions staff: Managing Editor: Sarah Moss.
RE-INVENTING FOURIER
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Abstract
Artists asked to represent sound in a visual way mysteriously re-invented many of the concepts that preside over the mathematical signal transforms used in computer music. Their drawings adopted a systematic 2-dimensional structure and sometimes resembled time-frequency representations such as the Fourier transform. This makes us ponder here over the different criteria of what makes a “good” computer representation for the scientist, and what makes a “good” visual work for the artist.

A sound waveform, when recorded in digital format, contains a lot of details: everything needed to play the sound with high-fidelity. Too much detail in fact, as it is nearly impossible to understand what the sound is by looking at it. This is a bit like looking at a very high-definition image by zooming very close: we lose the big picture. If we want to see and make anything useful with sound, we need to find another representation, a “transform” that changes the sound file into something simpler, something of which we can make more sense. Computers can do many sound transforms, the most famous of which is the Fourier transform.

Joseph Fourier is a 18\textsuperscript{th}-century French physicist who invented a way to calculate the many simultaneous speeds at which a phenomenon repeats itself. For sound, these frequencies notably tell us how high a given note sounds: the notes at the right end of a piano have a high frequency (“sharp”), those at the left end have a low frequency (“bass”). The Fourier transform (more precisely, a spectrogram of short-time fast Fourier transforms FFT) shows time horizontally and frequency vertically. A FFT contains a lot of information. It reveals things that are nearly impossible to hear: when our computer produced the FFT representation shown in Fig. 1, we could see clearly (with a little practice) a bird call at time 5.2 (3 superimposed inverted-V shapes), which took us several minutes to hear even after we knew it was there.

We (humans) tend to describe sounds in many ways: their color, brightness, their timbre (piano or clarinet), their mood (happy or sad), most of which are impossible to calculate for a computer. Conversely, FFT shows a property of sound, “frequency”, that humans cannot easily understand. We do not hear frequency (we hear pitch, which is quite a different construct in the case of everyday sounds [1]). The only reason computers do FFTs is because they can: the work of Fourier and others has yielded algorithms to let computers find/calculate these frequencies.

The art students involved in the Sound/Mindscape workshop (held in Art Center Ongoing, Tokyo, Nov. 26-31, 2008 [2]) did not know about Fourier, and they didn’t know about computers. When asked to represent a long sequence of sounds in a visual way, they reached for the paper and they painted (Fig. 2). They explored different ways to trace sounds. After a while, they decided to try out some “rules” (like the rules of a game), i.e. time should go from left to right of the page, the size of the brush should be proportional to the amplitude of the sound, etc. (Fig. 3) After a long experimentation, they presented one way to draw sounds with which they were particularly happy. From left to right – they explained – is the time, and from the bottom to the top of the page is the height of the sound.

I gasped. They had re-inventing Fourier.

Before my eyes was a human rendering of a FFT spectrogram (Fig. 4), splashes of paint drawn in synchroniza-
tion with the sounds, representing them in a time-frequency space.

Then I realized my mistake. It wasn’t frequency. When the artists talked about “sound height,” they really meant this: height as in how many meters in the air the sounds come from. Birds, HIGH in the sky; underground train, way down below. What I was looking at was a time-height representation. Surprisingly close to Fourier frequency on a linguistic level, but a different concept altogether.

Of course. I wasn’t talking to computers. Nevertheless, their painting had an intriguing appeal. It was well organized, the high/tall sounds balanced by a continuous stream of low sounds (which turned out to be footsteps), evenly distributed in time, yet not boring, thanks to the occasional random occurrence of a stroke here and there. The rules brought some things out of the sound, made them come real and visual in a very unique way. I could feel why the artists were satisfied with this “transform.” It was as satisfying for them as a Fourier transform is for me.

There, decades of computer research have favored the Fourier transform, for a purpose. The representation it provides is highly informative. It is compact, easy to understand, characterizes sounds precisely without drowning them in a haze of unnecessary details. With a FFT, one can identify bird songs, find the precise time of appearance of a plane, count how many trains in a day, or even transcribe the notes of a musical melody. It carries an optimal amount of information – something scientists since Claude Shannon can measure in a very precise way.

Here, hours of artistic research were eventually favoring the time-height transform. Why? What does this transform (which the artists called a “rule”) do that other alternatives do not achieve? Why set down for this and not, say, loud sounds from left to right and bright sounds from bottom to top? The goal is not information – since the representation is not meant to be processed nor to be useful. Beauty? I suspect it’s not just beauty – this would be a very limited vision of artistic research. Harmony? Interestingness? Artists are reluctant to define the goal of their practice, yet they talk a lot about “it.” They talk about “cheap” representations (too obvious? too objective?). They talk about honest piece of work (as in revealing some sincerely felt subjectivity). What precisely? Why time and height? Provocatively, I try to write a mathematical formula characterizing the properties of their chosen representation, compared to their previous, less interesting attempts. Do you optimize the space coverage (think of maximum-entropy spectral estimation [3])? The distribution of color? Of stroke size (think of sparse transforms [4])? The ability to visualize both small events and global scenes (think of wavelet transforms [5])?

They giggle and resist what they probably view as my attempt to find a magic formula for art. I’m not. I’m sincerely trying to understand, not to reduce. Maths is probably not the right way, I’m willing to admit. But what else would we have? What other option? Precisely?

This is important, I thought; this is crucially important. It felt like a very rare instant of contact between my world and their world, something that, if we can sustain it long enough, could change the way I do science and the way they do art.


References and Notes


THE MONUMENT PROJECT
(SI MONUMENTUM REQUIRIS CIRCUMSPICE)

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Abstract
This paper describes the concepts, ideas, background and operations of The Monument Project (Si Monumentum Requiris Circumspice), a digital video installation that produces a continuous stream of weather-responsive panoramic images from the top of the Monument in the City of London. The work, which was commissioned by Julian Harrap Architects, was part of a £4.5 million refurbishment of the 17th-century landmark, designed by Sir Christopher Wren and Dr. Robert Hooke to commemorate the Great Fire of London in 1666.

Background
In 2007, as a result of my previous work in Grizedale Forest, in the English Lake District, I was approached by London-based Julian Harrap Architects to develop a new video installation for The Monument in the City of London. The earlier installation, Interwoven Motion (2004), involved mounting a circle of solar- and wind-powered webcams at the top of a tall tree overlooking Lake Coniston, at a site with a view favoured by the Victorian artist and writer John Ruskin. This work was the development of a number of previous gallery-based installations in which I explored and developed relationships and associations between the site or location of the work and the history of imaging technologies.

For example, For William Henry Fox Talbot (the Pencil of Nature), (2002) relayed a stream of solar-powered live digital images of the famous oriel window at Lacock Abbey in Wiltshire—the subject of the world’s earliest surviving photographic image to the Victoria and Albert Museum in London. The continuously refreshed images of the famous window at the abbey were projected full size in the London Museum, providing a digital link between the two sites bridging the geographical and temporal space between the original image and the site of its creation.

The History of The Monument
The Monument to the Great Fire of London, designed by Wren and Hooke and completed in 1677, is the largest freestanding stone column in the world. It stands 211 ft high and is sited in the heart of the financial hub of London near to the river Thames. Credited to Wren, who as chief architect to King Charles II oversaw the project, it is now understood to be mostly the work of his friend and associate, the scientist and polymath Robert Hooke, who was at that time the city surveyor. Both Hooke and Wren were accomplished scientists as well as architects, and the design and construction of the Monument reflects the complex nature of their interests.

It is now clear that the Monument had a dual function; in addition to its role as a commemoration of the great fire and the resurrection of the city in its aftermath, the Monument was also a huge scientific instrument [1]. Both men were active members of the Royal Society, and both had experimented extensively with optics. Wren had made his reputation as an astronomer before becoming an architect, and Hooke had published one of the earliest books on microscopy and had previously built a zenith telescope at his lodgings [2]. The two men ensured that the design of the Monument, whilst fulfilling its main purpose as a landmark and memorial, would also enable them to continue their experiments. The base of the Monument contained a small room for an astronomer to gaze at the night sky. The hollow shaft of the Monument, ascended by a spiral staircase of precisely equal spacing, was ideal for conducting experiments with pendulums and for measuring the effects of gravity and barometric pressure.

The Project
Fascinated by the dual function of the structure, I decided to develop a work that referenced its scientific and historical significance and its role as a Monument sited in the centre of London. The architect’s brief required that the installation provide access to the magnificent views available from the top to those who were unable (or unwilling) to climb the 311 stairs to the observation platform, and I wanted to explore the potential for a work that would respond to the surrounding and ever-changing weather conditions and provide high-definition panoramic images of the view for display on a video screen located at the base of the Monument and to make an image-stream available on the Internet. The brief also stipulated that the installation should be capable of providing updated images 24 a day, seven days a week and be operational for three years! It was clear to me that this challenging project would require a knowledgeable and skilled collaborator. I worked closely with media technologist Onno Baudouin at Sandbox, a digital media R&D lab at the University of Central Lancashire, and we considered a number of options before selecting a robust and reliable digital stills camera to provide the images for the project. Onno developed eight different custom software programs for the installation including camera control and the manipulation of the image output of the camera, all remotely accessible via the Internet. The image stream from the camera is modified in real time by meteorological information about the wind speed and direction, air temperature and barometric pressure.

Fig. 1. A circular panoramic image from the installation.(© Chris Meigh-Andrews)
Details of the Installation

The installation provides a live stream of continually modified time-lapse images 24 hours a day, 7 days per week that can be accessed on a dedicated web site at <www.themonumentview.net> and as a “live” image via a video screen display which will be sited on the piazza near the base of the Monument. The web site also makes available a continuously updated series of “unwrapped” still images of the panorama from the top of the Monument which are digitally unfolded from the circular images produced by the camera/lens system.

A computer-controlled digital stills camera equipped with a Kidan VR 360 lens enclosed in a custom-produced weatherproof housing provides 360-degree panoramic views from the top of the Monument. Changes to the image display are facilitated by a dedicated computer system with interfaces and software to modify the image in response to changes in the ambient weather conditions of the surrounding environment, specifically wind velocity and direction, average temperature and barometric pressure. This data is used to modify the live output of the image stream in a number of different ways relating to the changes in the weather, so for example the frame rate of the image stream relates to the wind speed, and the rotation of the images relates to the wind direction. Ambient temperature modifies the hue of the image, whilst changes in the pressure modify the image contrast.

Technical Operations

Both the circular and “unwrapped” output image modes use a hi-spec PC. The images are stored in 16GB of memory (FBDIMM) in a compressed format at 2048x2048px. Depending on the wind-speed these are bitted at over 60FPS to a VGA or DVI output. Each time a new image is sent from the camera (via ethernet) the previous image is dropped. This results in a continuous, but ever changing 24-hour time-lapse sequence. Each time a weather condition changes, this affects the video images in real-time using GPU shaders that affect contrast, brightness, image rotation and colour-levels. The software was written by Onno Baudouin using C++, Python, C# and PHP and OpenGL in a native 64bit Windows application. All programs communicate via a custom-built TCP/IP protocol. The operating system runs from an SSD for reliability. All images produced by the camera system are backed up to a large computer storage housed in the basement of the Monument. In total there are eight different computer programs running simultaneously. If for any reason one element fails to work, the system has been designed to continue to display the last available image. The system was also designed to kill any applications that stop working and to auto-restart them.

References and Notes


Editor’s Note: See <www.mitpressjournals.org/hoc/leon/42/5> for supplemental files related to this article.
EMERGENCE AND GENERATIVE ART

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Abstract

Emergence, the idea that in some sense more comes out of a system than was put in, is the holy grail of generative art. Yet emergence is a slippery concept. Originating in the philosophy of science, it has been taken up in systems theory, cognitive science and Artificial Life. As a consequence there are numerous definitions of emergence in the literature, but none well-suited to discussions of generative art. The paper reviews some existing definitions and proposes a new definition of generative-art emergence.

According to the widely accepted definition of Philip Galanter [1], the term generative art covers art practices where the artist creates a process that acts with some degree of autonomy to create all or part of an artwork. One of the motivations for such a practice is a hope that something interesting and unforeseen will happen, that more will come out of a system than was put in, that emergence will occur. Mitchell Whitelaw, in his study of art inspired by Artificial Life, says “emergence can be seen to function as the focus of the field’s collective desire,” but he also says “part of the appeal of emergence as a concept is that it defies clear definition” [2].

In this note I review some of the definitions of emergence that have been used in discussions of generative art, and I propose a new definition, of generative-art emergence, which comes closer than the other definitions to capturing what artists are looking for under the name of emergence.

Objective Emergence

Most definitions of emergence attempt to be objective, avoiding reference to human observers or human subjectivity. Nonetheless, these objective definitions have frequently been used in discussions of generative art. I discuss four such definitions.

Categorical emergence: The language used to describe the construction of the system is not adequate to describe its behavior; new descriptive categories are needed.

A prime example comes from the flocking algorithms introduced by Craig Reynolds [3]; the language that suffices to describe the behavior of an individual bird does not have the appropriate categories for discussing the behavior of the flock. For example, a flock can divide to pass an obstacle, an individual bird cannot. The idea that new categories are needed to describe the behavior of the system leads on to the idea of considering a system at different “levels”; these may be thought of as design versus observation, as local versus global or as micro versus macro.

Simple-to-complex emergence: Simple rules give rise to complex behavior.

John Holland sees some board games as providing examples of emergence: Board games are a simple example of the emergence of great complexity from simple rules or laws … Chess and Go have enough emergent properties that they continue to intrigue us and offer new discoveries after centuries of study [4]. Fractals provide examples of very complex entities arising from quite simple rules (the Mandelbrot set can be described in two lines).

Many-agent emergence: Many simple agents together produce complex behavior.

The flocking algorithm of Reynolds fits under many-agent emergence, as does a large body of work involving competing simulated organisms. Work with cellular automata could also be classed here. However, the example of the Mandelbrot set shows that simple-to-complex emergence does not require many agents.

Difficulty-of-prediction emergence: The fastest way to predict what the system is going to do is to simulate it (run it and see what it does, if it is a computer system).

Vince Darley [5] gives this definition in the following form. Suppose that we have a system of (finite) size $n$; suppose that it can be simulated (or run) in $s(n)$ computational steps, and we have another approach to prediction involving “understanding” the system that takes $u(n)$ steps. If $s(n) \leq u(n)$ then the system is emergent.

Darley’s definition attempts to capture what is a common intuition about complex systems: the only way to find out what they do is to watch them.

Subjective Emergence

A small number of definitions have been given that refer to human capabilities or human subjectivity. I mention three such.

Emergence relative to a model: The system deviates from my model of it.

Unfortunately the phrase “emergence relative to a model” has been used in two different senses, which I will call “loose” and “strict.” The loose sense is simply that we have a system and a model of the system, and our model is wrong. Jon McCormack and Alan Dorin [6] discuss the situation of a user of a computer artwork, saying:

To achieve relative-to-the-model emergence, engagement with the computer needs to suggest that the work is more than its design intended it to be—it must be informationally open [emphasis in original].

This appears to be an example of the loose usage, especially as one of McCormack and Dorin’s examples is Ima Traveller [7], a cellular-automaton-based work generated by a computer program whose construction is known.

The strict sense of emergence relative to a model is: our model was previously correct, but ceases to be so. This notion has been discussed by Peter Cariani [8], who concludes that a non-interactive computer simulation cannot show emergence. However, Cariani’s argument depends on too much of a God’s-eye view to be relevant for artistic or scientific practice.

Surprising emergence: The system surprises me in some way, even if I have complete knowledge of its construction.

Edmund Ronald and co-workers [9] take a subjective view, arguing that “the existence of an observer is a sine qua non for the issue of emergence to arise at all,” and giving the following definition of emergence. They presuppose a system designer and a system observer (who can be the same person).

1. Design. The system has been constructed by the designer, by describing local elementary interactions between components (e.g. artificial creatures and elements of the environment) in a language $L_1$.

2. Observation. The observer is fully aware of the design, but describes global behaviors and properties of the running system, over a period of time, using a language $L_2$.

3. Surprise. The language of design $L_1$ and the language of observation $L_2$ are distinct, and the causal link between the elementary interactions programmed in $L_1$ and the behaviors observed in $L_2$ is non-obvious to the observer—who therefore experiences surprise. In other words, there is a cognitive dissonance between the observer’s mental image of
the system’s design stated in L₁ and his contemporaneous observation of the system’s behavior stated in L₂.

This definition manages to involve categorical emergence and the loose sense of emergence relative to a model, as well as the reaction of an observer. Ronald et al. draw an analogy with the Turing test for intelligence, which also requires an observer.

Frankensteinean emergence: Where the system outdoes its creator.

The idea that a machine can outdo humans in an activity that has previously been a prized attribute of humanness can give rise to extravagant emotions. For example, Douglas Hofstadter was deeply disturbed by the new Chomip mazurka composed by David Cope’s EMI computer program [10].

Generative-Art Emergence

The definition that I am proposing has as its starting-point the “surprising emergence” of Ronald et al. I define generative-art emergence as follows:

1. The observed behavior or output of the artwork is unobvious or difficult to predict, even when we have complete knowledge of the construction of the system.
2. The observed behavior or output evokes feelings of surprise-wonder-mystery-autonomy, even when we have complete knowledge of the construction of the system.

With respect to the first clause, it is certainly possible to have behavior that is not specified directly in the description of the system and still to claim that the behavior is obvious. Flocking algorithms are close to being in this category: Ronald et al. made the following comment:

The flocking behavior exhibited by the artificial birds [Reynolds’s Boids] was considered a clear case of emergence when it first appeared in 1987. However, one now could maintain that it no longer passes the emergence test, since widespread use of this technique in computer graphics has obviated the element of surprise [11].

One could argue that fractal art now falls into this category.

The main content of my proposed definition is in the second clause. There is no single word to describe the complex I have named surprise-wonder-mystery-autonomy. Often the word “surprise” implies “unexpected”, but not always. Thus Ronald et al. hedge their definition by stating immediately after it that “the

question reposes … on how evanescent the surprise effect is” [12].

I think that surprise is a necessary but not sufficient condition for emergence. The behavior should be unobvious, so that when we first encounter it we are surprised. But even when the behavior is no longer new to us, it should still generate a sense of mystery or wonder. “Wonder” and “mystery” are not synonymous: for me the Eiffel Tower is wonderful but not mysterious; any computer programmer can report on observing mysterious behavior that is the opposite of wonderful.

The last component of the complex I call autonomy. Associated with emergence is the idea of “going beyond,” transcending origins or a framework. Thus Mark Bedau [13] says:

1. Emergent phenomena are somehow constituted by, and generated from, underlying processes.
2. Emergent phenomena are somehow autonomous from underlying processes.

For emergence to occur it is not enough that the observed behavior should be difficult to deduce from the rules of the system; it should have coherence, “a life of its own”; in a word, autonomy.

I consider the game SimCity [14] to be an example of a work that fails the surprise-wonder-mystery-autonomy test, while satisfying most of the other definitions mentioned in this paper. The game undoubtedly exhibits emergence in some sense, as most of the things that occur, and especially the traffic jams, are only indirect consequences of the actions of the player. The problem for me is that the game works much as one would expect: we are all too familiar with traffic jams: the mystery and wonder are lacking!

Is Emergence Enough?

At the start of this note Whitelaw was quoted as saying that “emergence can be seen to function as the focus of a life art’s collective desire.” Yet Whitelaw also quotes the artist Bill Vorn as saying about a-life art:

Artists are now able to do things that have no sense, let them interact, and the overall meaning is going to emerge just by itself. Artificial Life is the Spirograph of the 90s [15].

So not everything that exhibits what has been commonly considered as emergent behavior is artistically satisfying. One approach is to require that systems show adaptive behavior. In science adaptive systems are important, and the book Emergence by Holland [16] is largely about adaptive systems. Yet Ima Traveller, a successful art work exhibiting emergence, is not adaptive at all. What separates Ima Traveller from the Spirograph-like art criticized by Vorn is just the surprise-wonder-mystery-autonomy test.

I consider that the definition of generative-art emergence given here comes closer than previous definitions to capturing what artists are looking for under the name of emergence. The definition also enables a finer-grained analysis of the reasons that an artwork may fail to be classified as emergent.

References and Notes

12. Ronald, Sipper and Capcarrère [9], p. 228; emphasis in original.
16. Holland [4].
PROCESSPATCHING, DEFINING NEW METHODS IN aRt&D

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Abstract

Keywords: Art and technology, collaborations, artistic methods, interface design, electronic art, engineering and computer science.

This article describes the PhD research: Processpatching, “Defining New Methods in aRt&D” that is informed by my work as media art laboratory manager at V2_Lab and my current work as director of The Patching Zone, a new interdisciplinary lab for innovation.

The study investigates how electronic art patches together processes and methods from the arts, engineering and (computer) science environments. It provides a framework describing electronic art methods, to improve collaboration by informing others about one’s artistic research and development approach.

The investigation addresses fundamental questions about the “research and development methods” of artists who are involved in interdisciplinary collaborations amongst and between the fields of Art, Computer Science, and Engineering. The breadth of the fields studied necessarily forced a tight focus on specific issues in the literature, addressed herein through a series of focused case studies, which demonstrate the points of synergy and divergence between the fields of artistic research and development, in a wider R&D context. It provides information about the practical and theoretical aspects of the research and development processes of artists. The artistic methods proposed in this research include references from a broad set of fields (e.g. Technology, Media Arts, Theatre and Performance, Systems Theories, the Humanities, and Design Practice) relevant to and intrinsically intertwined with this project and its placement in an interdisciplinary knowledge domain.

Field

What distinguishes electronic art is, on the one hand, that it works mainly with mechanical, electronic and digital technologies and means of communication, and, on the other, that it is always made in collaborations in which the contributions of scientists and technicians (hard- and software engineers) are as great as those of the artists who supply the ideas, concepts and in particular the motivations.

—Brouwer, Fauconnier, Mulder, Nigten [1]

This investigation is positioned in the electronic art laboratory where new alliances with other disciplines are established. In the context of a rapidly changing domain of contemporary electronic art practice where the speed of technological innovation and the topicality of art “process as research” methods are both under constant revision, the process of collaboration between art, computer science and engineering is an important addition to existing “R&D.”

Scholarly as well as practical exploration of artistic methods, viewed in relation to the field of new technology, can be seen to enable and foster innovation in both the conceptualisation and practice of the electronic arts. At the same time, citing new media art in the context of technological innovation brings a mix of scientific and engineering issues to the fore and thereby demands an extended functionality, which may lead to R&D as technology attempts to take account of aesthetic and social considerations in its re-development. This contemporary field of new media or electronic art R&D is different from the research and development aimed at practical applications of new technologies as we see them in daily life. The discourse dealing with the research and development process or the making of inter- or transdisciplinary art and technology practice is nearly absent in today’s knowledge resources. This is a major problem for the contemporary artist who plans to work with technology, in particular those who intend to collaborate in the research and development process with other disciplines. A next step for Research and Development in Art (aRt&D) is a formalisation or a verbalisation of the associated work methods, as an essential ingredient for interdisciplinary collaboration.

Proc

Processpatching [2] refers to the aRt&D process of electronic or interactive art, where different kinds of analogue and digital materials are stitched together for the creation of an art experience or an art project in a broader sense. Processpatching combines and remixes well-known approaches from the arts, design and various scientific branches; it accelerates creative and innovative approaches that build on years of discipline-specific expertise. Processpatching has its roots in the arts without being formalised as a method. The term Processpatching is chosen as an associative, connecting approach, which is similar to the process it describes. It is typical of many art and technology works that they are combinations of several techniques and methods borrowed from different disciplines. Processpatching represents an informal and intuitive approach to research and development. It has a strong emphasis on the creation of new aesthetics, which are created via new combinations or repurposing of existing materials and methods. In communication technology there are other references to patching, for example, software patches, the patchboard as a matrix to establish telephone connections etc. Further down the ontology of processpatching, one finds references to patchworking. Patchworking refers to needle work, to quilting bees and sewing circles, where the creation process is a social act. From needle works, Plant’s [3] allegory of weaving and computing vaguely refers to our notion of processpatching.

A processpatch is a connection, or association, and subject of constant modification. It can be torn, used or reworked by a group or individual (e.g. audience participation and the user-centred aspect in interactive participatory works). Processpatching is the most frequently identified electronic art method used in the zone between the disciplines, where a new practice comes into existence. It is the key method for stitching all different methods together and bridging the disciplinary, methodological differences in this zone. A focus on human-centred design, as well as on aesthetics and the iterative work-processes, are among the most significant Processpatching characteristics.

Outcomes

The positive outcome of this dissertation is a detailed study where one can find connections to improve one’s practice. Besides the above described processpatching method I would like to highlight here the other key outcomes of this study: The aRt&D Matrix provides a complete overview of the observed research and development methods in electronic arts, including references to related disciplines and methods from other fields. The matrix developed and offered in this thesis also provides an instrument for analysing the interdisciplinary collaboration process that exclusively reflects the information we need for the overview of the team constella-
tion. The reference table is used to inform the collaborators about the backgrounds of the other participants and thus about the expected methods and approaches. It provides a map of the bodies of knowledge and expertise represented in any given cross-disciplinary team, and thus aims to lay the groundwork for a future aRt&D framework of use to future scholars and practitioners alike. I would like to emphasise that the aRt&D Matrix is free to extend the processpatching references in the aRt&D Matrix with your favourite methods and approaches!

The aRt&D triangle is a small conceptual tool that assists the team members in the first project initiation phase; it enables the team to think and re-think where they come from before they move to the aRt&D Matrix. The tool is clear and useful in that it succeeds in informing the collaborators about each other’s backgrounds ($\alpha, \beta, \gamma$). It also visualises the distance between the knowledge domains represented by the collaborators. It indicates roles for possible mediators or multi taskers in the team and it indicates shared knowledge fields. It provides a clear map of the knowledge and expertise represented in the team.

Fig.1. aRt&D Triangle. (© A. Nigten)

The Patching Zone

Finally, The Patching Zone [4], an independent transdisciplinary praxis laboratory, is the most recent outcome of this study. In The Patching Zone, master, doctor, post-doc students and professionals from different backgrounds and education programmes meet and establish new practice-led collaborations. The Patching Zone brings together the best students who are interested and perfectly equipped for the collaborative process in a specific commission. The Patching Zone applies the Processpatching approach, which is defined in this PhD thesis, as its main methodology for creative research and development, and builds on the knowledge and expertise from the V2_Lab [5]. The Patching Zone promotes the strength of art and design practice as a valuable contribution to existing R&D. The Patching Zone combines the background theory from this PhD study with today’s transdisciplinary collaboration discourse as outlined in “Transdisciplinarity: recreating integrated knowledge” by Somerville and Rapport (editors). [6] The transdisciplinary model is different from a multidisciplinary model, as it moves beyond the mixing of fields and leads to a new hybrid between the disciplines. This conceptual space between the disciplines is a new field or are new fields, where methods are mixed or given new input, where all disciplines benefit and take the relevant parts of the generated knowledge back to their own disciplines; (temporary) migration to other disciplines is possible but not the main objective. This conceptual space between the disciplines could be interpreted as a “neutral” space, which is not governed by a specific discipline or discourse. This is closely related with Marcos Novak’s transvergence [7] concept, where he considers the space between the disciplines as a separate entity. This space serves as an “interface,” providing room for cross-disciplinary experiments. The space between the disciplines is a natural playground for critical, practice-oriented research and development in human-centred experience design. We promote the Processpatching method model as the most beneficial approach for all involved parties. In The Patching Zone, processpatching is combined with a transdisciplinary collaboration model that respects and acknowledges the importance of specialization; however, it considers new connections and combined knowledge as a surplus for innovation [8]. The constantly changing research perspective from first to third person is among the relevant characteristics of transdisciplinary collaboration model. This space between the disciplines brings forward opportunities for artists and designers who are well equipped to work from different perspectives and who are used to working with heterogeneous collaboration teams. The Patching Zone aims, as an extension to existing education and research programmes, to support and encourage these new types of innovative research and development. The Patching Zone uncovers, in particular, the practical details of implementing the processpatching method in practice. The Patching Zone participants are processpatchers who piece expertise, approaches, techniques, and materials together in an associative way to establish surprises, the unknown, (artistic) innovations.

Future Work

Future studies on this subject, as an extension of this research, should lead to an aRt&D handbook for project managers, teachers and students in the field. Project management topics and methods are to be included as well in this future publication. This research can also be further developed into a practical guide for professional artists, technicians and scientists. Based on today’s practice, this research also offers the basis for a toolkit to enhance today’s interdisciplinary practice. I suggest further development of the aRt&D triangle as a digital tool for direct practical use for those who plan to start a multi-, inter- or transdisciplinary collaboration. The provided overview in the aRt&D Matrix could be used to update and upgrade the status of electronic artwork in an interdisciplinary setting with technicians and computer scientists. It is recommended to use this research material in the course of positioning art in the collaboration process with computer science and other disciplines.

References and Notes


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