A Duet of Cyborg and Dancer:

Creative Autogenesis

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Abstract

Dance is a profoundly human activity, which makes it a particularly powerful tool in reflecting upon the human condition. This paper examines the complex evolution of a cyborg, comprising a dancer and technology in an environment of real-time animated virtual scenography. Through a creative process of software evolution the cyborg as a whole evolved structures and behaviours which can be seen as similar to the mind, thoughts and perhaps consciousness of a human dancer. Through this evolutionary process the cyborg system appeared to develop an ability to self-organise creating novel choreographic combinations persistently expanding into the adjacent possible as per Kaufmann (2000). This process is called here autogenesis. This paper describes this process of autogenesis in the framework of fitness analysis, autocatalysis and Complexity Theory. This process of autocatalysis is used to reflect on the nature of

creativity generally as a process involving both form and freedom, underlining the importance of improvisation. The cyborg can be seen as a greater statement of the human condition: working with its environment, understanding its environment and evolving with its environment. The technology becomes a mirror in which a likeness of ourselves is rendered clearer.

Introduction

> Art is the search for new language, new metaphors, new ways of constructing reality, and for the means of re-defining ourselves. It is language embodied in forms and behaviours, texts and structures. (Ascott, 2000: 2)

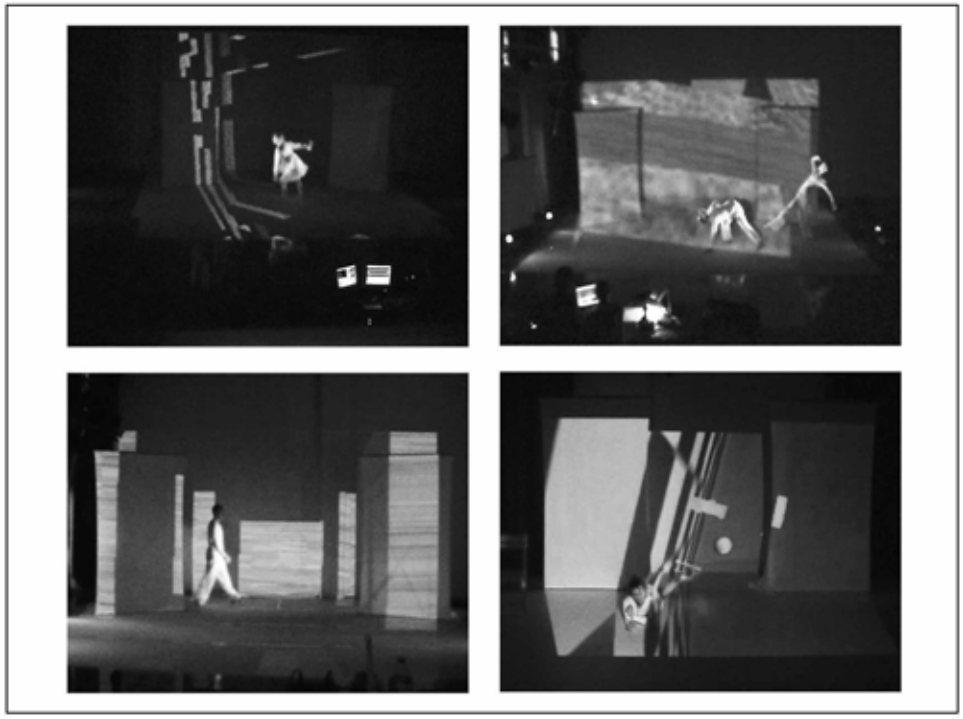

Figure 1 – Stills from Pre-Flux (2003), Flux (2004) and Living Room (2006) showing dancers onstage surrounded by RAVE

We have been using a process of dance and movement improvisation to enable us to develop methodologies to work with computer modelled scenographic RAVEs (Real-time Animated Virtual Environments), which are projected over an entire white stage space and dancer (referred to here as the 'Dancer') (figure 1).

The image projected onto the stage is rendered in real-time from a notional camera within a 3D computer model.

The movement of the camera in the computer model is controlled through bespoke software (the main interface of which is called the 'Plex') by an offstage dancer (the 'Cyber-dancer'*),* in such a manner that viewers of the stage may come to sense themselves, together with the Dancer as immersed and 'dancing' within the virtual environment of the 3D model. To the audience the onstage performers may appear as characters moving through the world of a bizarre computer game. The real presence of the performers juxtaposed with the ephemerality of the virtual environment within which they are immersed, creates a powerful theatrical statement.

Importantly, the Cyber-dancer (Curson) inspired by events onstage, not only gives input to the software through a variety of devices such as a mouse and joysticks, but is also responsible for developing the software, adding new functionality and redesigning the old. Curson has a history as a movement artist, a director/choreographer and software engineer.

This paper reflects on the artistically led co-creative process of the onstage 'physical' choreography and the configuration of the bespoke software controlling the movement of the virtual camera of the computer model. The bulk of this practice as research was done between September 2003 and June 2005. Our academic reflection

draws on ideas used in Cybernetics (Heylighen, 2001) and micro-biology (Kaufmann, 2000).

The Plex

We developed the bespoke software that the Cyber-dancer used to control the camera of the virtual model using a practice as research process and a complete performance technological setup that we refer to as a performance laboratory (Palmer, 2006: 112). New software functionality suggested by the creative process would be noted and added between lab sessions. Periodically we would review the direction this evolution of the software was taking (Curson 2004). Through this evolution a software interface called the *Plex* emerged. Prior to describing how the Plex was developed or evolved we will first describe the current version of the Plex and how it functions.

Idea Type	Description
VcPlace	Moves the camera, the Cyborg's body to a specific position and rotation.
VcMove	Applies a single vector move to the position and rotation of the camera. A single animation step.
VcFindPlace	Moves the camera to a given VcPlace over a given period of time.
VcSusMove	Repeats a given VcMove continuously or for a given period of time.
VcTimeline	A timeline containing other Idea types including VcTimeLines.
VcPallette	Organises a collection of Ideas, containing 26 named entries. The VcPallette allows only one, any number or only one palette entry throughout the system to be played simultaneously.
VcProgramme	Steps through a list of Ideas.
VcChooser	Possessing up to 10 buttons each of which can be linked to any input of any Idea. The chooser has a number of modes of operation, only one button down, any number of buttons down and step through and randomise.

Table 1 – Idea Types in the Plex/Mind

The Cyber-dancer establishes within the Plex virtual choreographic objects, (VcObjects), of a limited number of types (table 1). Each of these VcObjects appears as a window within the Plex, with a name that declares it to the Cyber-dancer, and can exist enabled or disabled (figure 2). Each VcObject has various input triggers depending on its type (PLAY, STOP, STEP, HIDE, ENABLE etc) and some VcObjects have output triggers (e.g. BUTTON UP, BUTTON DOWN of the VcChooser object). Inputs may be triggered directly by the Cyber-dancer through a mouse click, or indirectly by connecting to a joystick object, or by connecting it to an output of another VcObject in the Plex. This is the first way that VcObjects can be connected.

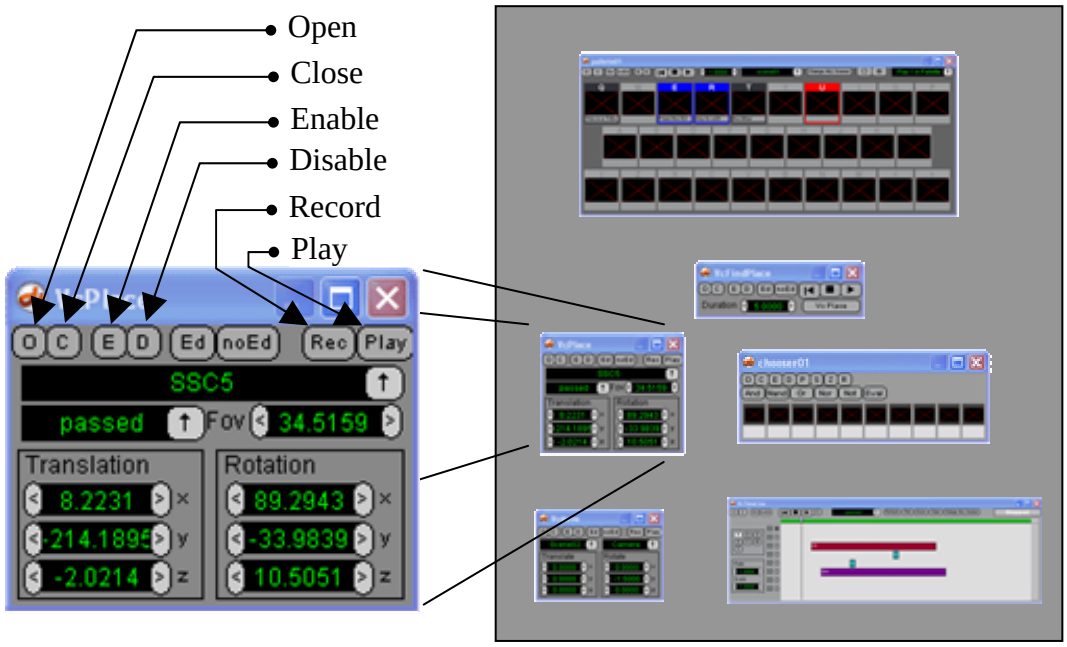

Figure 2 – Showing a VcPlace object with input triggers labelled and a sample Plex with a range of objects

The range of types of VcObjects evolved to be capable of describing the movement of the camera within the virtual model to fine detail. It includes object types that contain or reference other objects such as VcFindPlace, which moves the camera to a given (or referenced VcPlace) over a specified period of time. This referencing or containment is a second method of interconnection within the Plex. The VcObjects are designed to be as interconnectable as possible. (e.g. VcTimelines can contain any VcObject including other VcTimelines).

As the complexity of the system grew, we found it necessary to add the ability to hide (close) VcObjects from the Cyber-dancer so only

relevant objects at any given time during the performance would be visible (open) to him/her.

Through the choreographic creative process the Cyber-dancer manually connects VcObjects to each other by dragging from one object to another. For instance, the Cyber-dancer starts by controlling the movement of the camera with two joysticks as the dancer moves onstage. This virtual choreography (Vc) can be recorded as a VcTimeline containing a number of VcMoves. The VcTimeline can then be dragged into a VcPallette together with other virtual choreographic material and the phrases simply executed by clicking on the appropriate palette entry/ button. The original VcTimeline can now be hidden and the whole newly connected movement phrase executed using the palette button only. Also, through this process of referencing and interconnection, several movements can be activated simultaneously. Further, real-time movement can be included via the joystick. This allows the Cyber-dancer to use his/her artistic and improvisational sensibilities to explore novel choreographic combinations in real-time with the dancer(s) onstage.

The design of this system was inspired by Max/Msp and Isadora and ontological top-down artificial intelligent systems. It is not unlike the way a dancer would improvise with learnt movements using their skill to change and combine them creatively. In this analogy, the networks of VcObjects within the Plex, define virtual choreographies

by, for example: recalling specific material; defining specific scores and sequences; creating random choreographic choices; and offering pertinent choreographic choices to the Cyber-dancer in real-time.

The Cyborg

> Imagine that a computer is given the ability to control electronically all of the media of the stage, and is able to sense and understand in an abstract way what is happening in that space. Furthermore, suppose that the computer is given the ability to reason about what was happening and could construct abstract responses through media. What would be possible for the computer to do? In an analogy to the human body, the theatrical space is the computer's body… The space that holds the performance becomes an environment generated from behaviors of the computer, responding to and shaped by performers, designers, and technicians. (Lovell, 2000:1)

Lovell's analogy has inspired our work. We see the movements of the virtual camera, which are the virtual choreography (Vc) as becoming the expression of a performative entity composed of the Cyber-dancer and the virtual environment control system (i.e. both the software and hardware involved). In this paper we refer to this entity as the Cyborg, and see the Cyborg as analogous to a human performer.

The word Cyborg instantly engenders images of Terminator and Robocop, yet the word has come to mean any system that is

comprised part of human and part of technology (Calleja and Schwager, 2004:3-4).

The confluence of our digital technology with a human performer to become a cyborg is hardly surprising (Calleja and Schwager; 2004:5 Leao, 2005: 36-38; Shanken, 2005: 54). The Plex was evolved through a human performative led development process by Curson, a performer and technological artist who was significantly influenced by Lucas' (2006a&b, 2004a&b, 2000) writings on Complexity Theory. We found that conceptualising the complete assemblage of Cyber-dancer and technology as a discrete entity, the Cyborg, focuses and formalises our interrogation of the evolution of our technological art.

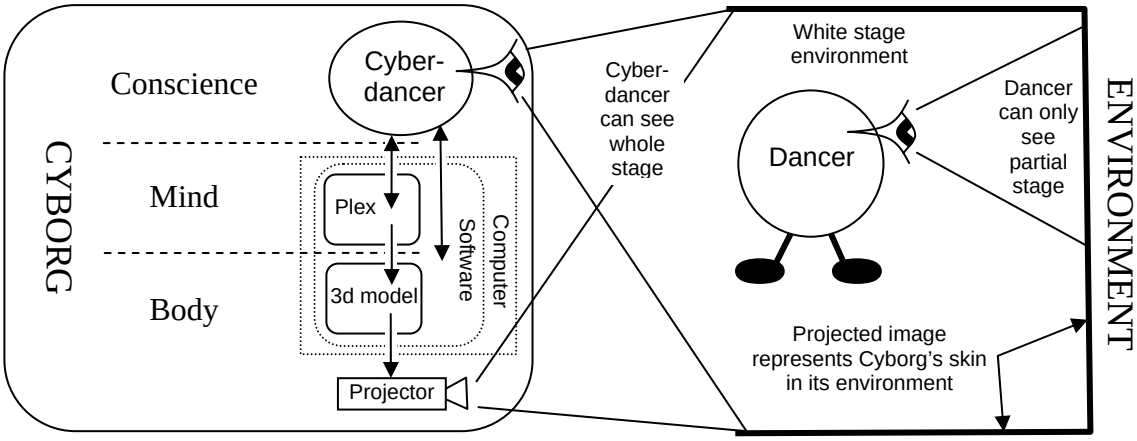

Figure 3 – The structure of the Cyborg and its environment

A dancer on stage has: consciousness, aware of her/his environment and of the performative choices open to him/her at any time; a mind in which movement material is remembered; and the ability to experiment creatively with choreographic ideas. In the analogy between the Cyborg and human dancer, the Cyber-dancer is the Cyborg's consciousness (figure 3); the Plex, its mind; the virtual camera of the computer model (the object that is moved in virtual space) is the Cyborg's body, and the projection of the rendered image onto the stage (the visible manifestation of the Cyborg) is its skin. This analogy does not stop at the Cyborg's structure but continues to its workings. The VcObjects (constructed by the Cyber-dancer) in the Plex can be thought of as the Cyborg's Ideas, and the web, in which the VcObjects are connected, forms the Cyborg's Understanding. VcObjects that are visible at any time to the Cyber-dancer are Ideas in the Cyborg's mind that are visible to its consciousness, i.e. conscious ideas. Hidden VcObjects are the Cyborg's unconscious Ideas. The process that connects the VcObjects together can be thought of as the Cyborg's intelligence.

The Cyborg is effectively the dance partner of the Dancer(s) onstage. Together they create a duet of the Cyborg's movement in virtual space, i.e. its virtual choreography (Vc) with the Dancer's movement in physical space, i.e. his/her physical choreography (Pc).

An Example of the Cyborg's Understanding

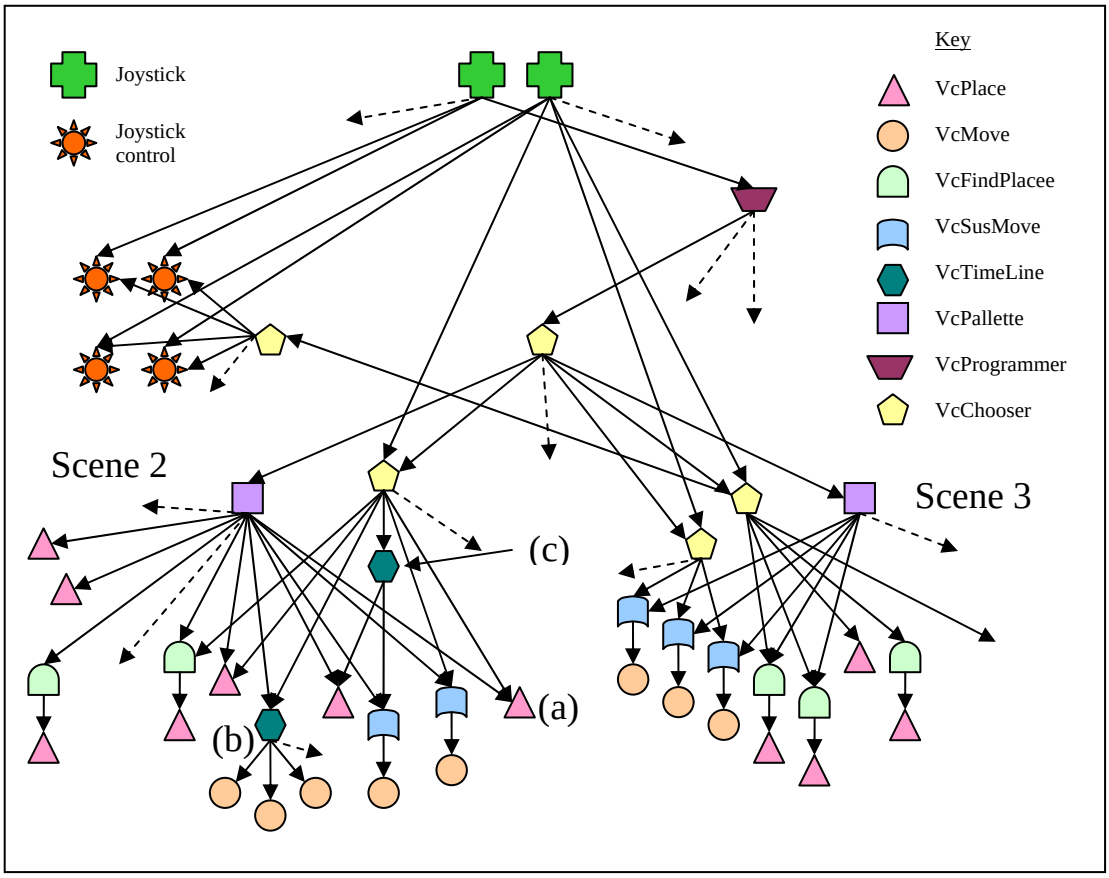

Figure 4 – Showing a simplified schematic of the interconnection of VcObjects for the performance piece Living Room (2006)

During the performative creative process the Cyborg's Understanding could grow to be a network of many thousands of VcObjects (figure 4). In figure 4 a button on the left joystick is depicted as controlling a 'VcProgrammer', which affects the transitions from scene to scene enabling and making the relevant VcPallettes and VcChoosers for these scenes visible to the Cyber-Dancer, and in effect making them conscious to the Cyborg.

For each scene there is typically a single palette that contains relevant selected material, which has been developed during the choreographic process. The Cyborg may consciously select from this material, (by the Cyber-dancer clicking on the appropriate palette entry) or the Cyborg may randomly select certain material from the scene using a VcChooser. In either of the above instances, when the Cyborg senses the time is right it executes the appropriate material. For example in Scene 2 this would include a VcPlace (a), a VcTimeline (b) and a move to a VcPlace followed by a sustained movement (c).

Although simplistic, this process of the cyborg selecting and executing movement material, is not unlike the process that any human dancer goes through in performance, as they execute a series of trained and learnt, material and processes, which are performed at the appropriate time and manner.

It is important to note that in our research, not all VcObjects or Cyborg's Ideas held within the Cyborg's Understanding are used in any final performance. Many Ideas created stay unused, while others may be only included at some later date. Some of the Cyborg's ideas enable the creation of new material, and while not used in any formal showing, they act like a scaffold becoming important for construction but superfluous on completion. We will return to the importance of having 'redundant Ideas' in the Discussion.

The Cyber-dancer

From previous experience we have found that the technological process can have a deleterious effect on the creative process. For example, our physical and virtual choreographic processes can be severely disrupted when even simple ‘on the fly’ technological modifications take 30 minutes, letting the dancers get cold (and bored). Artistic creativity is a fluid process where elements are in a constant state of flux being combined, blocked up, played with, pulled apart and recombined. This is very different to the precise nature of typical software engineering, where every element is precisely tailored to fit with its neighbours like a huge Swiss clock with many cogs all intermeshing exactly. A single incorrect character in a computer programme can have terminal consequences, while an arm in the wrong place in a dance, though perhaps having a deleterious effect in a choral piece still allows the performance to continue. The margins of error in each are often so dissimilar as to make the human creative process and the technological developmental process two seemingly very different creatures.

When we drew these two processes together in our initial practical research work, in reference to our aesthetic, four types of results frequently occurred. Firstly, when we tried to create the physical and virtual choreography together the physical choreography would

often become slow and ponderous, reflecting the technological process. The human creative process tended to be distorted as it adapted to the exigencies of the technological development process. Secondly, when the physical choreography led the virtual choreography, e.g. when dancers devised their choreography prior to bringing it to the performance lab, the results although encouraging were at the cost of painstaking hours of work aligning models, recording and editing timelines of movement, and drawing this material together in palettes that could be practically worked by the Cyber-dancer. Thirdly, when the virtual choreography led the physical choreography, the relationship, which was limited by the ineloquence of the software system, could become literal and often trite. Lastly, when both physical and virtual choreographies were created with minimal co-development .the relationship became vague and too abstract.

The meeting of the creative and the technological processes could be described as a collision between an oddly shaped rock and a ball of soft dough. The adaptive squiggy dough, of the human process takes the imprint of the rock, that is the strong structure of the technology. After each encounter, we would pull the dough and rock apart to refashion the software and try again.

The evolutionary emergence of the Plex during the project heralded a softening of this metaphor; with the ‘rock’ becoming, a block of ‘Lego’, allowing the virtual choreography to be reconstituted with

more ease and to become more fluid. In many ways the VcObjects are similar to Lego bricks: each is indivisible; created in the mould of one of a limited set of types; and designed to fit together in a multiplicity of ways. Also like Lego, each VcObject can not create and reconnect themselves. However over time, with the assistance of the Cyber-dancer, the network of VcObjects did reform and adapt as part of the creative process becoming the fluid Understanding of the Cyborg. In retrospect, it was like a time-lapse movie of a Lego structure forming and reforming through an unseen hand.

However, the fundamental problem endured. The networks of VcObjects in the Plex (the Cyborg's Understanding) did adapt and change as part of the creative process (through the Cyber-dancer), but the timescale of this change was still so much longer than the onstage process.

Could we create a Lego that could build itself; to auto-create? Could the software 'suggest' creative ideas while following our creative direction? Could we create a technology that is more human, capable of being a co-creative partner in the human process rather than a pedantic tool?

To answer these questions we need to understand the process behind the Cyborg's intelligence, the creative process the Cyber-dancer used to create and interconnect the VcObjects in the Plex.

To interrogate this process we draw on theories from two fields; cybernetics and micro-biology.

Fitness Analysis

Colloquially Cybernetics is thought to be synonymous with robotics, yet more accurately it may be thought of as the study of self governing systems, especially of self-organising complex systems (Lucas, 2006b & 2004b). One cybernetic tool is fitness analysis (Heylighen, 2001).

In fitness analysis all the possible states of a system can be represented on the x-y plane of a graph. The fitness of any state is indicated, usually negatively, on the z axis. Certain states within the system, attractors, are considered better, i.e. fitter than others. Feedback mechanisms within the system then contrive to change the system's state towards the fitter attractors, i.e. the system's state is attracted towards the attractors.

To illustrate this we use a humble multi-thickness office laminator. The laminator has a knob that is turned to select one of three laminate thicknesses (A, B or C) that the heated rollers inside should adjust to. A plane formed from the temperature of the laminating rollers on the x-axis and the angle through which the selection knob is turned on the y-axis indicates all combinations of the two and serves as a meaningful state space of this system. The mechanism of the switch ensures that it will set to only one of four positions. Even if you try to set the switch to half way between two positions the mechanism will move the knob to one of the adjacent

settings as soon as you release it. Once the laminate thickness is set the combination of the heater and a thermal switch in the machine adjust the rollers to the correct temperature for the selection. The combination of both the feedback mechanisms of the switch and temperature control system creates three distinct attractors within the fitness landscape. (figure 5)

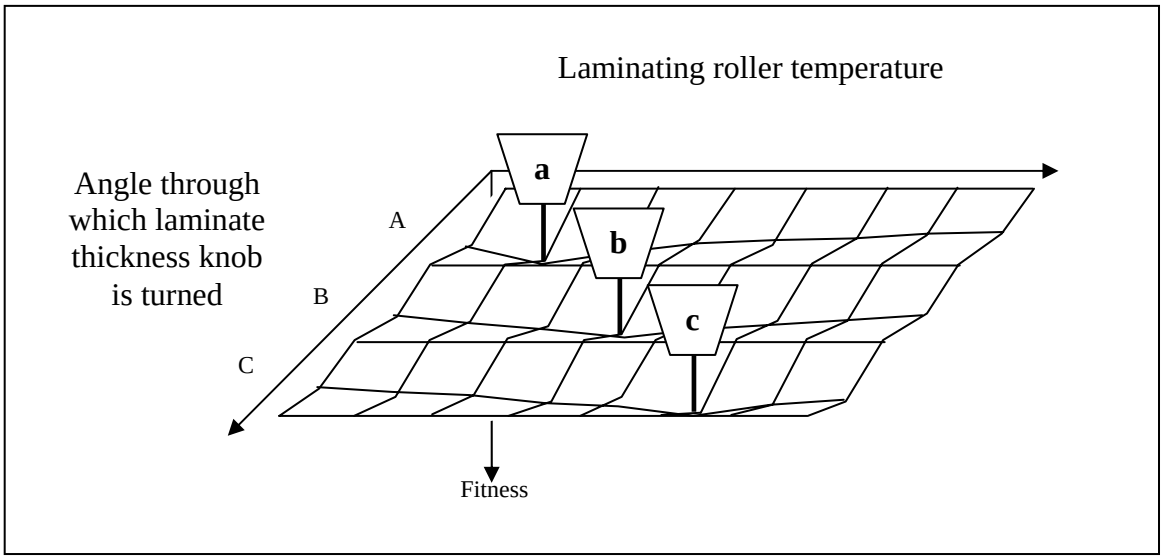

Figure 5 – Fitness landscape of office laminator showing attractors a, b and c.

In a creative system however the state space is constantly expanding as new possibilities are discovered i.e. the state space cannot be finitely prestated. However our creative process could be viewed as the sum of many small limited creative explorations, to each of which we can apply fitness analysis. An actual example of our creative process analysed in this way follows.

Creative Explorations – stage 1

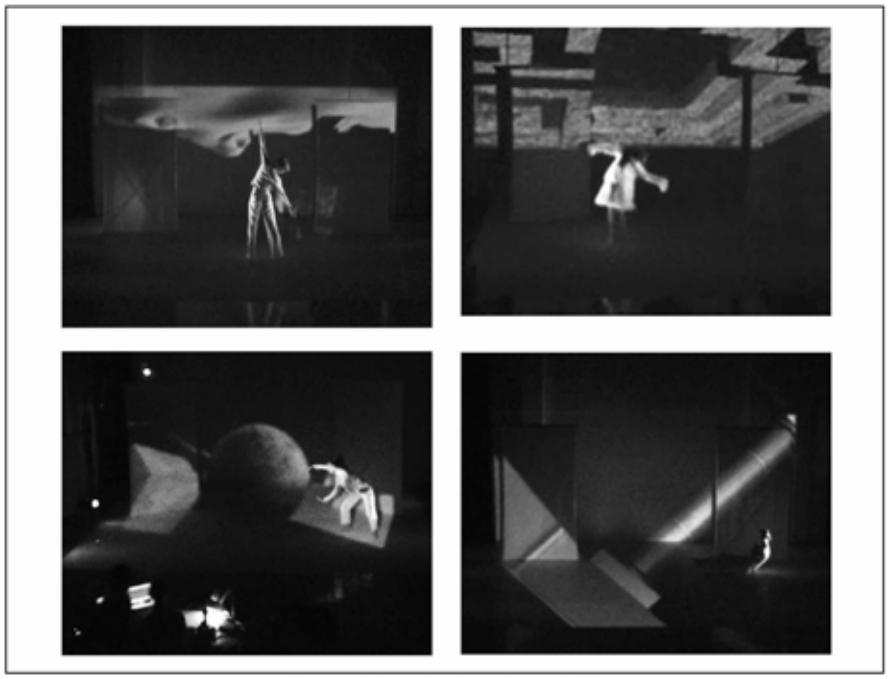

Figure 6 – Some successful Vc/Pc combinations

The Cyber-dancer first creates an empty VcPallette in the Plex. The Dancer improvises slowly around the stage relating to the projected environment, the Cyborg's Skin.

The Cyber-dancer, using the joysticks, moves the virtual camera (the Cyborg's Body) in response to the Dancer. Thus the Cyborg slowly moves its Body consciously aware of the 'point of contact' between its Skin and its partner, a form of virtual contact improvisation.

When the Cyber-dancer passes a combination of VcPlace and a position of the Dancer that he likes he records within the VcPallette, the position of the camera as a VcPlace and names it to describe

the Dancer's position. Thus the Cyborg remembers the position of the two dueting bodies. This is analogous to two dancers improvising. When the duet finds a 'successful' position both dancers remember it by connecting in their minds the position of their own bodies with the position of their partners.

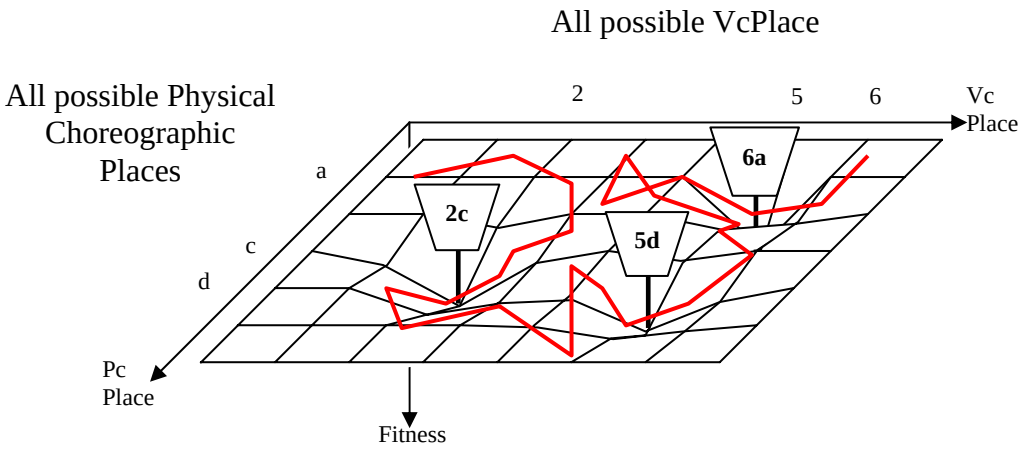

Figure 7 – Fitness landscape of a simple Vc/Pc place exploration showing Order through Noise Random path more likely to find attractors.

If all VcPlace possibilities of the Cyborg are notionally illustrated on the X axis of a graph and all physical choreographic possibilities of the Dancer on the Y axis, the X-Y plane defines a creative domain of all possible combinations of the two. The amount we, as the artistic creators liked any combination is the height measured downwards. A fitness landscape is created. (figure 7) in which favourable choreographic combinations appear as attractors or wells of creative opportunity.

The above choreographic exploration of the various combined Vc/Pc choreographic possibilities becomes akin to wandering around this fitness landscape until falling into a pit of creative potential. On falling, the location is marked by the creation of the named VcPlace object and thus becomes an idea in the Cyborg's mind. The exploration is then continued. These pits we can view as the attractors.

The landscape and hence the position of the attractors represent part of our artistic aesthetic. The imprecise nature of controlling the position of the camera using the joysticks and the improvised nature of the dance both make falling into an attractor more common, following Von Foerster's principle of order through noise (Heylighen, 2001). This serves to illustrate the importance of play in the creative process (see also Palmer, 2001).

From this creative process we derive a diverse VcPallette of Vc/Pc combinations stored as named VcPlace Ideas.

Creative Explorations – stage 2

The Dancer next improvises movement staying roughly on the same spot whilst the Cyborg improvises movement staying roughly in the same position (e.g. little orbits around a location in virtual space). This is similar to two dancers standing apart facing one another improvising movement between them, while staying in the same

location. Through a similar process to that described above we build up a diverse VcPallette, this time containing Vc/Pc movement combinations recorded as named VcTimelines, each containing a movement sequence as a sequence of VcMoves. This gives another explored and marked fitness landscape (figure 8b).

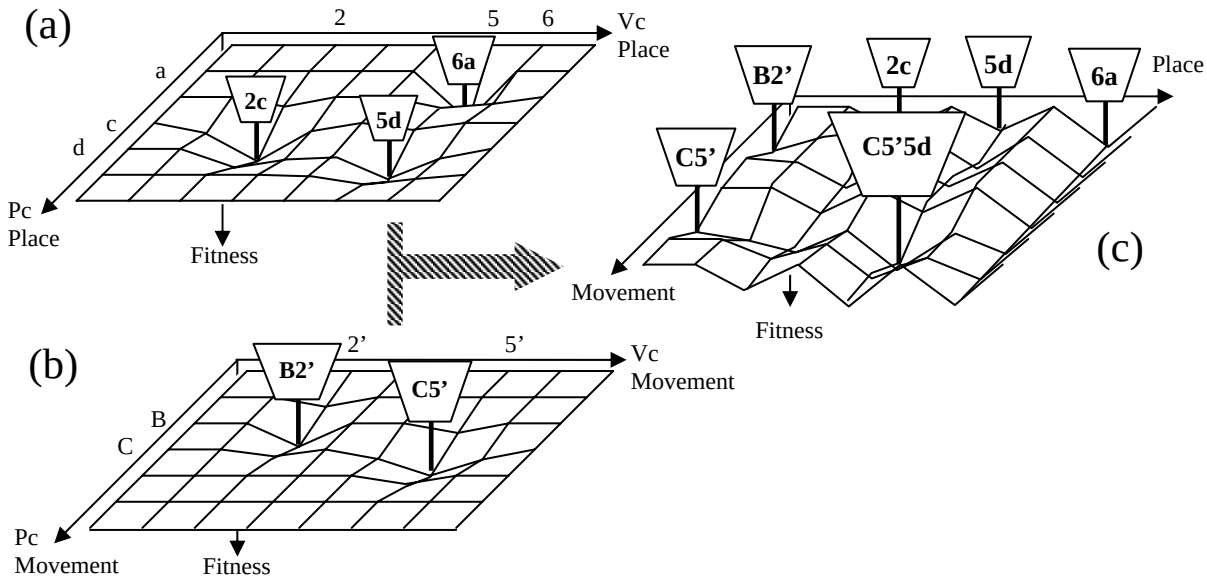

Figure 8 – Showing fitness landscapes of creative explorations stage 1 (a) & stage 2 (b) and their combination through autogenesis (simplified to show a small number of attractors)

The Cyborg now has two diverse VcPallettes in its Plex/Mind each containing about 20 Ideas; one of Ideas (VcPlace) representing combinations of Vc/Pc place and another of Ideas (VcTimeline) representing combinations of Vc/Pc movement.

The Cyborg and Dancer, now enter into an improvised duet using *just the selected material from the two previous explorations*. This is

another exploration of a fitness landscape (figure 8c). The topography of this new landscape represents the intricate interplay between both sets of previously discovered attractors. In some cases, but not all, the attractors may react together creating a deeper pit than the two simply added, a whole greater (or fitter) than the sum of its parts. The new attractors can be isolated by the Cyborg's Consciousness as new labelled Ideas created by interconnecting the two previously discovered ideas combining to form the attractor (the specific VcPlace and VcTimeLine).

Although in reality we found our creative process to be more complex than this, we believe that this process describes the essential mechanism behind the creative process we used. Further we speculate that figure 8 depicts a generic process of drawing together the results of *any* two creative explorations. This generic process we have called autogenesis.

And of Micro-Biology

> The radical new view of life that I adhere to is that life is based on collectively autocatalytic sets of molecules, not on template replication per se…the emergence of collectively autocatalytic sets of molecules is not impossible but becomes almost inevitable in sufficiently diverse chemical reaction networks. (Kaufmann 2000, p32)

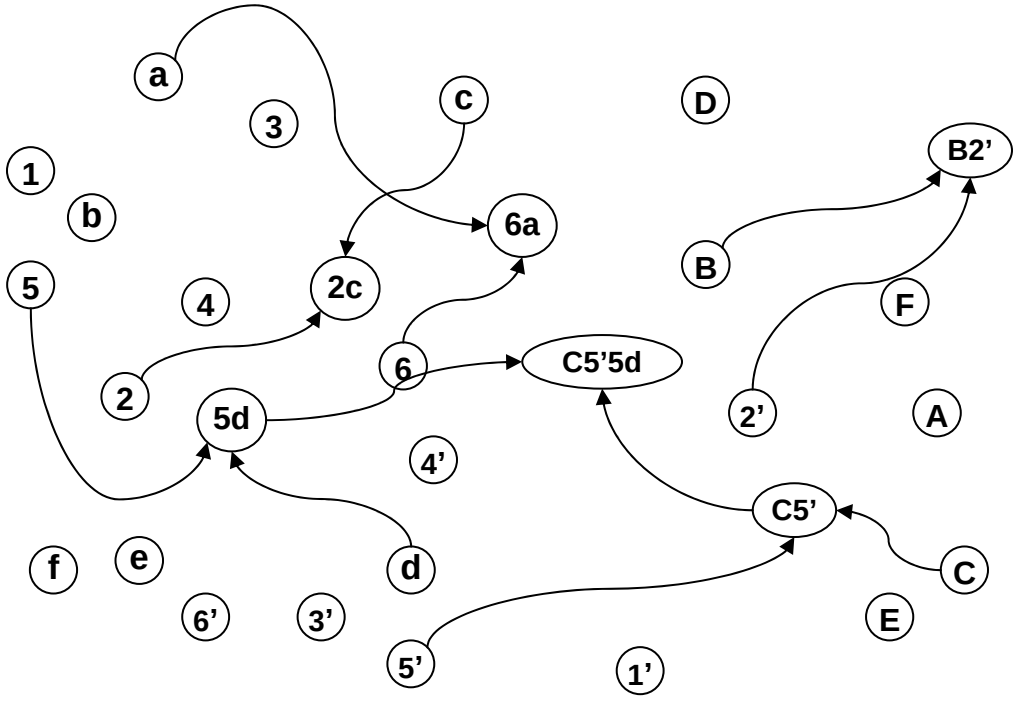

Figure 9 – the choreographic population expanding into the adjacent possible through autogenesis

We found that the Understanding in the Cyborg appeared to grow haphazardly in the manner of a living complex system (Stuart, 2005, Stuart and Curson 2006), rather than develop linearly into increasingly ordered hierarchies. Hence we decided to use a life-

science, microbiology, to provide us with a foundation for understanding this process of growth. The theoretical micro-biologist Kaufmann states that: “The adjacent possible consists of all those molecular species that are not members of the actual, but are one reaction step away from the actual.” If we represent all basic choreographic material that we started with (1,2,3…, a, b, c…, etc) as a population (figure 9). We find that during the creative process this population is progressively expanding, moving into the adjacent possible through steps of successive creative exploration, mutation, and recombination.

Factors important for the emergence of Autogenesis:

We believe autogenesis to be an emergent process, occurring when a number of factors within the Cyborg system occur simultaneously. This list may not be exhaustive.

- An ability to localise a creative field small enough to explore effectively yet diverse enough to create pools of creative possibilities (attractors). In microbiology this could be the containment of molecules within a small enough region for collective autocatalysis to take place, Kaufmann (2000) does point out that in order for collective autocatalysis to take place a sufficiently diverse set must be contained
- An ability to localise a creative field small enough to explore effectively yet diverse enough to create pools of creative possibilities (attractors). In microbiology this could be the containment of molecules within a small enough region for collective autocatalysis to take place, Kaufmann (2000) does point out that in order for collective autocatalysis to take place a sufficiently diverse set must be contained.
- An agency exists, which provides a yuk/yum ‘decision’, and gives a measure of fitness for each creative combination as they arise. The results of these ‘decisions’ determine whether each particular creative combination will be selected to become part

of the next global creative set. In a molecular context, this agency is provided by thermodynamics; in our artistic context the agency is our aesthetic choice.

- A means to combine creative elements together into an ordered set. The Cyber-dancer's ability to link Ideas using the advanced Idea types of the Cyborg's Plex/Mind is an example of combination through an ordered set. This also occurs in Kaufmann's autocatalytic sets of molecules.

- A playfully creative approach to the exploration or von Foerster's (Heylighen 2001) 'order through noise' process exists. The random movement of a large population of molecules allows for the creative exploration of the many possible combinations between them and hence, the formation of favourable products. The nature of improvisation and also the inexact control afforded to the Cyber-dancer by the joystick and timing of mouse clicks allow more extensive exploration of the creative choreographic domain between the Dancer and the Cyborg.

- A sufficient diversity in each creative exploration is built before the emergence of new products from recombination can occur. Kaufmann (2000) suggested that the emergence of autocatalytic sets of molecules becomes almost inevitable with sufficient molecular diversity. We also found that through multiple applications of autogenesis, the emergence of new choreographic ideas became almost inevitable. We found that

as the diversity and sophistication of Ideas within the Plex/Mind increased, then wide variations of choreography, multiple scenes and hypertextual narrative emerged.

Discussion

We cannot understate the importance of the Cyber-dancer being central not only to the actual dance and process of choreography, but also to the development of the software. Palmer (2006:115) also has observed how important it is, when creating in this media, for technologists to be artists. The use of a dancer rather than a technician as the Cyber-dancer gave the Cyborg artistic sensibilities: a human reacting to another human in space. In turn, the technology by becoming a recording mechanism, allowed recollection of the artistic process for further creative development and study and enabled the human element of the Cyborg toward greater artistic potential. The virtual choreographies were stored as VcObject networks in the Plex and the evolved creative mechanism was in part stored as the software. The human/technology combination itself became autocatalytic; a whole, greater than the sum of its parts.

During the performative research process not only did the choreography expand into the adjacent possible, through the suggested process of autogenesis; but the functionality of the software also expanded into the adjacent possible (its evolution), through an apparently simultaneous process of autogenesis. Just as the development of the web of VcObjects in the Plex can be seen as the development of choreographic thoughts within the mind of the Cyborg, so can the development of the software be seen as the evolution of the Cyborg's mind itself. The co-development of the Cyborg's mind and

thoughts occurred within multiple interlinked layers of autogenesis. This co-development arose from an intrinsic reflexivity, which we believe has imparted intelligence to the system as a whole and maybe, additionally, a kind of ‘consciousness’ beyond the Cyber-dancer. This co-development is similar to the multiple feedback loops within the brain that Jones (2004:45) speculates give rise to ‘conscious artefacts’ of the mind. Other researchers such as Leao (2005: 37-38), and Shanken (2005: 52-54) have speculated about the form of the relationship between human consciousness and technology, particularly digital and virtual web technology. They suggest that some form of emergent consciousness beyond the solely human conscience arises. Jones continues by suggesting that ‘consciousness within self-organized entities is not only possible but inevitable’ (2004:45).

The fact that autogenesis occurred even simply through the agency of a personal aesthetic applied as a ‘yuck/yum’ reaction, implies that autogenesis, that is in this case the self-organisation into evolving levels of creativity, will occur with at least a range of aesthetics if not all aesthetics. This suggests the importance of integrity within the process of autogenesis over any specific arbitrary aesthetic. This result encourages us as artists to trust our own aesthetic as the integrity of our creative process.

The Cyborg could not only organise its body in space, but also organise the organisation of its body in space. It was complicit in its own evolution. We believe that the organisation of the cyborg responding to and being able to

evolve in its environment, as a performer, allowed it to develop traits that were akin to a biological entity evolving with its environment.

As mentioned earlier (in section headed ‘An Example of the Cyborg’s Understanding’) the networks of VcObjects, the Cyborg’s Understanding, develops along non-linear lines, exhibiting redundancy and inconsistency. While some Ideas readily find connection, others appear redundant, but then eventually may be used in later creative combinations or become important as ‘scaffolding’ structures. This characteristic of our autogenic system affirms what, we as artists, felt intuitively: the importance in creativity to combine form and freedom, and the necessity to produce through play diversity to later build with, and not be too critical too early on.

We speculate that the described process of autogenesis could not only be a mechanism for artistic creation but could also explain both the creation of ideas in the virtual world of our minds and the creation of forms in the natural world. For example, many geneticists are still perplexed as to the amount of the human genome that does not directly code for proteins in the body (Pearson, 2007, Coghlan, 2007: 20). Just as many of the Cyborg’s Ideas are not used in a performance, but are a result of its creative journey, autogenesis suggests that the genome is not simply a template for an organism, but a result of its evolution; it is the story about how the organism came to exist, not just a description of the organism as it is now. Importantly, the concomitant redundancy that evolves through autogenesis would seem intrinsic for the

emergence of new useful combinations in the creative system. This implies that ‘junk’ DNA could be important for the evolution of beneficial future biological traits.

If Kaufmann's assertion that life is based on autocatalytic sets of molecules holds, and our analogy between a creative process and Kaufmann's work also holds; then perhaps we might say that life is founded less on mechanical scientific processes, but more on artistic creative processes. By the same token, we might also say that a truly creative process becomes a living process.

If the Cyborg is a true reflection of the human condition, then the workings of the Cyborg’s mind, described in this paper as autogenesis, may go some way to describe the workings of *human* intelligence. Thus our intelligence may not be a mechanical machine, a super super computer, but rather be a playful artist, who continually creates new links and patterns to adequately describe the world around us.

We are often asked in the contemporary artistic culture: why we do not use sensors to give information about what is happening onstage directly to the computer, but instead use the Cyber-dancer to sense onstage events and manually affect a cyborg response. We believe that by actively acknowledging the designer/ technologist as artist, and one with a real-time response capability, we have been particularly enabled toward gaining our insight into the

creative process. We have developed a technological system that reflected to some degree the contemporary nature of the human condition which exists now in many levels of our society as Cyborg (Calleja, G. and Schwager, C. 2004).

We feel our use of performance led improvised exploration led the Cyborg to become, both in structure and workings a reflection of both ourselves and our process; a greater multilayered statement of the human condition: working with environment, understanding its environment and evolving with its environment. In attempting to express the human creative process in technical terms we aim to open up the possibility of our technology becoming a true co-creator in our human-technological art form. Instead of technicallising the human condition, we see the process more accurately as humanising the technological.

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