

Becoming Digital

by R. Bruce Elder

For the past fifteen years I have been working in a sort of digital cinema, that is (to be precise about my meaning) a cinema that incorporates digital images. I work with digital images at a fundamental level, manipulating the array of 1s and 0s that constitute its most basic level of representation. I subject that array of 1s and 0s to various sorts of mathematical transformation. I began my university studies in science and my Platonic proclivities led me to read widely in the history of mathematics. As early as the late 1970s, I became convinced (as I remarked recently to your festival organizer Hang Jun Lee), that that mathematical structures are homologous to structures of consciousness—and that cinematic elements can be configured in forms that are isomorphic to mathematical structures (and so it follows, according to a postulate that many have come to reflect upon by studying Euclidean geometry, these some mathematical forms are isomorphic to the structures of consciousness). It struck me that a judicious selection among mathematical principles could reveal something important about the working of mind. The application of algorithmic theory in artificial intelligence I believed could be a guide to making that judicious selection. In the last decades of the twentieth century, we had arrived a new way of understanding Plato's claims that the study of mathematics leads to insight into the nature of reason itself.

In the mid-1980s, my work reached a crisis point. It was clear that I could not continue to make the films I had been making to that point—long forms (whose models were the Ezra Pound's *Cantos*, Louis Zukofsky's 'A', and longer poems of Kenneth Rexroth, especially *The Phoenix and the Tortoise* and *The Dragon and the Unicorn*) that were grounded in montage: Zukofsky taught me how a montage of quotidian elements could articulate a far-reaching theory of value that grounds a political economy (shades of Eisenstein's hopes to render *Das Kapital* cinematic), Pound taught me how the montage could offer an imitation of thought processes, and Rexroth (the teacher with whom I spent the most and learned the greatest lessons): it was Rexroth who taught me the simple truth that a poet is "one who creates / Sacramental relationships / That last always." Among those of his poems that are most dear to me is "Time is the Mercy of Eternity." It concludes

There are no fish in the water.
There are few deer or bear in the woods.
Only the bright blue damsel flies
On the reeds in the daytime,
And the nighthawks overhead
In the evening. Suspended
In absolutely transparent
Air and water and time, I
Take on a kind of crystalline
Being. In this translucent
Immense here and now, if ever,
The form of the person should be
Visible, its geometry,
Its crystallography, and
Its astronomy. The good
And evil of my history
Go by. I can see them and
Weigh them. They go first, with all

The other personal facts,
And sensations, and desires.
At last there is nothing left
But knowledge, itself a vast
Crystal encompassing the
Limitless crystal of air
And rock and water. And the
Two crystals are perfectly
Silent. There is nothing to
Say about them. Nothing at all

Elsewhere he outlined an erotic mysticism that became the core around which the various strands of my work wound themselves—in *The Phoenix and the Tortoise*, Rexroth noted that he found in sacramental marriage a source of values in the midst of the disintegration of traditional culture. The aim of life lived according to this principle, he noted, is to show how from full love of one other person the self can develop a reverence for all life. “The process as I see it goes something like this: from abandon to erotic mysticism, from erotic mysticism to the ethical mysticism of universal responsibility—from the Dual to the Other.

Such love leads to an identification of the self with what Rexroth called “the tragic unity of creative process”—as Rexroth saw it, the creative process is because creation and destruction are yoked together, as are love and death, light and dark, and in all these forms arising from the union of opposites are in their turn inseparable phases of the whole process of the world. They do not lead us beyond the world. Rather they serve as lessons in the absolute, ineluctable and insuperable value of contingency. Love, Rexroth taught, does not lead us out of the world. The place of transcendental calm is located in the intense relation of one to another. Love is “essentially a relationship,” and contingent as all relations are: yet the most important value in “the shifting and flowing of contingency,” it is illuminated by the transcendent. So often we want to find our value in a realm beyond that of contingent fact—think of Wittgenstein’s comments in his *Tractatus Logico-Philosophicus* 6.4: propositions merely express facts about the world, propositions in themselves are entirely devoid of value. The facts are just the facts. Everything else, everything about which we care, everything that might render the world meaningful, must reside elsewhere. Rexroth’s teaching was more profound: the contingent and the ultimate, fact and value, become one when one discovers within himself the illumination of love that allows one to experience everything with an intensity that reveals that it is of ultimate value. The division of reality into contraries is the work of reason, and not of love. Reason sunders, love unites, and in yoking apparent contraries together reveals the essential nature of reality, which is love. Just as mortality gives life its value, so contingency and relativity gives love its meaning and its pathos:

It seems to me that the fullest realization of the self comes in the acceptance of the limits of contingency. It is harder, but more ennobling, to love a wife as another human being, fugitive as oneself, than it is to carry on imaginary conversations with an imaginary Absolute. The demand to be loved totally, irrevocably, destroys first the love and then the lover. It is a kind of depersonalization—the opposite pole, but exactly like prostitution.

In an interview in Cyrena N. Pondrom published in *Contemporary Literature* (Vol. 10, No. 3) Rexroth remarked

My point in those lines . . . is that if reality can be apprehended without grasping, the epistemological problem disappears. The beginning of the experience of reality is the same as the end of it. The source or spring of experience is an experience like that of final illumination. That is to say, rather than being built on perception on receiving and sorting sense data, our experience of reality begins and ends in illumination. Jacques Maritain [a neo-Thomist philosopher whose major works were produced between 1920 and 1970] talks again and again about the idea, although this is not really Thomism. It is an idea that goes back to medieval mystical philosophy, to the thought of Richard of Saint Victor. Experience begins with illumination since this is true, there ceases to be a problem of transcendence of the mundane world. This idea occurs over and over again in my poetry. I think one of the clearest expressions of it is in *The Heart's Garden*: "He who lives without grasping/ Lives always in experience/ Of the immediate as the/ Ultimate. The solution/ Of the problem of knowing/And being is ethical./ Epistemology is moral."

Rexroth devoted his life and art to identifying a way of living fully, deeply, in the flowing world. How to reconcile this belief that of the ultimate value of floating world with my Platonic disposition (reinforced by my encounter with George Grant's and Simone Weil's writings) became the central topic of my films and the generator the forms my work assumed.

But it became clear to me that I could no longer afford working in such extended forms (particularly in a time when "vanguard cinema" was in peril of being co-opted by those who believe that "experiments art" is an excuse for adolescent behaviour and the equivalent of fart and pimple jokes). It occurred to me that the dialogue between mathematical form and contingent imagery might provide a forum for working out these issues, a way of working that would be less expensive than those I had employed to this date.

But that required that I expand my mathematical abilities. I went back to night-school and, I suppose, did the equivalent of a degree in applied mathematics and computer science, and subsequently devoted most of my "research" activities to writing computer programs for processing images in ways that conform to my aesthetic ideas.

Whatever else one might believe about digital of cinema, it seems clear that there a radical breach between the classic, photographically-based cinema and new, digital cinema. Of a photograph, it is always reasonable to ask: "Who created the photograph, the photographer or nature?" The question cannot be answered, but one must acknowledge that an aspect of the beauty of a photograph, is that a photograph, as André Bazin pointed out long ago, strikes us as a phenomenon of nature. Thus, making photographs, or photographically-based films, seemed to me a way of cherishing the gift of what reality – actually, of what is more accurately described as *natura naturans* – makes for us. Photography, I concluded, succeeds when the photographer transcends wilfulness and learns to cherish the gifts given him or her. That the will of the human "maker" should have no place in the creation of the image is the most radical implication of photography, its most profound rupture with the traditional image-making. Photography even allows the imagination to be circumvented, and by this, it reveals our being-with-the-world

Digital cinema is another matter entirely—digital cinema gives the subject back its traditional role—or rather, something close to its traditional role. The imagination resumes its traditional function in image-making: digital images once again require that we step back from the world and enter into the space of subjectivity. And all the usual ontological and epistemological problems that tradition has with images—both philosophical tradition that descends from Plato and the theological tradition that developed out the Judaic religion—

reassert themselves with digital images: one can ask whether what one sees in the image is an object; the image allows for contradictory interpretations, and so exposes the knowledge we gain through them to doubt; images mediate between the subjective and the objective world (and so, in a process that Baudrillard's writings expose, take precedence over the objects they purport to represent and, finally, block access to those objects).

The digital image does offer something that changes the tradition of image-making: it makes it possible to realize the Pythagorean dream of producing images/reality through number and through calculations of a complexity that Pythagoreans could never have conceived them rather than through the depictions of facts (pictures as Wittgenstein understood them – arrangements of elements that mirror states of affairs). This is a whole new possibility for the imagination, and, though I have dabbled with it, I have not been able to come to terms with it.

Insisting on the role of subjectivity and imagination in the production of digital images of course raises the question of the subject, and issues around the subject are vexed. One can see the appeal of the idea that the subject is something that can be detached from one body and transplanted. For let's admit that the term "I," as it is ordinarily used in intellectual discourse, is hopelessly troubled—its meaning all but indiscernible, inasmuch as it is surrounded by a thick fog of philosophical, theological and psychological confusions. The new technologies, and the new media they have produced, promise to help render these traditional confusions obsolete, for they propose a new definition of the subject: "I" am a complex system of electromagnetic and chemical brain processes. This new start on the description of the subject at least promises to clarify what this reality that we refer as "I" really is.

But it also proposes the hope that the "I" might be transplanted – already the brains (or parts of brains) of rats can be transplanted from dying bodies to fetuses. In this sense, the immortality of "I," through the repeated transfer of brain parts, has become a theoretical possibility that the new technology will undoubtedly strive to realize.

Despite all the confusions that have surrounded the traditional concept of the subject, and potential of the new conception to sweep away that fog of confusions, I find the whole idea really pernicious. It denies the important role of the particular body that each of us has in establishing his or her identity – thus, because our identities are so crucial, it devalues the body. All my recent work – and much of the work that I did earlier (though I didn't realize it at the time) – has been devoted to enhancing the sensation of flesh (and flesh's belonging to the world). I think the topic of the body is the most important topic one can devote oneself to in this contemporary climate, where "despisers of the body" are so prevalent. If I were starting out now (or, rather, if I were young enough) I would surely be doing very "in your face" performance pieces that dealt with the body. They would be "in your face" pieces not so as to be transgressive—the idea of transgressive art strikes me as among cultural theory's most boring ideas – but because body art can so bring to our attention the importance of rapture. By "rapture" I mean any intense experience (because of its extreme intensity, such experience is sometimes felt as displeasure) that deranges focussed, analytical consciousness – experience so intense that it leaves conventional ways of thinking in ruin (at whatever cost). This sort of experience invariably makes us sense the body's role of experience: we feel at once acute anxiety (one can even feel some measure of nausea) and acute pleasure as every nerve ending seems to tingle and we feel waves of bliss surge through the body, from head to toe and from toe to head. One experiences this when the energy of the body rises up and imposes itself on us, as occurs in love-making, or when we find ourselves intensely aroused and intensely embarrassed at the same time—I sometimes experienced it when my assistant photographed me for films we made together (as she did many times), and it was primarily those occasions that taught me the crucial importance of this sort of experience. I am sure that making performance art would allow me to focus much more directly and clearly on that sort of

experience, which I believe is so important.

The most important thing that the body teaches us through experience of this sort is that we are “owned”—first by the divine, that fills flesh with desire, and then, through the divine, by all other people. Thus flesh teaches us we owe deep allegiance to one another. It teaches us that the obligation that any other person imposes on me, just by being human, is absolute and unconditional; and we have even more profound obligations to those who fall into the circle of our love. I have no choice but to care for others around me, and seek to live a life in which I care profoundly for a number of friends whom I love deeply. Through the divine, they own me; and I am not free to choose what I wish to do—I belong to them and must act out of my concern for them.

Art should reveal areas of experience that we cannot reveal to others except by making art—forms of imagining that we cannot reveal in any other way. By doing this, art gives us a more profound sense of what human being is—it acknowledges that we think in ways other than the analytic/instrumental/propositional forms that have dominated us (in the West) at least from the time of the Enlightenment (and possibly earlier). Propositional thinking, thinking that can be modelled by rewriting of one string of symbols into another according to an established rule (thinking of the sort that computer scientists are prone to think of as the sole form of thinking available to us), is “deranged” by the intense feelings surge through the body as it responds to the field of energy that lies “beyond us.” I believe it is important to tell one another that we possess the capacity for rapture, too – and for all those sorts of experience that are close to rapture (such as mad love or the states that strong, repetitive rhythms induce, a state akin to trance and prayer). To do this, art has to acknowledge the less seemly contents of our thoughts.

The fundamental responsibility artists have is to make contact that beneficent field of energy that lies around us and to enter into that energy. When one does this, it takes control. Then one’s responsibility is to obey its commands; in this, there is no “freedom of imagination.” One takes orders—an image flashes into your mind and you have to make it, no matter how wrong-headed or embarrassing or unaesthetic or humiliating it might be. One cannot be allow considerations of audience/reception to intrude upon this; such concerns make one less willing to go to the extremes to which one might be commanded to go – one might get to thinking “What will people think?!?” When one becomes disobedient, one breaks with the source of one’s imaginings. This is why the Muses were frequently thought to be very jealous.

I am concerned to reject assertions like those of Arthur Kroker that the new media (cyberspace and virtual reality) will lead us into a better future – a future that will undo all the devastations of the centuries since the Enlightenment have wreaked on us, a future that will be heaven-on-earth. One hysterical comment from Kroker, formulated on the model of neo-Platonic philosophers Robert Grosseteste’s metaphysical light proposes “So begins our violent descent into the electronic cage of virtual reality. Down we go into the floating world of liquid media where the body is daily downloaded into the floating world of the net, where data is the real, and where high technology can fulfil its destiny of an out-of-body experience.” Gibson opines that soon we be shuffled off into “bodiless exultation.” And Microsoft asks “*Where do you want to go today?*” as we sit in front of the screen of our monitor. Eric Voegelin, in his *The New Science of Politics* identifies the historical shift that generated these hysterical, and body-despising, comments: in the 13th Century, Joachim of Flora (or Fiore) broke with the Augustinian notion of a de-divinized “Civitas Dei” by resurrecting the Gnostic notion of heaven-on-earth. Joachim was nominally a Cisterian monk in Calabria but actually a Gnostic. One of Joachim’s contribution to the history of millenarianism was the notion that history should be divided into three periods that correspond to the three persons of the Trinity. The Second Age of the Son was coming to a close, Joachim professed, and the glorious Third Age of the Spirit was about to

dawn.

Later Utopian movements adopted this formula for dividing history into three periods. Ivan IV forced Constantinople to recognize Moscow as the Third Rome in 1589 – an early painting of the Theosophist/Gnostic painter Wassily Kandinsky in fact depicted the dream that Moscow would be the Third Rome. The historical fantasy that was the Third Reich incorporated possessed the same mythological structure. The later example, especially, imposes on new media thinkers who adopt the gnostic metaphysics—and they are many—the responsibility of considering with whom else (besides the Urantians, Tim Learyian reprogrammers, and other extravagant cult-adherents who have played a role in formulating the received “metaphysics of digital reality”) they are associating themselves.

According to one prevalent conception of the metaphysics of digital reality, the convergence of the media (of text, image, moving image, and sound, all “interactively” available) promises to unite non-corporeal information and non-corporeal individuals in the same electronic medium, in which everything and everybody are co-extensive. This total co-extensivity is the basis for the “total awareness” my new media students keep telling me is dawning (or rather, I understand, their classes inform them is dawning). This idea of the non-corporeal self, of the self that is identical with information, is a modern version of the soteriological dream of transcendence through the emptying out of the self. The appeal that the idea of dematerialization has to new media theorists is that it supposedly exposes that nothing possesses an internal principle that accounts for its growth – that the self, to take it as an instance, is wholly and completely malleable, and can be—and is—constantly made and remade by changes in the conditions of the system of representation that shape it. The Gnosticism of this conception is evident: our world is a wrong world not only because it is a bad world, but also because it offers the illusion of corporeality (that things have a nature by virtue of their constitution). According to the soteriological principles of these new media theorists, why it is so important to see through the illusion of the self—why it is so important to understand that we possess no internal principle but are subject to endless remaking – is that the new non-corporeal world can come under our complete control, because we know how we made it and how to reproduce it. In the end, we would act as a new Creator—this is the dream that fuels those who proclaim that the new media offer unlimited creative freedom, that we might usurp the place of the Divine. We are unshackled from all moral limitations of our world as it is, and nothing outside of us limits our capacity to impose on the world.

The great Canadian philosopher George Grant critiqued this very position in such stunning books as *Technology and Empire* and *Technology and Justice*. Grant showed that the belief that the Good is not inherent in the order of nature underpins that belief, essential to the regime of technique in which we exist and through which we conceive the world, that humans are free to remake the world. Grant pointed out the notion of technique is central to modern civilization—so much so that the progress of techniques has now become the horizon for those who seek to understand the Good. Moderns have lost the ability to understand the standards of goodness by which particular techniques may be judged. The conviction that human knowledge has the purpose of mastering human and non-human nature is central to moderns’ ideas about the nature of human being. The idea that new media theorists expound, that human being possesses no inherent nature has the purpose of justifying the proposition that humans can be made and remade at will—that nothing in the nature of human being limits society’s/ideology’s/ the artist’s freedom to refashion them. And that conception, in its turn, belongs to a discourse on value and freedom that is associated with the will to technique—indeed it is part and parcel of the modern belief that nature, since it is objectively devoid of value, can be remade at will.

What more than anything impresses me about what the propositions issued as the metaphysics of digital reality is their tendency towards imperial aggrandizement. The

consequence of this, I fear, may well be tyranny. I mean “tyranny” here in the Straussian sense, as it arose within a remarkable exchange between Leo Strauss, the renown conservative political philosopher, and Alexandre Kojève, France’s great interpreter of Hegel. A key topic of the debate was Kojève’s affirmation that “that the universal and homogeneous state is the best social order, and that mankind advances to the establishment of such an order.” Kojève pointed out that the final stage of civilization, the establishment of the universal and homogeneous state, comes into being as the secularization of the political ideal of the Christian community, which proposed that all humans could transcend their given differences through their faith, and be made one in the body of Christ’s church—I hope everyone noted that this claim resonates in the beliefs of the new media communitarians. Behind this lies the assumption (not unlike that of soteriological assumptions that undergird the metaphysics of digital media), that thought (and specifically, for the ancients, philosophy) takes its bearings not from an ahistorical eternal order, but from eternity as the totality of all historical epochs (the sum of all knowledge that our new hypertextual “koran” represents).

Strauss argued, against Kojève, that the goal of Hegel’s state, universal happiness, is unachievable – and what is worse, that it will end in tyranny. I don’t find myself in agreement with much in Strauss’s political outlook, but on this matter I think he absolutely right – his thesis turned out, in fact, to be prophetic. Strauss’ argument was founded in the classical belief that humans find their fulfilment in that thinking which leads to wisdom—a premise the Hegel had rejected for the premise that humans find adequate fulfilment in that form of recognition that is available to all. Hegel’s gambit, Strauss argued, had effectively lowered the goal of political action, for his idea of universal recognition as the basis of community and state cannot recognize the inevitable differences among humans, and conceives of communities as nexûs of undifferentiated humans. When we must all be the same, no person will be a true thinker. Philosophy will disappear in such state, through the wedding of technology and ideology (a process that probably is now too far advanced to be reversed). The ideas of a totalization of truth and of total awareness (acquired through the complete co-extensivity of the decorporealized mind and the decorporealized text) that cyberspace promises will surely eventuate in tyranny.

It is time to put away this myth of decorporealization, of the totalization of knowledge that will bring history to end. Because it is grounded in the myth of total identity, total transparency, the prevalent metaphysics of digital reality neglects the actual condition of knowledge: it arises from the Gnostic belief in the possibility of immanentizing of the *eschaton*, a belief that goes hand in hand with the idea that the future can be foreseen and planned. The prevalent metaphysics of digital reality is simply the “dream world” of Gnostic lore, where the structure of reality is disregarded, the facts ignored, and the openness of history replaced by a revolutionary step into the New Age. To replace this myth, may I suggest that we return to where all true understanding starts—with the real body, not the amalgam of metal and flesh that is the cyborg nor the data body of Kroker’s Gnostic dream, but the real body of flesh.

Attunement to the rhythm of what unfolds beyond us – a rhythm that is flexible and ever changing, has the strength to release us from the tyranny of an abstract, rationalized temporality. Awareness of rhythm, because rhythm is experienced corporeally, also undoes the effects of the rationalization of space into a wholly abstract form. Contemporary virtual existence has rendered space wholly abstract. The etiology of that form of space can be readily charted, beginning with the geometric optics of the Renaissance. The development of geometric optics and camera obscura led to the rationalization of vision around an axis consisting of the fiction of a single, fixed vantage point outside the depicted scene, at a place established by the vertex of a pyramid, whose base is the surface of the painting and the slope of whose sides is arbitrary. Thus, the body was removed from the scene of vision. But in the nineteenth century

representation took on a different character: the space of a drawing, especially those drawings whose primary purpose is to provide information about reality, came to be understood as a Cartesian plane, and the relations between elements in the drawing were to be determined not through appearance, as projective geometry had attempted to do, but rather through measurements, which were then transposed orthogonally to the drawing surface. If the body had been excluded in the system of Renaissance perspective, the subject was excluded in the representational regime that developed in the nineteenth century. When the subject is given no place, the drawing surface itself becomes utopian. That utopic space is the predecessor of the utopia of cyber-nonreality – a non-place where “there is no there there,” and, above all, no place for the body. Paul Virilio points out that cyberspace constitutes a new space without the usual space-time coordinates; as a result, cyberspace engenders a disorienting and disembodied form of experience in which communication and interaction takes place instantaneously in a new global time, overcoming boundaries of time and space. It is a disembodied space without fixed coordinates, a space in which one loses connection with one’s body, with nature, and with one’s community. It is a dematerialized and abstract realm in which cybernauts can become lost in space and divorced from their bodies and social world. To counter the abstraction of space and time, we insist on working methods that, in their intensity, leave the trace of the body all over them.

Suggested Questions

***Crack, Brual Grief, Eros & Wonder* and *The Young Prince*, was created using digital technology. How did you become interested in using digital technology in your filmmaking.**

B: My interest in computers started early, and grew out of my fascination with the fact that beautiful patterns are often mathematically elegant. There is an entire field of design that explores the beauty of mathematical patterns, and I was fascinated by it; from the time I was boy, I read about the Fibonacci series, and the golden mean, and logarithmic spirals – various topics of that sort. There is another sizable field of investigation, this one rather flaky (to be sure), known as spiritual geometry, which uses the mathematics of harmony and both an image of and a means for tuning the soul. I spent a lot of reading in that disreputable field of well. You might be surprised how many artists of the last 100 years have.

Your use of digital technology in *Eros and Wonder* is quite different, however. There you used computer technology to process digital images. I believe that you write the computer programs you use to make your films. Could you tell us about these programs?

B: When I decided to use digital processes in my art making, I started by studying the requisite fields of mathematics and computer science; I went back to night-school and took classes for engineers. Working with the knowledge I was able to garner, I developed a computer application that would allow me to collaborate with the machine to produce “visual compositions” – that would allow me to use many of the same principles that I have employed in my filmmaking today, but would help eliminate subjective whim.

I developed a rudimentary application that stored a set of images into a database along with a set of image descriptors (“meta-data”) and a set of image processing algorithms. The application’s function was to decide what image-processing methods to apply to the images in

the database, and to apply them. At first the method for selecting the processing methods to be applied to the images was pretty simple: Images were partitioned in groups based on the similarities indicated by their descriptors, as were the image processing methods (my decision on which methods most closely resembled other methods was completely informal and subjective); the image processing methods to be applied to a reference image were chosen at random – the operator got to approve the selection, and if he or she approved it, then the methods most similar to the randomly chosen method were applied to the images in the database that most resembled the reference image.

I used this application in a film I finished almost three years ago now, *Crack, Brutal Grief*. This way of using image processing methods in film/video production interested me enough (and, I thought, the results were good enough) that I wanted to work further on this application.

It was obvious what refinement I should introduce first: using image descriptors as I did was awkward and introduced an unnecessary subjective element that conflicted with the ideal of avoiding authorial imposition. I quickly realised the application would need to use methods to “compute” the similarity between the two images algorithmically.

Can you elaborate on the ideal of avoiding authorial imposition?

B: John Cage protested against the idea that an artwork is the product of an artist’s feelings, believing instead that the creative process should imitate nature in its manner of operation. Cage was among the first composer to make the use of chance operations central to his compositional processes -- and he developed a variety of aleatory techniques that allow chance and indeterminacy to play key roles in shaping musical result. Cage insisted that aleatory operations mimicked natural processes and that by imitating the operation of natural processes, the composer bypass his or her limiting ego and allow a larger system or set of systems to shape the work. This principle has been very important to me. The richness of Cage’s writing helped make the use of aleatory techniques common among composers. The rigour of writings by Iannis Xenakis and James Tenney -- composers who, like Cage, took an interest in stochastic methods – and the power of their works re-enforced this influence.

Over the past few years, I have worked on projects that explored the possibility of extending these composers’ ideas to the visual domain. The initial framework for this exploration was drawn from composer James Tenney who made extensive use of measures of similarity in the analysis of music structures in his book *Meta+Hodos*. I was intrigued by the possibility of developing analogous compositional procedures for working with sets of images and, in particular, by the possibility of using measures of similarity to constrain random processes.

How does your computer programme calculate image similarity?

B: The process takes place in a number of steps:

- 1) Load the “key image” or “query image” (the image for which we want to find similar images).
- 2) Utilizing methods of feature extraction, measure a number of features of the key image. This stage creates a “signature” for the image.
- 3) For every image in the database, load and generate a signature.
- 4) Calculate the Euclidean distance between the signature for the key image and the signatures for each of the database images. Sort and store these values -- what results is a list that shows the proximity (based on

its signature) of each of the database images to the query image.

The features I used for creating an image signatures were the intensity of the image, its dominant colours, the mean and standard deviation of image's RGB values, the frequency of change in RGB values, the number of defined areas ("pixel groups") enclosed within a well-defined boundary, the compactness of the principal (i.e. largest) pixel group, the major and minor axis of the principal pixel group, its circularity and its perimeter.

The challenge was—and remains—to select image features and a distance function such that the resultant distance really is a measure of image similarity: ideally the distance between the images, gauged on this metric would correspond to our subjective assessments of image similarity. Measuring the distance between two images which we judge to be alike would result in a relatively low aggregate value, while measuring the distance between two images which we judge to be quite different would result in a larger aggregate value.

How do you use these measures of similarity to help you decide what effects you will apply to images?

B: First, I wanted my program to emulate the filmmaking methods to which I have become accustomed. To this end, I formulated some loose rules that would capture some of my experience in deciding what image processing algorithms might be appropriate to images that possess a given set of features. (Examples of such rules are: if there are a large number of pixel groups in the image and there are many changes in colour between adjacent pixels, then sharpening the image is not highly recommended; if the image is of very low contrast, then reducing the intensity of the image is seldom valuable; if the average size of pixel groups is large, then applying algorithms that enhance the texture of the image is a less valuable choice.) I created a program that employed a constrained random process—the constraints were based on these rules as well as on the image's signature—to decide which image processing algorithm or algorithms would be applied to images.

The program looks at images and assesses their features, and based on what it discovers, decides which processing procedures most likely suit the image, and what procedures will be less likely (and how much less likely). Different features of an image are assigned different weights, and those features that are assigned greater weight are given a greater role in deciding which image processing methods are desirable or undesirable (and how much less desirable or undesirable). The application then chooses, by chance operations, a set of processing methods to apply to the database images.

Where would you like to take your work with this computer programme? How do you want to improve it?

B: I want to introduce better means for modelling a film- or video-maker's working methods, for capturing a filmmaker's (or videomaker's) understanding of what characteristics of the image make certain image-processing appropriate and other's inappropriate. The way I modelled one's estimation of the appropriateness of a particular method to a given image was far, far too simple. What I did was simply to imbed in the program a "seat-of-the-pants" "guess-timate" of how undesirable a certain feature made a particular algorithm. For example, having a certain property might make using given image-processing methods either "slightly undesirable," or

“moderately undesirable,” or “very undesirable” (each represented by a different weight), and more precise measures of a filmmaker’s sense of the appropriateness of a method need be introduced.

I also incorporated a kludgy sort of “fail-safe” provision into the application. After applying the constraints I have described, the program selected one or more image processing methods to apply to the image, processed the image and displayed the result. The user was then asked to confirm that what he or she sees is satisfactory -- thus, instead of modelling the film- or video-maker’s knowledge, I simply called upon it (and used it interactively). If the result was deemed satisfactory, the program applied a similar treatment to a set of similar images and saved the result to film.

All this needs to be drastically reworked. My “fail-safe” method of allowing the operator to interact with the program conflicts with my goal of refusing immediate authorial imposition. Further, I need to develop means to capture the “fuzzy logic” involved in these decisions. This could be done by building a learning component into the program that would enable the program to correlate the features an image possesses with the image-processing methods a particular film- or video-maker finds appropriate. Further, to make the program more flexible and better able to accommodate different ways of working, the user should be given the choice as to which sets of features, from a broader array of features than I now employ, would be relevant to determining which image-processing methods might be applied to the image.

Introducing fuzzy and neural learning into this application would have this benefit as well: the assumption that there can be standardised metric that corresponds to all users judgements of image similarity is a doubtful one -- just as it is doubtful that all film or video editors take into account the same set of features when they are creating “plastic” cuts (edits based, essentially, on the similarity of images), or even that an individual editor takes the same features into account on all occasions. Creating a system that would adapt to individual users (and, perhaps, even to individual circumstance) by being “re-trained” could allow for these variations.

Despite its current limitations, however, I believe the programme is a novel way of using image processing in film and video production. I also believe that the Cagean compositional ideas on which this application is based are rich and this makes me eager to continue to develop the project.