

Choreographic and Performance Systems

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1. Digital Performance

Around the turn of the millennium reviewers began to take note that the marriage of dance and technology had produced a few significant works which startled audiences and shifted attention to what we now call *digital performance*. While the growth of computer-based art is an accepted phenomenon in today's art worlds and technological cultures, the genre of "digital performance" is still a very young one, barely defined and thus in need of historical and conceptual underpinnings. The more sustained lineage of dance on screen and multimedia performances which incorporate projections of screen images offers a solid background for understanding the compatibility between live dance and the moving image, between the polyrhythmic components of movement and the digital behaviors of images and sound. *Digital performance*, however, is not a screen-based medium. Rather, it is characterized by an *interface structure* and can be said to include all performance works in which computational processes are integral for the composition and content, the aesthetic techniques, interactive configurations and delivery forms. In many instances, this integration of human-machine interfaces implies the design of interactive systems and real-time synthesis of digital outputs/objects. Installation architectures slowly replace the dominance of the proscenium stage, and contextual design of programmable systems becomes a new form of architecture, protocol, and bio-informatic space.

When widely known choreographers Merce Cunningham and Bill T. Jones collaborated with digital artists and computer scientists (Paul Kaiser, Shelley Eshkar, Michael Girard, Marc Downie) to create a series of dance works and installations exploring the artistic potential of motion capture technology – *Hand-drawn Spaces* (1998), *BIPED* (1999), *Ghostcatching* (1999), *Loops* (2001-04) – the reviews in *Time* Magazine spoke of

“hypnotic groundbreaking performances” bringing dance, the most physical of the arts, into the digital age.

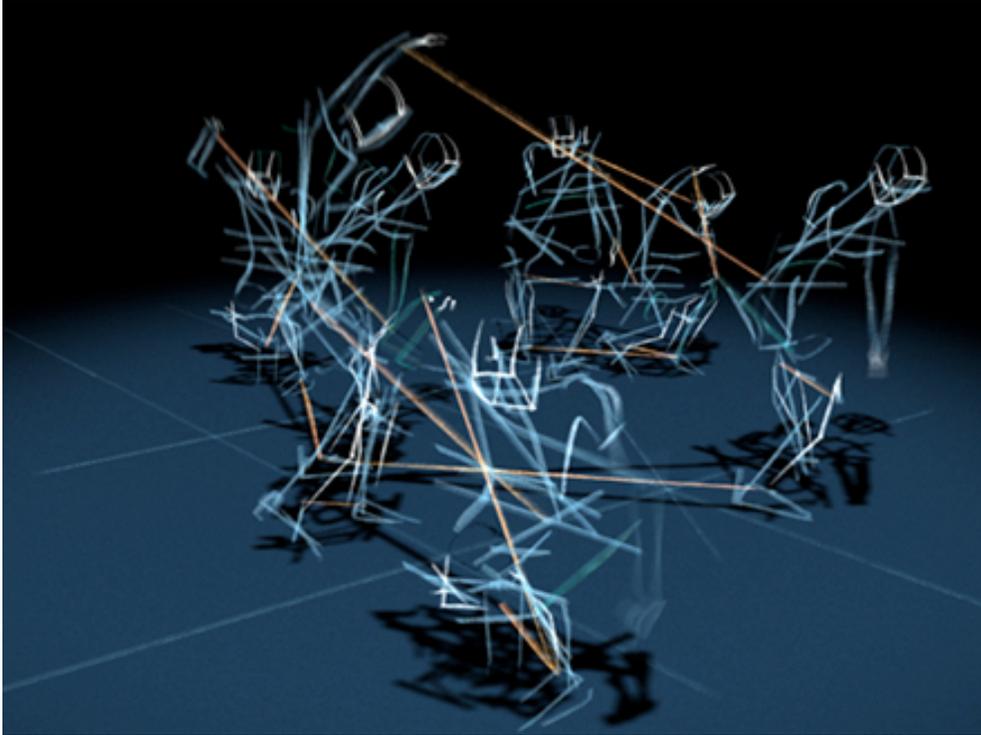


Fig. 1 Bill T. Jones, with Paul Kaiser/Shelley Eshkar. *Ghostcatching*, 1999. Photo courtesy of Paul Kaiser.



Fig. 2 Merce Cunningham Dance Company, with Paul Kaiser/Shelley Eshkar. *BIPED*, 1999. Photo: Archive/Stephanie Berger

The filmic use of motion capture-based digital graphics had already been widely seen in Hollywood and Hong-Kong martial arts movies, and now we await the refinements of 3D Cinema. (Wim Wenders released his retrospective film on Pina Bausch – *Pina: Dance Or We Are Lost* – in 3D in 2011.) Digital animation is a staple of the film industry, television advertising, MTV, club-house VJ'ing, and games design. Tight choreographic systems with live and prerecorded video projections are commonplace at most rock concerts. Madonna's "Sticky & Sweet Tour" was a typical example of precisely cued (and hyper-psychedelic) interaction with video monitors. The question of what is groundbreaking in the coupling of dance and technology must be examined carefully in order to make any claims for a new art form, a successful marriage of dance and interactive image or a sustained impact of new media on theatrical art.

It appears today that video cameras play a significant directorial role in theatrical productions. Berlin Volksbühne director Frank Castorf or British director Katie Mitchell have perfected the use of onstage camera crews for their dramaturgies, as did the Wooster Group in their numerous intermedial performances. The same tendency to "audio-visualize" music theatre and to probe the extent of "digital composition" is seen in the contemporary opera and sound art performances. But the role of the physical body, vis à vis camera and computer software, and the limits of physical presence are generally assumed to be crucial theoretical issues for the discussion of technological embodiment. The development of new techniques should also be a major artistic concern, and I shall argue, in this essay, that it is important for the field to worry about the integration of a new understanding of choreography/composition/improvisation and software design/interactive system architecture.

[Example from Korea:

KIM Sung Yong: contemporary dance (solo)

<http://www.youtube.com/watch?v=SwUeUJtOTIM>

Korean contemporary dancer Sung-Yong KIM's work(solo work)

Part 1 cf. (Glow) Part 2 return to return Part 3 Process of Mayday
(light bulb, French text, projection upstage/back (intermedia dance))

Choreographing for the camera became an early challenge in the 20th century as the motion picture industry evolved, and videodance is now a classic genre having moved from analog ancestors to digital successors, from Maya Deren's pathbreaking *A Study in Choreography for Camera* (1945) to the works of younger generations of video makers. At the 2005 Digital Cultures festival in Nottingham, a program of videodance works ("Motion at the Edge") beautifully reflected the aesthetic genres with which contemporary choreographer-filmmakers work today, ranging from the poetic to the quasi-documentary, the ethnographic to the abstract-experimental, including various cross-overs between video, dance and performance art. The program included *Vanishing Point* (Rosemary Butcher/Martin Otter), *Infected* (Gina Czarnecki), *Ascendance* (Chris Dugrenier), *Birds* (David Hinton), *Arrested Development* (Grace Ndiritu), and *Romanz* (Katharina Mayer). All videos in this program featured images composed with very carefully choreographed camerawork enabling both a remoteness of settings and a deep intimacy of viewpoints rarely possible in theatre-based performances. In the videos by Czarnecki, Ndiritu, Dugrenier and Mayer, the body movements were edited into unusual staccato jitters, ritualizations, aerial views and repetitive fixations of minimalist states of entrancement. Butcher's dance featured a figure traversing a desert of hallucinatory ambiguities, a slow-motion *fata morgana* evoking the kind of luminous transcendental quality of Bill Viola's early films such as *Chott el-Djerid* (A Portrait in Light and Heat). Hinton created his videodance by slicing together archival film stock of wild bird movements, eschewing the human figure altogether. In the last dance screen festival I attended, the 2011 Cinedans Amsterdam, there were some new categories as well, the "1 Minute Dances" and "Online Dances" – reflecting recent evolutions in the compression and uploading of dance to the internet. The prize for emerging filmmakers was won by Fabian Kimoto's *The Rising Sun*, a vivid portrait of a young hip hop company.

Beyond the screen-based medium, real-time interaction with a camera-vision, sensor or artificial intelligence system requires attention to the system creation and to larger issues of the space and sensory experience of the digital, as well as to its constraints. If dance or movement based performance is considered a medium, and if we look for artistically challenging dance content created by emerging interactional choreography, an

interactive-medium-specific analysis requires an examination of choreography, spatial design, dancing, software environments and dance-technologies in their own particular interactional manifestations. The digital, at the same time, is now being perceived more clearly as our contemporary phenomenological dimension, our technically mediated interface with “mixed reality” as a “social-media world” (expanding to YouTube and the so-called “New Aesthetics” of ephemeral curation in the blogs, Facebook, image boards, and tumblrs of net.culture). Future dance makers and performance artists will be “born digital” and have grown up with pervasive computing, network culture, and a torrent of images.

2. Track Back: Extended Genealogies of Choreographic Systems

If one surveys dance/theatre festivals around the world or the regular programming of metropolitan and regional theatres, the appearance of fully integrated digital performances is minimal. But the emergence of digital dance under favorable infrastructural conditions happened in the 90s, after some practitioners in the international community began to experiment with computer-assisted design linking performance and new technologies. The use of electronics in music composition and performance was not new, nor should it come as a surprise that choreographers attracted to film shifted their attention to digital video when cameras and editing software became widely available since the 80s. Multimedia performance in the theatre had also used film/video projections and monitors for decades, even though a specific media aesthetic in performance did not take hold of text and actor-based dramaturgies outside of the experimental avant-garde traditions. The New York based Wooster Group had a significant impact on younger theatre companies working with multiple media today, whereas digital media groups (e.g. Dumb Type, igloo, Company in Space, The Builders Association, George Coates Performance Works) or individual experimenters like Stelarc, Robert Lepage, Guillermo Gómez-Peña, Thecla Schiphorst, Sarah Rubidge, Andrea Zapp, Susan Kozel, Simon Biggs or Paul Sermon have not had a similar influence on the younger dance generation.

Similarly, it is hard to say whether innovative digital art works, like Sermon's *Telematic Dreaming*, and Eduardo Kac's, Andrea Davidson's or Toni Dove's installations created models of interactivity which influenced the choreographic imagination. The development of new systems tends to have greater impact if it comes from well-known choreographers like William Forsythe, who released his first pedagogical tool (the CD-ROM *Improvisation Technologies*) in 1999. Forsythe has now created a major online research project, *Synchronous Objects*, which presents collaborative research on organizational principles in Forsythe's choreography, conducted at Ohio State University's Advanced Computing Center for the Arts and Design. The researchers analyze and creatively redeploy spatial data from the dance (the test case is Forsythe's *One Flat Thing, reproduced*), re-visualizing the kinetic *dispositif*. *Synchronous Objects* is a series of re-mappings of the distributed flows of the dancers' movements providing tools that allow the user to trace, re-imagine and re-draw spatio-temporal behaviors from the dance (<http://synchronousobjects.osu.edu>). More recently, the Croatian BADco. also released a tool kit, the "Whatever Dance Toolbox" (software written by Daniel Turing), enabling image analysis of the process of compositional, improvisational and dynamic decision making, as well as the study of how a machine "sees" performance and how we can think about the totality of relations between performer, system setup, choreography and generated images.

The Brazilian Cena 11 company, directed by Alejandro Ahmed, is an interesting case of a young company working directly with software programmers and developing their own custom-built systems. They are currently exploring the combination of dance and robotics, similar to the experimentations of Margie Medlin (*Quartet*), Pablo Ventura (*kubic's cube*) or Garry Stewart's Australian Dance Theatre (*Devolution*). The dance and technology community arguably grew over time because the initial custom-built systems were soon shared: Troika Ranch's Mark Coniglio, who wrote the interactive software "Isadora" (available at www.troikaranch.org), demonstrated its application in many workshops. International platforms such as IDAT, Digital Cultures, Future Physical/bodydataspace, CYNETart, Boston Cyberarts and the Monaco Dance Forum

helped to bring practitioners together and provide occasions for the exchange of knowledge and artistic methods.



Fig 3. Cena 11, *Pequenas frestas de ficção sobre realidade insistente*, 2007. Photo courtesy of the artists/Cristiano Prim.

In the history of experimental performance, live artists have often mixed old and new media, especially as live art practices often emerged from visual arts contexts and

commingled with video and installation art. The poetics of improvised live creation with video, webcams and network connection characterizes the work of *Corpos Informáticos* (www.corpos.org) in Brazil; the group's installation events often take place in galleries or museums but always involve online participants joining the composite action from afar. This is a participatory philosophy also promoted by Ghislaine Boddington's *bodydataspace* programs (www.bodydataspace.net) or Sher Doruff's projects for the Waag Society for Old and New Media (Amsterdam) that include multiplayer online collaborations and a performance ecology which bridges remote sites (via webcams and interactive software) and plays with the tension between determinate structures and indeterminate potentials. In *Cassis Caput* (2003) Doruff linked Amsterdam with Berlin, London and New York utilizing public webcams as found objects/performance-space tools to create "conditions of possibility" from which events and relations may or may not have occurred once dancers moved into the camera-sites and improvised relationships with observers (seen and unseen), thus exploring performance concepts now associated with scientific notions of emergence or *autopoiesis*, and well as with political critiques of CCTV surveillance systems or the kind of "rhythmanalysis" (Henry Lefebvre) in public space proffered, for example, by the recent phenomenon of flashmobs or Parkour.

Rafael Lozano-Hemmer's "relational architectures," for example his large-scale outdoor *Body Movies* installation which caused much attention at *ars electronica* (2002), uses simple shadow casting in combination with a large data bank of prerecorded portraits and a real time camera-tracking system. The digital images only become visible when passersby block the lights that wash out the projections, while the participants at the same time superpose their shadows onto the digital ghosts. Doruff's and Lozano-Hemmer's practice echoes the Situationist concern with psychogeographic experience and political and affective situations in everyday urban life.(3)



Fig.4 Rafael Lozano-Hemmer, *Body Movies*, Duisburg, 2001. Photo: Courtesy of the artist.

The everyday presence of computers in our cultures has brought about emerging art forms that inhabit the internet or use information and communications technologies to develop interactive virtual performances that link remote sites (telepresence or networked performance), or mingle coding with choreography. Igloo's digital dance animations, *WindowsNinetyEight* (1996) and *dotdotdot* (2002) are inspired by ASCII code, and the British company has continued their exploration of virtual environments with *SwanQuake* (2007), a stunning hybrid work placing motion-capture driven "ballet avatars" inside game landscapes.



Fig. 5 *SwanQuake* (part 1-House): Virtual Environment - Computer Installation with surround sound, dimensions variable. (c) igloo 2007

The particular relationship of unconventional dance to technology illuminates the changing contexts for new performance concepts. They may be derived from new tools or innovative scientific and sci-art frameworks for the creation of digitally augmented human movement or digital movement archives. *Synchronous Objects*, William Forsythe's web-based research project, is a prominent case of such re-examination of

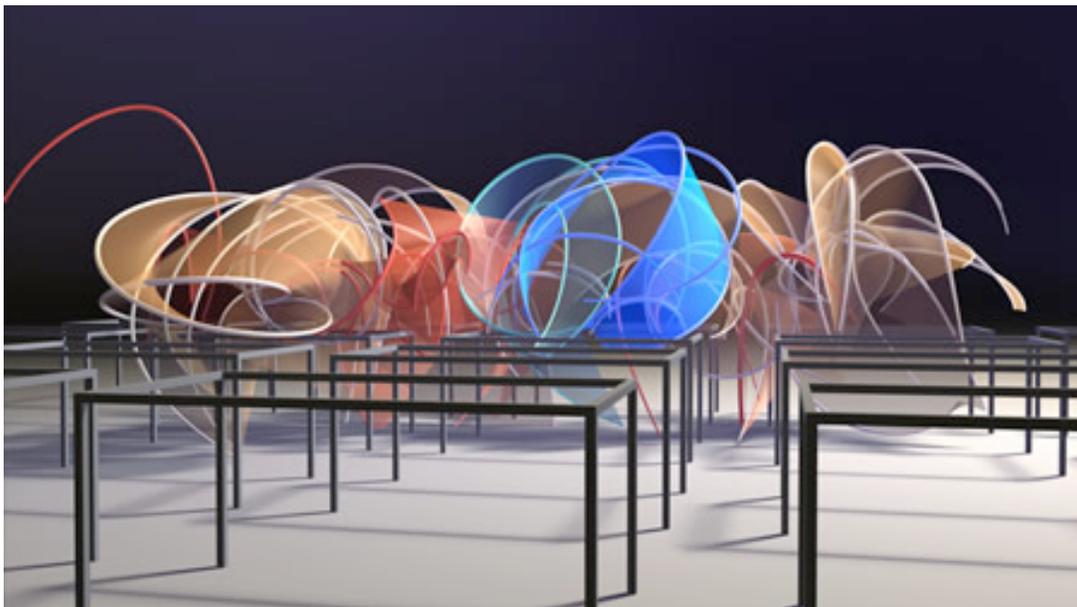


Fig. 6 3D Alignment Forms within *Synchronous Objects*, taking a sampling of dancers' alignments into three-dimensional space creating volumes between them to create new sculptural-spatial configurations. Video still from <<http://synchronousobjects.osu.edu/>>

digital technology in regard to its representations of the corporeal and of a choreographic system of operations. We also need to keep historical precedents in perspective. Today's motion capture-based animations, created in the commercial film industry but also in computer science, biomechanics, and graphic art departments that always look for performers to be the "subjects" for capture, find their historical roots in late 19th century motion studies in chronophotography and early cinema (Muybridge, Marey, Méliès).(4) However, figure animation for avatar choreography today does not even need motion-capture systems and real subjects as it can just as easily be generated in software programs (Lifeforms, 3D Studio Max, Maya, etc).

The modest role of dance in the history of narrative film and the film musical is well documented; the visibility of screen dance increased with the adaptation/translation of stage choreographies into film and, especially, with the production of specialized choreographies for the camera shown in dance programs on public television (since the 1970s) and in the growing international network of videodance festivals since the 1980s.(5) Owing much to filmic and non-linear editing techniques, as well as to particular collaborative visions of filmmakers and choreographers, videodance is a hybrid site where televisual/cinematic styles act upon the dancing body. But directors of videodance also draw on postmodern stage dance strategies and video art techniques which disrupt televisual code and technological function, while less well documented trajectories of audio-visual composition point to non-representational genres of early abstract animation (Oskar Fischinger), visual music, structuralist film and computer graphics animation. Recent developments within the sound arts indicate that with the increase in computing power and available programming tools, software artists can more flexibly explore video in ways similar to the traditions of experimental film practice. Real time synthesis and a kinaesthetic sensibility derived from motion graphics could contribute to the emergence of a new art based on structural aesthetic similarities between the two forms, similarities which are fundamental to an understanding of both experimental avant-garde film, and contemporary electronic music practice. Furthermore, supporting evidence from the fields of cognition and neuroscience (including a wave of current studies in sensorimotor perception, biological motion observation, movement

dynamics and velocity, for example in the “Choreography and Cognition” project initiated by Scott deLahunta) is generating renewed interest in structural approaches to artistic practice and perception.(6)

Finally, dance makers, researchers and teachers have used film/video as a vital means of documenting or analyzing existing choreographies that have been passed on, in practice, from performing bodies to other performing bodies. Some scholars and software programmers published tools (LabanWriter, LifeForms, FIELD) that attracted attention in the area of dance notation and preservation as well as among choreographers (e.g. Merce Cunningham, Pablo Ventura, Ivani Santana, Wayne McGregor) who wanted to utilize the computer for the invention and visualization of new movement possibilities.(7) Computer engineers such as Frieder Weiss (who wrote the EyeCon software) are now much sought-after collaborators, for example in Chunky Move’s creation of *Glow*, a beautiful solo performed with interactive graphics projected onto the floor underneath the dancer whose movement becomes entangled with lines of light and cascading shapes. A video of *Glow*

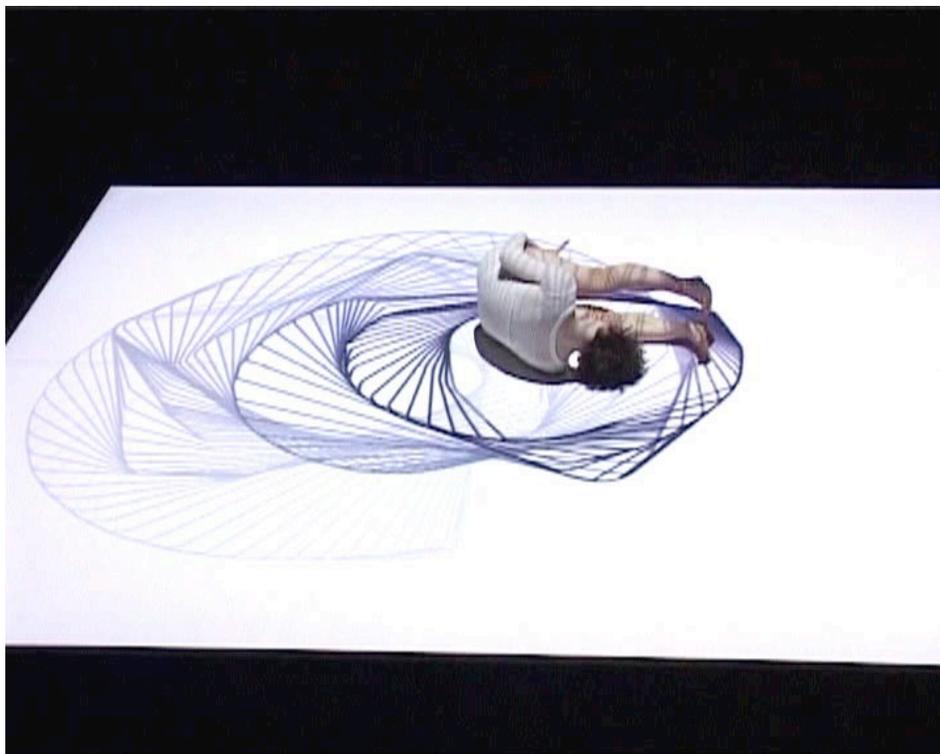


Fig. 7 *Glow*, Chunky Move, chor.: Gideon Obarzanek, 2007. Photo: Frieder Weiss.

was quickly released and debated on the dance-tech.net website, a thriving collective social network which embraces a crowd-sourcing approach to document, discuss and market new information on diverse practices and processes in the field, using a bottom-up method of collaboratively generated knowledge (in the manner of WIKIPEDIA).

I mention these extended genealogies because choreographic systems are not only constituted by principles of organizing movement in space-time or by combinatories of movement and other media or software environments, but can even point beyond screenic (projected) and auditory scenographies to current conceptions of “machining architectures” (Lars Spuybroek) informed by patterns of spatial mobilization, flows or behavioral expressions studied by designers who re-imagine the kinetic organism of motion in the city and in buildings, re-defining architecture as an intelligent machine that integrates numerous computers dedicated to sensing-calculating-actuating – each making their own decisions in order to produce an interactive interface.(8)

Performance Systems and Thinking Images

In the new century, overlapping interests in related fields – film, electronic music, digital art, science and technology, design, engineering, robotics, architecture – thus advance our understanding of the complementary thinking processes that drive interdisciplinary research, generating conceptual models derived from informatics, artificial intelligence, biology and a-life, wearable computing and telecommunications. Like music before it, dance has incorporated “instruments” (cameras, video-projectors, microphones, sensors, microcontrollers) and software tools which allow it to structure and control the various components of any performance event, i.e. sound, video, 3D animation and motion graphics, biofeedback, light. It is the convergence of choreography and system design with the languages of programming, electronic music and film editing in interactive, real-time processing that I want to define here as "performance system." I propose that we do not look at human performers in the interface as separate from an interactive software

system or programming environment. In fact, software programs can also be performers of choreography.(9)

If we use a diachronic perspective, I would suggest there are two generations of interactional design. In the *first generation* of interactive dance theatre, when “mapping” (gesture to sound, gesture to video output) was explored in the interface design for performer and reactive environment, such understanding of the “system” was inspired by the cybernetic vision of feedback control and the modeling of the machine on the human actor. Direct interfaces (flex sensors, micro switches, pressure plates, smart fabric, etc.) required specific techniques of use which sometimes led choreographers to argue that the dancer acted as a live video editor or musical instrument. But aesthetic and conceptual concerns regarding the emergent techniques (which were criticized as limiting in their “triggering” function) eventually led to a search for alternate interfaces. Dance-tech or music-tech collaborations involving direct, gestural interfaces have declined even if some practitioners continue to argue that the interface should remain tangible so that mappings between performative input (gestural) and output (video/sonic) are easily inferred.

An analysis of specific artist-instrument combinations suggests that localized techniques had to be developed to combine choreography and improvisation, and one can also identify a common set of software techniques (e.g. granular synthesis) and filtering parameters applied to digital video/sonic output. Especially with regard to digital dance/music collaborations on stage or in interactive installations, and to music technology’s concern with analog/digital sound production and transformation, both the gestural and the software parameterization techniques should be given equal recognition. If there were a larger range of works available for analysis, one would be better able to distinguish the scales of sensor data values (able to be transformed by the reactive environment) from the particular aesthetic performance technique – or *through* the style of choreography/ improvisation harnessed for a particular output.

I shall look at three examples. The first is *Titled On*, from the Interaktionslabor, an international media lab which takes place every summer in the abandoned Coal Mine at

Göttelborn (Germany). In July 2003, the gigantic Engine Room was used to receive the public for an interactive sensor-dance which dramatized the breathing organism and the correlation of dancer-to-landscape. Upon entering a door leading to a staircase, the audience would glance down thirty or forty feet to an empty space where one of the two winding engines of ten thousand horsepower had stood, the remaining one now facing a gaping hole on the south side, the entire building a deep resonance body, with the western wall serving as film screen. The collaboration between Lynn Luktas/Mark Henrickson (Minneapolis)/Paul Verity Smith(Bristol)/Marija Stamenkovic Herranz (Barcelona) and Kelli Dipple (Melbourne) opened up some striking possibilities of the sensor-interface, pointing to “spaces” in-between the aural, the rhythmic, the visual and the visceral.



Fig. 8: *Titled On*, Stamenkovic/Luktas/Henrickson/Smith/Dipple, 2003. Photo: J.Birringer

In this interface environment, the body's actions were measured not only as sound (via microphone) but as the most subtle variations in the biomechanics: the pulse, breath, and

heart rhythm in the body itself (via a Bioradio attached with electrodes). The electrically measurable signals were transmitted wirelessly as data to the computer, where they affected not only the sound processes in real time but the rhythm of the image movement of the projected film sequences stored in the computer. Stamenkovic performed the dance of breath, first improvising softly with extended vocal techniques as she descended the staircase in midst of the audience, then purely with heavily amplified breathing as she moved onto the flat plane of the engine room, and finally with her whole body and staccato voice as she propelled herself into an untrammelled trance-like flurry of movement. Her voice crept under our skins, the magnificent resonating sound in the huge room entering through our pores and stomachs, and as we listened we realized how her breath controlled the image movement and thus the dramaturgy of the story. If Stamenkovic stopped her breath, the film's motion froze. When she breathed, we saw her (on film) walk across the slag heap of the Mine, descending into a hollow path. Lukkas had filmed her outside movement differently in each section, the third one using a hyperactive zoom. In conjunction with Stamenkovic's accelerated breathing, this final segment materialized as pure hyperkinetic sensation, transforming the entire space-volume into an irregular pulsating body-machine of continuously unfolding exhaustive yet libidinal intensities. A performance of this kind is hard to describe; it appeared to produce an extended three-dimensional space where pure sensation broke the continuity and stability of her own image (on film) even as she entered into a feedback loop with remembered movements she had enacted outside. Additional sound began to grow inside the building, transforming sense perceptions of spatial images even further, or allowing the audience to recognize how their own sensations framed or pulsed the virtual images. Image-movement of landscape and figure, sound clusters and pebbles, breath and body, echoed and transformed one another in recursive couplings.

If one looks at the documentary photographs of such performances, they must disappoint. Generally, one sees a dancer and a screen projection, which in this case is nearly meaningless since all the other sensations and the volume of the space itself are lost. The sensorial coupling of interactivity and real time also tends to get rid of the conception of a "work" – there is no *Titled On*. It does not survive as an object or a choreography, yet the

diagram of the system awaits new concretizations. Its event structure implies that the digital performance is entirely contingent on the concrete situation and the interlaced process which produces itself in real time before a public.

My second example is not site-specific/improvisatory but reflects the creation of an interactive choreography which can be repeated and cued within the various states of the system. It might be contradictory to speak of repeatable choreography when introducing the *second generation* of interactive systems, as the continuity of computer processing co-evolves with the dance movement and generates its own creative behavior that might be re-adapted into the choreography. Whereas the first interactivity understood human-computer interaction on a stimulus-response or action-reaction model, the second interactivity emphasizes sensorial dialogue insofar as human enaction and machinic processes each have their own autonomy, being able to self-reorganize in constant dynamic relationship.

The *second-generation* interactivity heightens the experience of human embodiment and sensory experience as the coupling of dancer and virtual environment evolves in noncausal correlation with one another. Ideally, both performer and performance system respond to the other's enaction by undergoing self-permutations on the basis of distinct operational rules (a new form of "post-choreography") which are internal to them.(10) Moving towards indirect interfaces (optical, magnetic, and ultrasonic sensors or machine vision), however, creators of such performance systems often prioritize the development of software techniques over physical techniques. In innumerable performances of this kind one sees mediocre or underdeveloped dancing. In such cases, perfunctory physical techniques are used to patch the interface rather than expanding the transformational capabilities of the system or developing new re-organizations of the body and its expressive metabolism. The situation tends to be worse, I think, in interactive installations inviting the unprepared public to move around and become "co-authors."

In an indirect interface, the performers (or participants) are challenged to re-organize their motional, affective, perceptive and proprioceptive behavior in the environment. The

desired aesthetic aim would be to anticipate direct *dance transformations* or disjunctive, differential relations in real time. Code and matter symbiotically differentiate, alien perspectives open up, unholy alliances emerge when strange avatars appear “face-to-face.” In other words, the more complex the technologies behind the interface become, the more attention, creativity and originality need to be applied to transformative techniques and (dis)synaesthetic processes.

A first response to this challenge can be observed today in the care given to the subtleties and nuances of gestural quality. Troika Ranch, the New York-based dance company, recently toured their new piece *16 (R)evolutions*, a performance which almost reads as an allegory of the evolutionary development of gestural control and refinement of motion tracking within the programming environment they have created. Rather than deploying a high-end multi-camera motion capture system for real time graphic animation, as it was used in Trisha Brown’s *how long does the subject linger on the edge of the volume...* (2005), Troika Ranch designed a small system that can easily travel and is inexpensive, combining Isadora with a motion capture software (Eyesweb) created by Italian scientists at the Genova InfoMus Lab that allows a particular gesture analysis here used for the transformation of points in space, contours, lines, and motion energy or direction into animated graphics. It is tempting to call this a process of real time translation. The dancers onstage move and the system analyses the motion by generating graphic shapes in the digital screen projection. In this computational environment, movement-action and motion graphics co-evolve. The points in space, recognized each second almost as in Marey’s or Muybridge’s chronophotography a hundred years ago, are here transformed instantly in real-time. They generate a trail of successive movements in fluid continuity which form a *Gestalt* or, rather, *Gestalten* (in the plural).

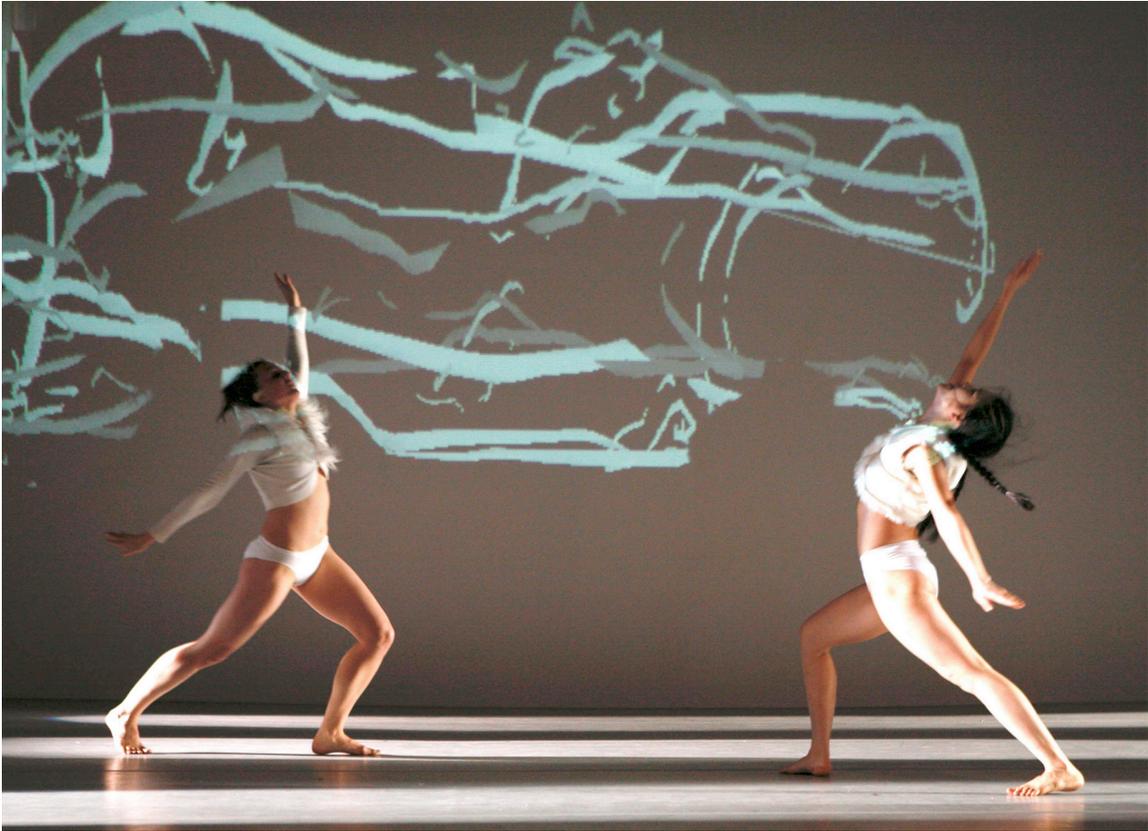


Fig. 9: *16 (R)evolutions*, Troika Ranch, 2005. Photo: Richard Termine.

At this juncture in the development of real-time motion tracking, the interactivity is no longer focused on direct mapping of gesture but on the creation of complex “action paintings” or action palimpsests, calligraphies of human gesture translated into image-flows. In my book *Performance, Technology & Science* I compare the digital system at work here with the extraordinary analog dance with ink calligraphies created in Cloud Gate Dance Theatre’s *Cursive* (2006).⁽¹¹⁾ Cloud Gate’s flowing ink is real, and the dancers move in front of the suspended rice paper panels, whereas Troika Ranch’s virtual calligraphies emerge from the interface. The interface is opaque. Mathematically, the procedure remains identical: Isadora tracks motion and analyzes the bodily data. The software functions as a measuring tool or tool of observation. Depending on the values, filters and modifiers assigned to the data, the program analyzes slight changes in the motion gesture – observing the “living state” or properties of such movement (four categories: straight, curved, lateral, complex). Recognizing change of direction, speed, dynamics and velocity of movement within these categories, the program then renders the

graphic output in real-time, and we can perceive the three-dimensional dance and the projected 3D worlds of colors and shapes. Using a musical analogy, one could argue that the software program observes “tonal” qualities of the dancer’s movement.

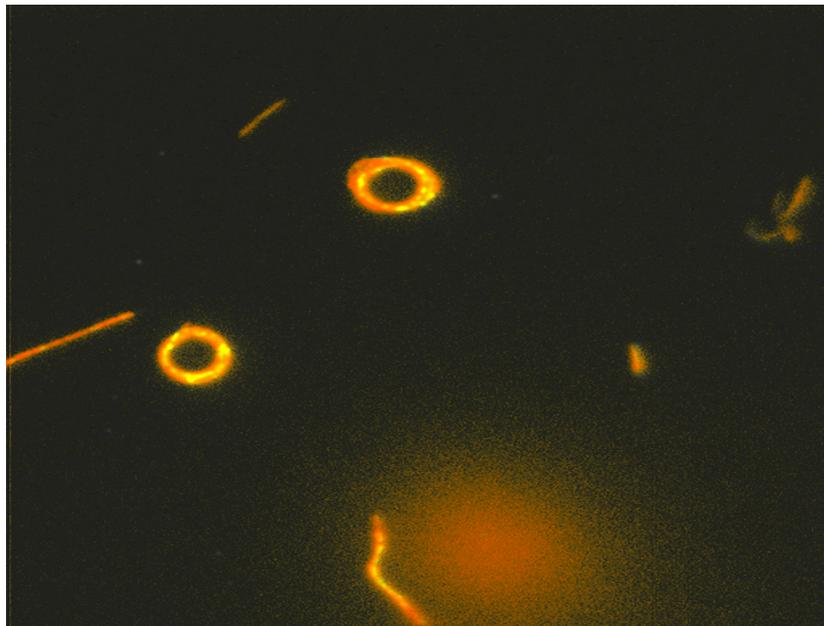


Fig.10 : *Image-controlled sound nanospheres*, a project by DS-X.org (video programming: Matthias Härtig; sound programming: Daniel Mühe, film material: Thomas Müller-Reichert, Stefan Diez, Bert Nietsche (MPI-CBG Dresden), 2005. Video still courtesy of DS-X.org

Another level of critical analysis would then have to be applied to the particular choices the designers make for the visualization of the data and feedback qualities of the control system. Numerous researchers in the hard sciences, including molecular biologists working on cellular dynamics and chemical transformations, are currently preoccupied with visualization technologies, and here an exchange of knowledge between fields of observation appears relevant, even if aesthetic or political questions about the meaning and affect of gestures may address different concerns from those of the cell biologist. Yet artists and cell biologists both show concern for pattern recognition and micro-behavioral change. It is worth dwelling on such procedures with which we construct categories for observation. The computer, for example, cannot “feel” the gesture in the way in which the human audience will sense the weight or import of a particular movement behavior and movement quality of expression. Mark Coniglio admits that he would not know

himself where a gesture begins and ends, where it “divides.”(12) His software reacts to properties of the motion and is set to modify the Gestalt of the image we see projected continuously (color changes; change in size; rotating planes to effect a more three-dimensional and topsy-turvy feeling of the images). The images themselves can have various tactile characteristics connected to the “gestural-ness” of drawing and painting (sinewy) or the more architectural look of geometric, polygonal shapes (rigid). In one scene of *16 (R)evolutions*, a meshwork of lines (vertical and horizontal) appears all over the floor and back projection which is pulsating and constantly moving, growing, decreasing, turning, evolving. In another, a meshwork of more densified criss-crossed lines and architectural Gestalts gains polyphonic complexity in motion, and in rotations that defy Euclidian space.

Choreographer Dawn Stoppello suggests that such current explorations in motion tracking and visualization emphasize highly subtle manipulations of visual and aural qualities, correlated to new concepts of dynamic systems or semi-chaotic systems whose philosophical and scientific thought-models are derived from research in biology, a-life, computer science and cognitive science (Maturana/Varela, Prigogine/Stengers, Kauffman, Iberall, and others). No longer based on notational systems (Labanotation) but on computational analysis and mathematics, “description of movement” is rendered as image-movement, yet the fuzzy logic in the chaotic state of the system reminds us how difficult it is to speak of a digital aesthetics. The digital medium itself is indifferent to movement poetics or authorship.

Dance and interaction designers, in other words, now reflect on what could be called the psychology of spontaneous, intuitive, unpredictable or ritualized behavior in “traversable interfaces” which allow fluid transitions between digitally augmented human/machinic movement. The difference to earlier anthropological studies of role behavior lies in the fact that performance is here always understood to take place in relationship to system-design which often embeds performer and interface within a physically traversable projected display or immersive environment, and thus within the time/duration of virtual abstractions as it was demonstrated in Cunningham’s *BIPED*. When robots and avatars

are involved, the language of object manipulation (actuators) enters the scene, creating a fascinating and complex re-orientation of our anthropomorphic assumptions about presence, performance and agency.

Trisha Brown's stage work, *how long does the subject linger on the edge of the volume...*, recreated for the 2006 Monaco Dance Forum, interfaces with animated graphics from real-time motion-capture driven by a custom-built artificial-intelligence software that responds to the kinematic data and generates particular behaviors. Marc Downie speaks of "choreographing" these extended agent-bodies, but he carefully distinguishes such motion behavior from human, physical intelligence. The software draws its own dance diagrams live during the performance, and the graphic agents are projected on a transparent scrim in front of the stage. The agents are software "creatures," acting according to their artificial intelligence. They have their own autonomy. Their imagery comes about as they picture things to themselves, trying to make sense of what they see onstage in real-time as the dance unfolds.

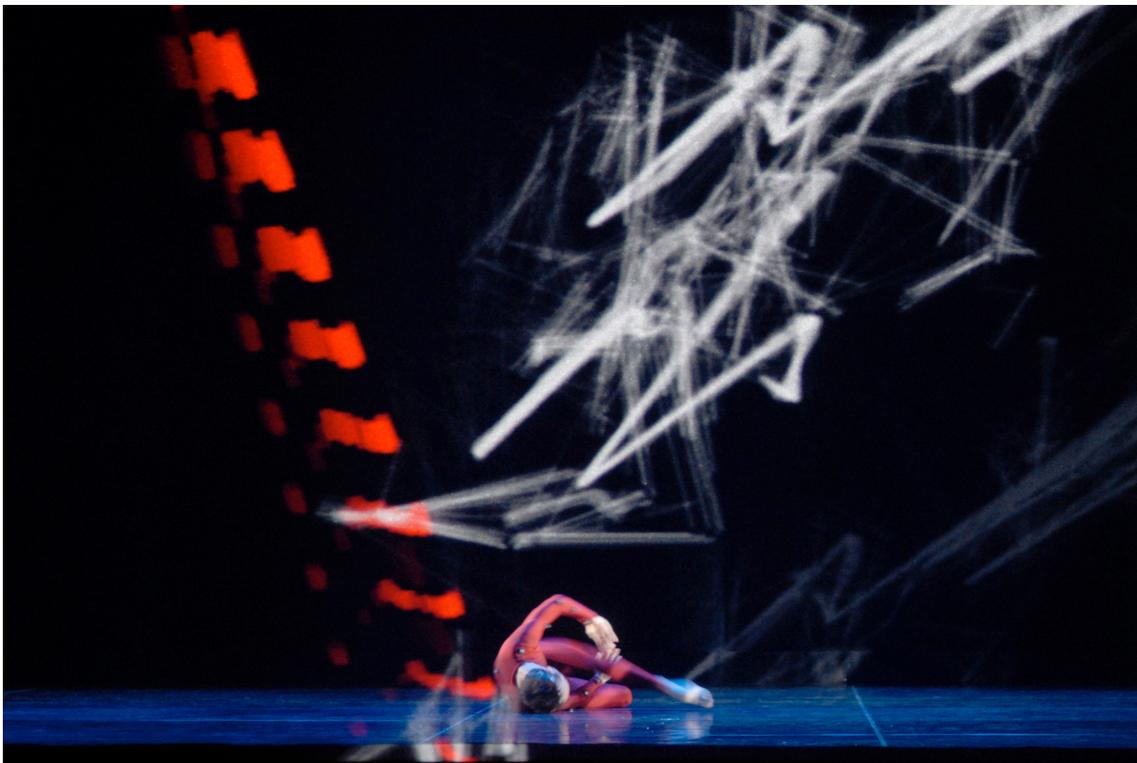


Fig.11: *how long does the subject linger on the edge of the volume...*, Trisha Brown Dance Company, with Paul Kaiser, Marc Downie, Shelley Eshkar, Curtis Bahn. 2006. Photo courtesy of Monaco Dance Forum.

For example, *how long* opens up with a triangle-creature, whose intention is to move from stage right to stage left. It does so by hitching rides on points in the motion-captured dancers' bodies, guessing which ones are moving in the right direction. It extends a line out to a likely point, and is then tugged that way if it has guessed correctly. Sometimes its hunch is wrong; it has to relinquish its grip on that point and await the next opportunity. In such a case, that line is left as a trace, and thus the whole image as it progresses is simultaneously a history of its attempts. This virtual "choreography," in other words, has memory.

The Monaco Dance Festival gave testimony to such surprising advances in digital composition, as we watched the physical intelligence of Trisha Brown's dancers interact with the artificial intelligence of Downie and Kaiser's "thinking images." In a workshop talk, Downie emphasized that the computer is an embodied agent, deeply coupled to its environment such that its actions on its environment – mediated by the physical constraints of some virtual animated body – must be carefully produced and its perceptions of its environment – mediated by its limited sensory apparatus – must be carefully maintained. The machine is learning from dance, and it can be trained to do so. The creatures' bodies and their physics are purely imaginary, of course, and it is noteworthy that the software artists prefer indeterminate images, lingering between abstraction and figuration, hinting perhaps at the spiritual in art once described by Kandinsky during his teaching at the Bauhaus. Many of today's performane technology workshops and projects continue the great modernist tradition of Kandinsky's painting and Schlemmer's Bauhaus dances, to which my own work with the DAP-Lab is also indebted.

The maintenance of the motion analysis and real-time rendering system for the *how long* concert involved a huge technical effort, unlikely to be repeated too often on the choreographer's busy touring schedule. Such work is also built on extensive research involving numerous artists and scientists over a period of years: the R&D requires laboratory conditions not generally available to dance companies. And yet, they are slowly being created at universities and art studios across the world; young artists will

find ways to build their own collaborative networks and use unconventional approaches (reverse engineering, adapting game engines or mobile devices, etc) to make use of media assemblages in performance. It is important to acknowledge the diversity of interactive possibilities; yet it is also crucial that dancers and designers have sustained time to discover and develop specific performance techniques which can be trained. Each dance or media festival thus also provides an occasion to encourage critical dialogue between pioneers and newcomers, artists, audiences and scholars, in order to foster knowledge transfer for placing and evaluating new methods of practice and the provocative resonance of the systems and avatar-performer connections that stretch our known frames of reference.

Wearable Design: UKIYO [Moveable Worlds]



Fig. 12: Katsura Isobe [right] in organic Gingko leaves dress dancing the “creation scene” actuating 3D virtual landscape projected onto weather ball. *UKIYO*, Sadler’s Wells © 2010 DAP-Lab

In conclusion, I will show a brief film of my own work with the DAP-Lab, developed over the past years in close collaboration especially with fashion designer Michèle Danjoux and our ensemble of performers, composers and software artists. The film is meant to evoke another area of research – what we consider a specialized experimentation with wearable design/wearable space or “design-in-motion” inspired, as I indicated, by the Bauhaus but also by recent developments in interaction and smart textile design, audiophonic design and 3D virtual world design. This particular choreographic installation, *UKIYO [Moveable Worlds]* also reflects the transcultural cooperation we conducted with artists and scientists in Japan and Singapore. As a brief introduction to the film, I want to emphasize that the main concept for the “system design” is the open installation architecture with five *hanamichi*, on the one hand, and the development of analog and digital techniques used for the movement with “sounding costumes,” on the other. These wearables, each developed as “characters,” play a crucial part in the overall scenographic and choreographic organization of the real-time interactive performance which also includes both asynchronous film worlds (black & white film noir) and synchronous virtual 3D worlds.

The installation manifests the multifaceted, dynamic and relational aspects of garments/accessories, performing bodies, and digital articulations happening in close, intimate spatial proximity to the audience moving inside/around the dance. The (post)choreographic system also exemplifies the kind of sound-motion design research we conducted with DAP-Lab, where we looked for parallels and extensions to earlier historical models developed by avant-garde engineers, scientists and artists at the beginning of the 20th Century (Marey, Méliès and chronophotography; Russian constructivism), also comparing the Russian and Japanese models influencing the composition (Futurism, Musique Concrète, ukiyo-e prints, Kabuki theatre, manga, deconstructivist fashion), and this is an interest we now also pursue in our current work *for the time being* (2012). In all of our collections we freely mix old and new media, allowing the performers to develop their movement vocabulary through the potentials and constraints of the wearables, the flow of materiality and visceral sensuality they discover in the nuances of inter/action. In *UKIYO*, analog technologies were foregrounded, to

some extent, in a performance that was embedded in a digital programming environment. But in *UKIYO*, movement gestures also tell stories as they would in a silent expressionist film; they are stories about different worlds, past and future, and the performers' movements animate sound and images through interactive techniques of extending the bodily instrument in a musical/sonic sense. Some of these techniques use a "cracked media" approach, i.e. the actions use tools of media playback expanded beyond and distorting/breaking their original function as a simple playback device for prerecorded sound or image. Some of the costumes use dysfunctional audio objects, others are translating musical instruments (such as the bandoneon) into hieratic garments evoking a surreal and comic (Kyogen) character. And some of the movement language in the second Act is "learnt" and adopted, copying avatar choreography developed by software. Describing the main features of the *UKIYO* system would stretch beyond the scope of this essay. Our brief film may replace analysis and evoke some of the integrated methods for creating kinaesonic choreographies for the contemporary intermedial theatre and the expanding sector of media arts and mobile arts.(13)

Notes

(1) The most comprehensive study of new technological performance to date is found in Steve Dixon's *Digital Performance: A History of New Media in Theater, Dance, Performance Art and Installation* (Cambridge, MA.: MIT Press, 2007). See also: Johannes Birringer, *Performance, Technology, and Science* (New York: PAJ Publications, 2008), Alexander R. Galloway, *Protocol* (Cambridge MA.: MIT Press, 2004), and Malcolm McCullough, *Digital Ground* (Cambridge, MA.: MIT Press, 2004).

2) This is described by Paolo C. Chagas in *Digital Composition: Von der Klangregie Elektronischer Musik zur intermedialen Ästhetik. Eine Mediologie der Studios als Klangkörper, KlangOrt und Kulturraum* (Siegen: Muk, 2012) and several recent publications by David Roesner, cf. "Musicality as a paradigm for the theatre: a kind of manifesto," *Studies in Musical Theatre*, 4:3 (2010), pp. 293-303.

(3) See Mark B.N. Hansen, *Bodies in Code: Interfaces with Digital Media* (New York: Routledge, 2006), p.5.

(3) Activist artists connected to grassroots movements and political protest never hesitated to articulate their interventions "by any media necessary." Cf. Critical Art Ensemble, *Digital Resistance: Explorations in Tactical Media* (Brooklyn, NY: autonopedia, 2001), p.2. Ricardo Dominguez, in a lecture on his work with CAE and

Electronic Disturbance Theater, coined the term "hacktivism" when referring to his online art and activism which is focused on the development of electronic civil disobedience. See also Sher Doruff, "Collaborative Culture", in: Joke Bouwer, Arjen Mulder, Susan Charlton, eds., *Making Art of Databases* (Rotterdam: V2_Publishing/NAI Publishers, 2003), pp. 70-99. For Lozano-Hemmer's theories, see his *Vectorial Elevation: Relational Architecture 4* (Mexico City: Conaculta and Ediciones San Jorge, 2000).

(4) When I created the MFA program in Dance and Technology at Ohio State University in 1999-2000, a motion capture studio was opened at the Advanced Center for Computing in Art and Design, and dancers in my lab were among the first to be asked to "provide" capture data. For critical discussions of post-cinema and motion studies, see Lev Manovich, "What is Digital Cinema?" in *The Digital Dialectic: New Essays on New Media*, ed. Peter Lunenfeld (Cambridge: MIT Press, 1999), 172-92. See also, Johannes Birringer, *Media and Performance: Along the Border* (Baltimore: Johns Hopkins University Press, 1998) and *Performance, Technology and Science* (New York: PAJ Books, 2009); Söke Dinkla & Martina Leeker, eds., *Dance and Technology/Tanz und Technologie: Moving towards Media Productions - Auf dem Weg zu medialen Inszenierungen* (Berlin: Alexander Verlag, 2002).

(5) See Judy Mitoma, ed., with Elizabeth Zimmer (text editor), Dale Ann Stieber (DVD editor), *Envisioning Dance on Film and Video* (New York and London: Routledge, 2002), and Sherril Dodds, *Dance on Screen: Genres and Media from Hollywood to Experimental Art* (Houndmills: Palgrave Macmillan, 2001).

(6) For more information on this research project, see <http://www.choreocog.net>. For current cross-overs between neuroscience and dance, see Johannes Birringer/Josephine Fenger, eds., *Tanz im Kopf/Dance and Cognition* (Münster, LIT Verlag, 2005).

(7) Cunningham first worked with LifeForms in 1990 for the creation of *Trackers*. His interest in and use of video dates back to 1974, followed by numerous projects with Charles Atlas, Elliot Kaplan, and other filmmakers. For Ventura's work, see <http://www.ventura-dance.com>. For Santana, see her book *Corpo Aberto: Cunningham, dança e as novas tecnologias* (São Paulo: EDUC/FAPESP, 2002).

(8) Cf. Lars Spuybroek, *NOX: Machining Architecture* (London: Thames & Hudson, 2004), and the recent presentation by Alexandros Kallegias and Yosuke Kamiyama at KINETICA 2012 on their "tensegrity design" projected for interactive, moveable canopy structures for a public square in Athens. The tensegrity design uses new materials made of innovative biometal/artificial muscle material that can flex and bend.

(9) Software systems used in performance include: VNS, BigEye, Image/ine, EyeCon, Kalypso, Max/Msp/Jitter, Nato, ChoreoGraph, EyesWeb, Isadora, Keystroke, dance Forms, and numerous VJ'ing tools. PD (Pure Data) is now a popular alternative to Max/Msp. An overview of software development for performance is offered by Scott deLahunta: <<http://huizen.dds.nl/~sdela/transdance/report/>>. He organized the pathbreaking workshop "Software for Dancers" at Sadler's Wells Theatre in London

(October 2001); it was followed by a collaboration with Johannes Birringer on the international laboratory "Performance Tools: Dance and Interactive Systems," at Ohio State University in January 2002; cf. <http://minuet.dance.ohio-state.edu/~jbirringer/Dance_and_Technology/tt.html />. More recently deLahunta coordinated the research project "Choreographic Objects: traces and artifacts of physical intelligence," which includes Forsythe's *Synchronous Objects*, Emio Greco/PC's *Capturing Intention*, Wayne McGregor's *Autonomous Choreographic Agents*, and the *Siobhan Davies Dance Archive*; he now leads the Motion Bank Project for the Forsythe Company in Frankfurt <<http://motionbank.org/en/>>

(10) Earlier reflections on the "post-choreographic" were released from my interaction laboratory (<http://interaktionslabor.de>) in 2006 and, subsequently, in "After Choreography," *Performance Research* 13:1 (2008), 118-22, when they became subjected to vigorous criticism by some dance practitioners/theorists yet also spurred support and further elaborations on the dance.tech.net site, where the debate is published: <<http://dancetech.ning.com/forum/topic/show?id=1462368%3ATopic%3A15914&page=1> > For further contextualisation, see "Corps numériques en scène," the 2008 issue of *Bains numériques* published by the Centre des Arts Enghien-les-Bains.

(11) Johannes Birringer, *Performance, Technology & Science* (New York: PAJ Books, 2009), pp. 155-56.

(12) An early version of *16 (R)evolutions* was shown at the 2005 Digital Cultures festival which I produced at Nottingham (<http://www.digitalcultures.org>), and Coniglio and Stoppiello commented on their work in a post-show discussion. For current research into kinaesthetic empathy, conducted by dance practitioners and cognitive scientists, see "Watching Dance" <<http://www.watchingdance.org/>>. "Watching Dance" has now been published: see Dee Reynolds and Matthew Reason, eds., *Kinesthetic Empathy in Creative and Cultural Contexts* (Bristol: Intellect, 2012). For my commentary on Yoko Ando's choreographic system for *Reacting Space for Dividual Behavior* (YCAM 2012), see "Gesture and Politics," *VLAKE: Contemporary Poetics & the Arts* 2012, pp. 380-88.

(13) *UKIYO [Moveable Worlds]* was first shown at the Artaud Performance Center, Brunel University, in June 2009, then developed further before touring to Canada and Europe (2010-11). It was filmed at the London Sadlers' Wells premiere in November 2010. See: <http://people.brunel.ac.uk/dap/Ukiyo_Sadlerswells.html>. For a film excerpt of our new production, *for the time being*, see: <<http://youtu.be/WeAIYCnsDe4>>

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performance projects, most recently the live game performance *See you in Walhalla*. He is also founder of DAP-Lab (<http://www.brunel.ac.uk/dap>), conducting research into sensor choreography, wearable computing and soft technologies.