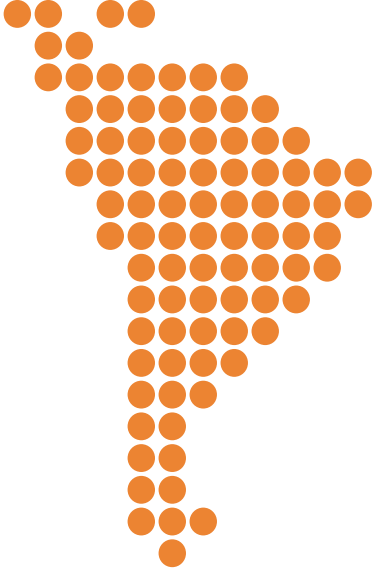

CREATIVE PROCESSES AND EXTENDED COGNITION IN EMBODIED IN VARIOS DARMSTADT 58

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Abstract

In this essay, we explore the creative and technological processes involved in the development of the performance "Embodied in various Darmstadt'58" from the viewpoint of the extended and distributed cognition. Although the literature has discussed the telematic art from a variety of similar points of view, the project "Embodied in various Darmstadt'58" features an unusual conFiguretion of openings and randomness, complexity and minimalism, engineering and art, which allow a distinguished approach on the relationship between technology, art and cognition. In this essay, we present guiding concepts that substantiate the theories of embodied mind and describe part of development of computational tools used in the creative process. We argue that the complexity of creative concepts involved the performance had promoted the extension of poetic elements and cognitive loads to the technological domain of the machines.

Keywords:

extended cognition, embodied cognition, music, dance, interactive systems.

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Introduction

Embodied cognition, extended cognition and technological artifacts

The idea of embodied cognition has become an essential tool to process, understand and "translate" the sort of knowledge operated by artistic actions, especially those involving knowledge typically operated by the body, such as the musical and choreographic cultures, gesture or ritual. The concepts of embodied mind and cognition build on the assumption that there is no separation between mind and body, perception and action (Varela; Thompson; Rosch, 1991). In this perspective, the reference to a body or mind, for example, would not reflect a physiological division between the brain and the "rest" of the body. As a result, the embodied cognition is not a plan of the studies about the body (as it were separated from the brain), but a concept of a mind that entails and is defined by the body.

The understanding of the dissolution of this epistemological boundary between body and mind is fundamental to this proposal. It is an essential change of paradigm in the plan of theory, based on a body of evidence found in experimental, social and scientific approaches across a broad spectrum of disciplines. In the field of robotics and design, the incorporation of "form" as a computing mechanism enabled the development of more efficient devices and design of products (Pfeifer; Lungarella; Iida, 2007). In the field of music studies, the dissolution of the division between forms of dance and music enabled a shift of the theoretical tools to understand the universality of the relationship between body and music (Leman, 2007; Naveda; Leman, 2006; Van Noorden; Moelants, 1999). In the anthropology, the reaction against this division between forms of knowledge of the "body" and "mind" enabled the incorporation of a set of non-European traditions and gave rise to a more comprehensive ecological view of the diversity of knowledge forms in human cultures (Blacking, 1983; Clayton; Sager; Will, 2004; Desmond,1994).

A superficial analysis, however, seems to suggest that the idea of embodied cognition does not comply with the inherent abstractions of the artistic "code" mediated by networks and computers, or by the art produced by means of computers. This superficial viewpoint on the "disembodied space" of the computing methods suggests that the machines operate in opposition to the body, or the embodied knowledge. Seen this way, the machines seem to rather reproduce the decadent boundaries between the symbolic and cerebral spaces and spaces for the body in the artistic action. However, by assuming that the forms of knowledge are mediated by the possibilities of a human body (Leman, 2007), new frontiers are opened in the direction of new artifacts in the outside world and other boundaries are created. Does the physiological limit of our body define a limit for the operation of our thoughts? Are these machines isolated from the cognitive processes engaged in the art creation?

The concept of enactivism responds to this question by arguing that the representations we have of the world are also built by the experiences that the external world generate through our actions (Varela; Thompson;; Rosch, 1991). The "action", seen as an intermittent and inseparable loop between perception and action, would form an open field of knowledge, freely interacting with objects and external agents. The process of embodiment of knowledge through actions with the tools of the external world would give rise to a kind of knowledge that is ready-for-action (Magnusson, 2009): an object-action that could be recognized as a theoretical or symbolic knowledge about how artifacts work in the outside world. Knowing how to play a musical instrument, for example, would not be defined as the theoretical knowledge one has about the instrument, but as an abstract, fluid and non-verbal relationship between the intention of playing the instrument and the sound produced.

The extension of the action on objects, actors and tools in outside world draws another boundary of knowledge caught between the embodied mind and the objects. By using the artifacts as a field for action, we also transform them in a field of thoughts: we delegate cognitive processes such as calculating or memorizing, to agents that are external to our body. The concepts of extended cognition (Clark and Chalmers 1998) and distributed cognition (Hutchins, 1995) discuss the idea of projecting actions and thoughts to external objects and unloading cognitive processes on these artifacts. In some way, by expanding the viewpoint on cognition to the external environment, we incorporate the external environment into the embodied mind. These concepts also include the strengths and weaknesses involved in this idea of extended production of knowledge, as illustrated by Clark & Chalmers:

> "In these cases, the human organism is linked with an external entity in a two-way interaction, creating a coupled system that can be seen as a cognitive system in its own right. All the components in the system play an active causal role, and they jointly govern behavior in the same sort of way that cognition usually does. If we remove the external component the system's behavioral competence will drop, just as it would if we removed part of its brain. Our thesis is that this sort of coupled process counts equally well as a cognitive process, whether or not it is wholly in the head." (Clark; Chalmers, 1998: 9)

This viewpoint extends our analytical power and proposes new dimensions to the understanding of cognition, particularly in the complex of artifacts engaged in creative performance in dance, music, composition and virtually all artistic actions. In this essay, we try to understand the performance Embodied in various Darmstadt'58 as a playground of thoughts crossing the spaces of artists, machines, tools and ideas that work to support the artistic concept and original poetic principles, as described in the next sections.

The Darmstad'58 project as an extended cognition

The networked art performance Embodied in various Darmstadt'58 was conducted by Grupo de Pesquisa Poéticas Tecnológicas in Salvador, in collaboration with the Translab (Multimedia Centre / CENART) of Mexico City and the Kònic Thtr23 of Barcelona. The term "Darmstadt" 58" recapitulates the phrase of Nam June Paik: "My past 14 years are nothing but an extension of one memorable evening at Darmstadt '58, " when she met John Cage for the first time. Its conceptual definition, as described in Santana (2014), involved a number of local multimodal networks, connected by interactive multimedia and technological artifacts distributed in nodes of three countries:

> "The development of the scenes looked for a transit departing from analog to digital; from the biological body to its computational synthesis; from internal body sound to the sound of space-time of corporality; from the body as present to the tele-present body. Every sound of the performance commenced from the action of the body in both presential and in telematic space-time, since the flow of image, audio and data was overlaid on all points of presence. The composers of each site served as managers of these flows, without the intention to create sound independent from the possibilities arising from the activation and interaction of the dancers' bodies. Each country resolved how to do this according to local possibilities.
>
> The teams were made up of dancers, choreographers, musicians, programmers, visual artists among others, and had the freedom to create starting from the above criteria and from workshops held to discuss the three instances of the sonorous body. Thus, we did not intend to address these levels of the tele-sonorous body linearly, but by previously discussed understanding that provided a basis in order that each group maintained openness and the conditions necessary to enact their local conception. " (Santana, 2014: 91)

The concept of the performance, though based on the relationship between body and sound, also remained bounded to the principles of openness and randomness, inspired by Cage's work. More specifically, this bound was almost systematically composed of random processes and uncertainty[1], developed during the process of creation and performance.

The performance of a work of this magnitude involves extended cognitive processes that are broader than those involved in the use of an everyday object, such as a notebook or a calculator. The diverse multimodal connections involved in Embodied in various Darmstadt'58 allow to search for elements of indeterminacy by means of projecting actions-reactions that are dissipated by algorithmic randomness of the machines, by the movement variability of the bodies and by the unpredictability of

the latency in the network of real and digital connections. In a distributed art project highly populated by computation, artistic improvisation and randomness, the interactions seem to be balanced by flows of control and uncertainty without a centralized control.

In the specific case of the concept that oriented Embodied in various Darmstadt'58, there were two problems or opposing forces, working on the structure of the sound design. On the one hand, the necessity to provide a control for the dancer over the sound results, the relationship between action and sound, and the proposed conceptual pathway from the sonic organicity of the body to its dissolution into the digital. On the other hand, there are the strength of the openness of the artwork, the random interactions between local and displaced agents, and the possibilities of control and computational randomness. The resolution of these forces in a multimodal real-time performance demanded technical solutions in the form of specialized tools. These tools were necessary due to the impossibility of musicians and dancers to control all sound parameters necessary for the performance, or be able to control the massive streams of random processes in the context. The displacement of the cognitive demands to computational algorithms was the procedure where the structural concepts of work were extended to external devices.

Extension of conceptual metaphors to artifacts

The construction of the network of interactive systems involved motion capture processing (using computer vision), sound and control interfaces. These elements interacted with synthesis and sampling processes, projection of vectorial images and processed video. On stage, the dancer and two musicians coordinated the development of actions dialoguing with the major part of sound, image and movement media. Projections of video were broadcasted and projected on screens by the team off the stage.

The division of the performing scenes reflected the metaphors of sound transformations of the body, as described in Santana (2014: 97):

- SCENE 1: materiality of the body. From the body in silence to the sound of the organic and acoustic body
- SCENE 2: transformation of the physical body to the synthesis body. From the silhouette to the binary body
- SCENE 3: body in code. The revealed sonority of the space-time of the embodiment.

The third scene conveys the moment where there is a systematic use of computing and algorithms for the extraction of motion data, which are used in the development of a sound texture that reflects the metaphor of the code Practically, this process leads to a programming of media that injects artifacts that are perceived as having a sound metaphor of the "code" in the sound and visual textures, and a certain loss of control

of sound events in favor of an artificial entity (the "code"). The guiding concept of the system was to delegate the "high level" control to musicians and dancers while several "low level" processes were operated by algorithms or guided by the structure of the gestures of dancers and musicians. The high-level controls involved the management of interactions between movement and sound, activation of random processes, controlling of the quality of sound and visual responses or segmentation of media and phases of the performance. The "low-level" processes involved the connections between the structure of the movement and sound design, the generation of sound patterns and image among others, including random patterns. It was realized by means of a toolkit of algorithms called "Topos" (Naveda; Santana, 2014), programmed in Pure Data (Puckette, Miller, n.d.) and designed to operate the extraction motion descriptors and the computing of relations between movement, sound and image[2].

Extensions from indeterminacy to code

The idea of a certain set of tools that help in the task of handling the work of indeterminacy is also present in the work of John Cage, especially in his exploration of chance and indeterminacy at the end of 1950's. The works Variations I (1958) and Variations II (1961) of John Cage, for any number of performers and instruments, make use of a notation composed of transparencies with lines and dots of different sizes. Fig. 1 shows an example of this score (Miller, 2003). The overlapping of the graphics works as a starting point for a flexible parameterization of music or sound characteristics. The permeability of the transparency, the graphic arrangement of the elements of the score, the format and interpretation of the parameters by the musician, allows the production of indeterminacy at various levels: macro-structure, evolution of the parameters and events in time, composition of events and clusters and composition of the sound structure of the musical events (Vickery; Hope; James, 2012).

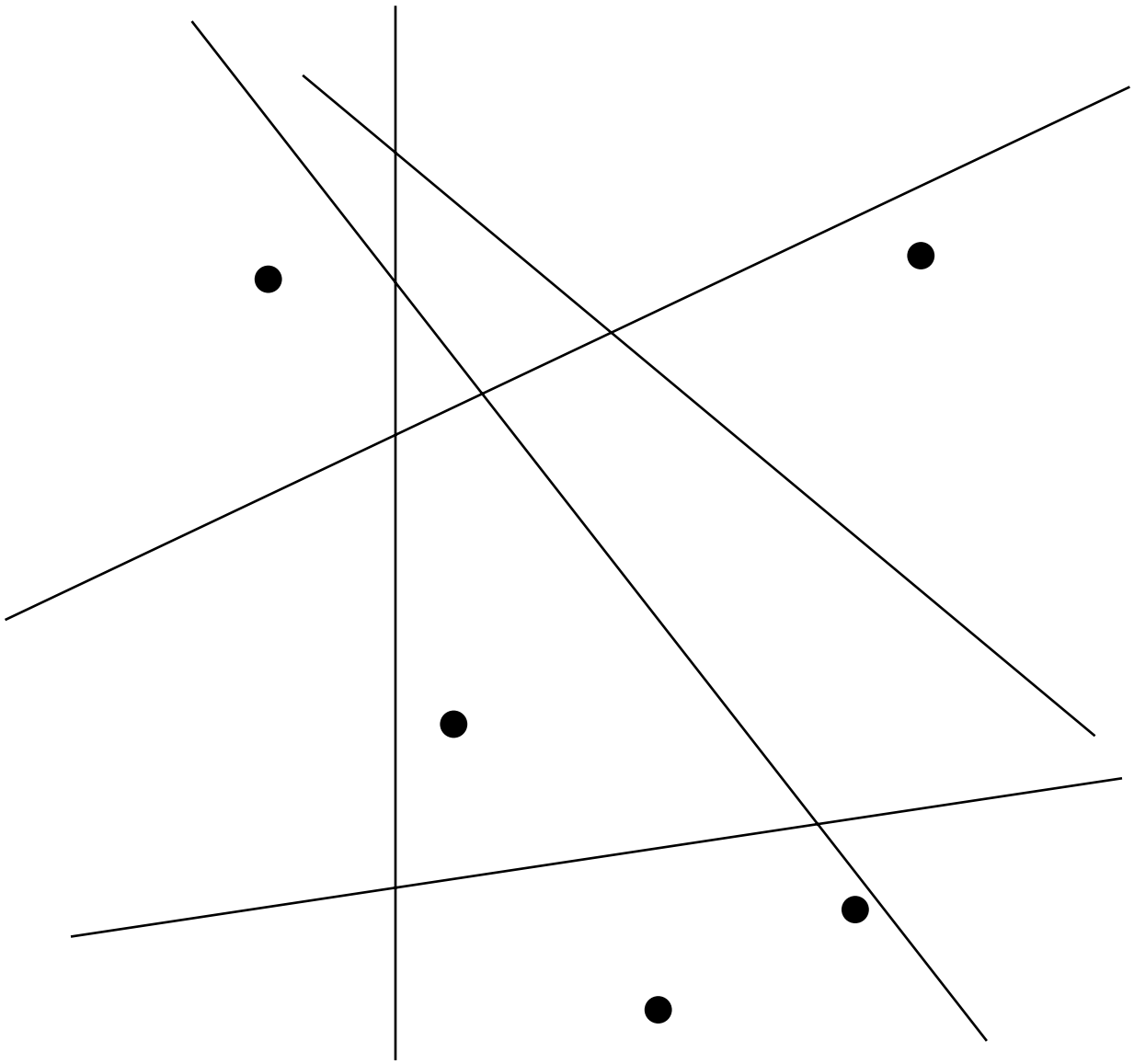

Figure 1. One of the possible configurations of points and lines for Variations II, as displayed in Miller (2003).

Although the common sense may relate the production of randomness to the lack of rationality or planning, the intentional (or unintentional) support to randomness in artistic action and in the media (e.g.: control a musical instrument) demands a considerable cognitive effort (Falk and Konold 1997; Wagenaar 1970). In this sense, the use of strategies to produce indeterminacy in the composition resembles the process of shifting cognitive loads: random games are used as an expanded field of aesthetic thought aiming at o producing indeterminate processes, which otherwise could not be controlled in detail by the artists on stage.

Extensions of gesture interpretation

The indeterminacy in the relationship between dance and music reserves other problems and contradictions. Developed as different modalities but always linked in the cultural traditions, the dance and music cultures were attached to relationships marked by a strong temporal synchronization: events in the body of the dancers are often accompanied by events in the musical texture.

One way to release the relationship between movement and sound from a direct (and causal) relationship in real-time would be to establish connections with various dimensions of a "memory" of the movement. This memory of space used by the dancer in a time window which, as a gesture idea presented in improvisation, could be used as starting point for indeterminacy. The various interactions with this compressed representation in space (motion) and time (memory) could produce descriptors related to the improvised dance, similar to the strategies used by John Cage to parameterize the musical texture by means of games of transparencies and graphical objects. The construction of this memory is one of the main elements of the tools developed for the performance, realized with tool the toolkit "Topos".

The development of the "gesture memory" by the algorithms presented in the Topos toolkit is programmed as a buffer of N samples collected from a motion data stream (position in space). This buffer forms a "point cloud" , a portion of the space, which represents the memory of a time window of the movement developed by the dancer in the (detailed in Naveda and Santana, 2014). This digital representation allows the numerical expression of expressive characteristics of the movement, such as the evolution of the size of the space occupied by the choreography, its distribution and geometry (e.g.: flat, in the form of a line or a ball) and relations with other regions and points in space. Fig. 2 shows a diagram illustrating the algorithm that produces a point-cloud together with its programming code, in Pure Data platform.

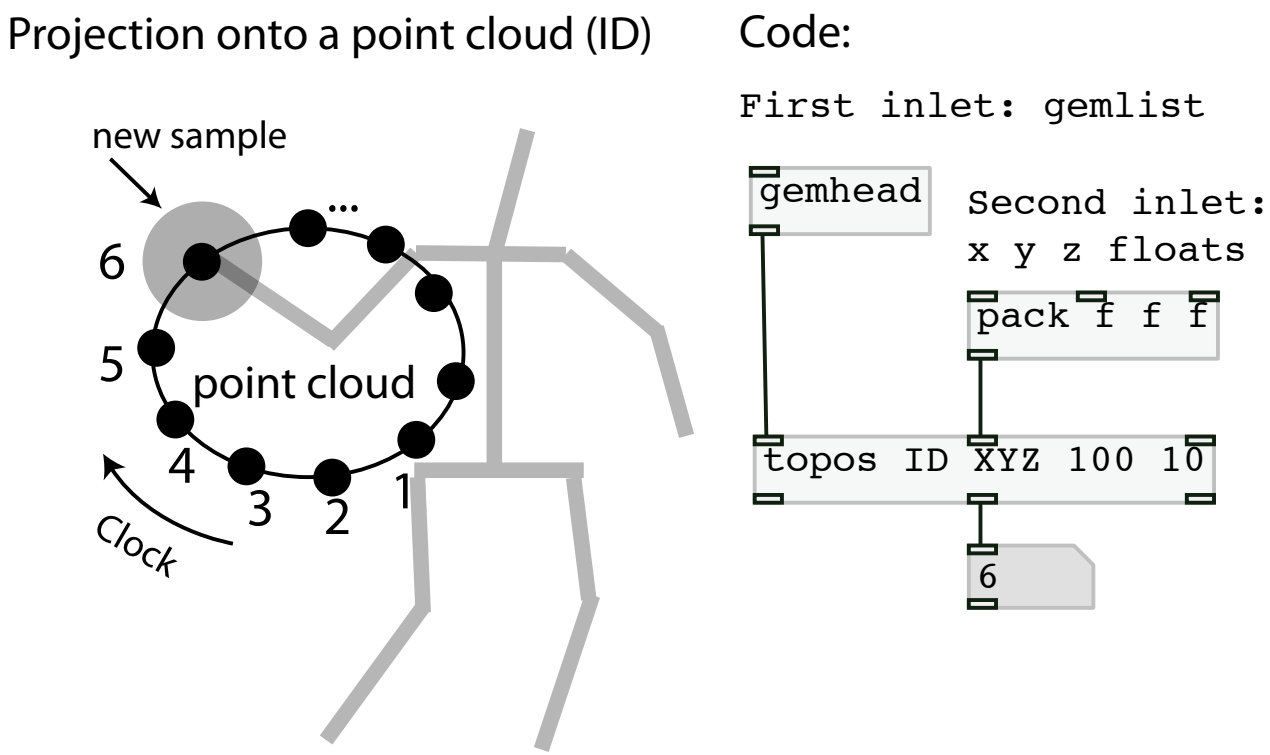

Figure 2. Scheme of the algorithm that creates a point-cloud using the object [topos], in Pure Data platform (Puckette, Miller, n.d.).

Extensions of the performance control

Perhaps one of the most intriguing cases in the development of the performance is the overflow of cognitive loads to the media and computation. During the development we have observed a gradual transformation of tasks that would be in charge of musicians and dancers to structured forms of visualization and control tools. In the literature, this process is described as scaffolding, when part of cognition and basic processes are delegated to external agents or to high-level controls (Hollan; Hutchins; Kirsh, 2000).

For example, the visualization of the memory of movement processed by the Topos toolkit has become a visual element explicitly projected in the screen to represent a "code-body". The data captured and transmitted by displaced nodes (México and Madrid) served as visual and sonic reference by means of its projections on a translucent screen. Just as the superposition in the scores of Cage's Variations I and II involved the suggestion of indeterminacy processes, a graphic representation provided the interactive elements for the development of the choreography in the local node. Figure 3 shows the dancer superimposed by representations of the memory of the moving bodies transmitted and projected from the three nodos.

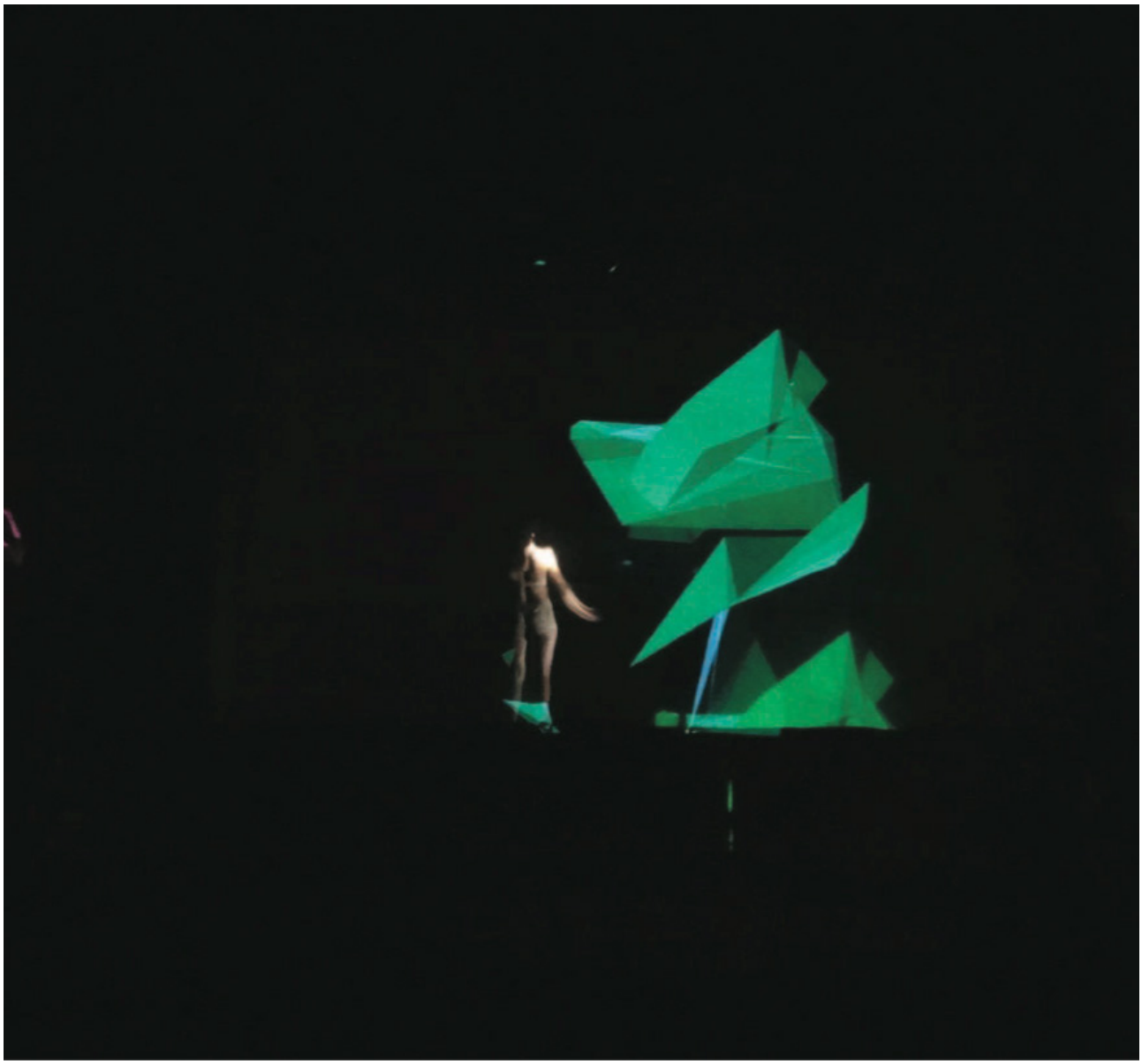

Figure 3. Dancer and projections of overlapped "gesture memories". The graphical representations describe the space occupied by parts of the body of the dancers (including dancers in displaced nodes) in a time window lasting a few seconds.

The fragmentation of the processing demands also occurs externally by the exhaustion of the processing capabilities of machines. The development of the capture and processing of movement descriptors was separated in three different machines, segmenting the processing of video capture, video processing and audio. Given the complexity and accumulation of tools, the control of the performance had to be outsourced to a tactile interface. This interface provided a high-level access to the continuous control of various parameters in real time (limited to the possibilities the touch display). Otherwise, the control of so many parameters would be virtually impossible in a traditional controlling scenario with a mouse or keyboard. Figure 4 illustrates the control interface for scene 3, including the control of syntheses, projected image and control of interacting of the body capture and nodes.

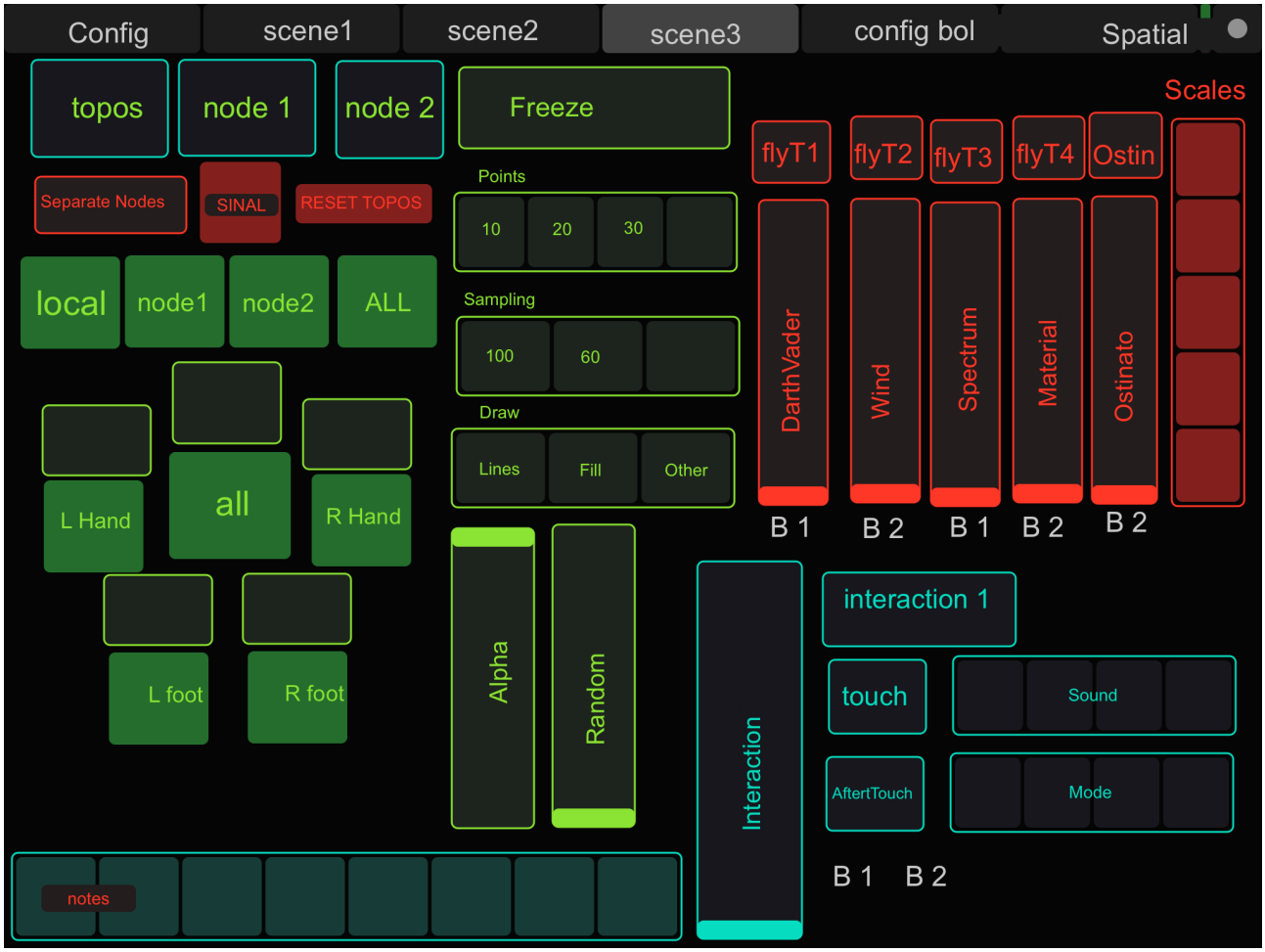

Figure 4. TScreen capture of the touch control interface (Interface: Ipad, Application: TouchOSC) designed to control the elements of the scene 3.

Concluding remarks

In this article we seek to describe a parallel between the notion of extended cognition and the artifacts and connections involved in the development of the performance Embodied in various Darmstadt'58. The comparison, although taken as a free metaphor, allows elucidating an intrinsic process of outsourcing demands and developments into artifacts, tools and connections. Although being far from the dry reality of the code, this comparison shows relevant points in the development of the code in networked art, which is intensified by the actual dissemination of mass and sensor interfaces in a process of unprecedented data production.

From the point of view of extended cognition, the process of extension of cognition operates from a dynamic cycle of action and re-evaluation, supported by the connection between the embodied mind, the mediator body and the artifacts. Similar to the learning of a musical instrument, computational tools require a level of symbolic operation and the accommodation processes, which are not built instantly.

As the learning of a musical instrument, a cognitive system involves a maturation period, which depends on the complexity, intention and stage of the interfaces. Although the technical revolutions have opened several possibilities, the stage of the connections between man and machine still obstruct an agile development of conceptual relationships at higher levels. This greatly impacts on the resources and energy deposited in the implementation of conceptual ideas. In this sense, there is an intense demand for simplification of capturing and connecting processes between interfaces, simplification of connection and mapping protocols and data accessibility to proper processing levels. Projects that work in the limit of technical and conceptual possibilities, as the Embodied in various Darmstadt'58, operate not only as aesthetic vanguards but also as testing bed for the possibilities of the mind and machines in areas of cognition that we still don't understand satisfactorily.

Notes

1 We use here the definitions of John Cage himself where the accident "refers to the use of a sort of random procedure in the act of composition," and where uncertainty "refers to the ability of a piece be played in substantially different ways" (Miller, 2003) .

2 For more details access http://topos.naveda.info, available for download.

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