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From real to virtual embodied performance - a case study between dance and technology.

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Abstract

Co:Lateral is an artistic project that aims to explore the means offered by digital technologies in performance. We conceptualized, developed and implemented a digital artifact, resulting in a digital performance based on the structure of realities born of a body and its double in movement. In this project, authors carried out a research and experimentation process in close collaboration with a contemporary dance company, in order to design the relation between real and virtual body and extend it in a relationship of intimacy with interactive virtual reality. The performative discourse that resulted from this dialogue allows a poetic impulse that evokes moments of the death of the swan immersed in an immaterial space of light and projection: a phantom of a dance file that now returns to a reality of illusory imprisonment. We will make a general introduction to digital art and interactivity, introducing the concept of digital performance and its contextualization in digital and contemporary art.

Keywords

Digital Performance, Virtual Reality, Dance, Embodiment, Cyberspace, Media Arts.

Introduction

William Gibson was the first to use the phrase cyberspace in 1984, in his futuristic novel Neuromancer [1]. Since then, there has been much debate about how this medium should be defined and conceptualized. We will make a general introduction to digital art and interactivity, specifically associated with the field of artistic performance. We approach the concept of digital performance and its contextualization in digital and contemporary art. In the following sections, we present the development of the Co:Lateral performance (figure 1) and its different components: a) the body traced in time, b) body extended in depth, and c) sound development.

Digital art and interactivity

We can define digital art as art produced in digital environments, characterizing itself as a virtual process carried out through software. The term digital art is applied to contemporary art, which uses methods of production using digital media [2]. Kuspit states that, in this area, the importance of "code creativity" goes beyond the creativity of the image, being the central element in artistic creation. Marcos, Branco, and Carvalho define digital art as art that explores the computational environment as a tool and material for creation [3]. Interactivity is present in digital art when it is possible to create a dialogue between the spectator and the artistic creation [4]. Thus, an artistic creation that involves interactivity allows the existence of communication, based on a critical and reflexive action. The interactivity becomes, therefore, a tool for the artist, being a characterizing element in the relation between the artist and the creation, and the relation between the creation and the spectator that experiences it [5].

Figure 1: The Co: Lateral performance, presented at the Teatro Virgínia, Torres Novas, on February 24, 2018.
Photo: Raul Sousa. (Balleteatro)

For Ascott, the concept of interactive art encompasses diverse adaptive practices, media, structures, and environments, allowing the action of the subject who experiences the creation, participating in and interacting with the work [4]. For the authors, the concept of digital art is closely linked to the concepts of interactivity, simulation, and artificial intelligence. The development of systems, structures, and strategies that mobilize feelings and emotions in the viewer, promote the experimentation in the multimedia and hypermedia environments and the subsequent acquisition of meanings. The Co:Lateral project, continuously being developed since 2016 until now, was originated by the NUVE performance [6] (Fig. 2), initiated in 2008, from the same authors. In both projects,

interactivity is a relevant factor, since the entire creative process translates into an artistic output of the conjugation of the real process, the performer, who is exploring space, its real and physical movements, and digital space, which is transformed by these movements.

Figure 2: Essays with Né Barros and João Martinho Moura, for the piece NUVE, in the black box of Balleteatro (2009).

Digital performance

Several contemporary dance companies in Europe are experimenting with new ways of presenting choreographies and movements using digital media [7]. When a performance is conceptualized, there is a process of mediation, translation, and regulation of the inner and outer space, the relationship between ourselves and others [8]. In a digital performance, where technologies play a relevant role, they can be seen not as tools, but as filters for our meetings with others or with ourselves [9]. Here, performance is supposed to involve attention, perception, and reflection, translated so that there is space for a change, an evolution, in the sense that the performative practice is a partial and temporary redefinition that consists of attempts to do something new at the moment. For Saltz, performance, such as dance and theater, is a visual and auditory event, but above all, corporeal [10]. For Dixon and Kozel, performance translates into an emerging state, a deep interconnection between reality and fiction [11][9]. For Fred Forest, art maintains close relations with reality and seeks to use its influence to modify its perception [12].

Regarding the definition of the concept of performance, while Schechner [13] sees it anthropologically, arguing that it embarks on all human activities, Saltz draws a line that defines performance as art, as the action of acting before an audience, and staged performance, where the actions performed in that context are aesthetically significant. The digital term, when applied to performances, is seen as an instrumental facilitator concept, which offers its users a series of tools with interactivity, sensitivity, and subjectivity that, due to their theatrical effects, become characters on stage [11][9]. A digital performance attempts to transcend the division that seems to exist between the underlying concept of performance and its implementation and interpretation, an attempt that is facilitated by digital technologies, creating a virtual world where the real is experienced, transcending its physical limits [14]. According to Dixon, the use of digital technologies in performances is generally referred to as 'digitally manipulated content' and 'technical'. Candy and Edmonds argue that the exploration and development of this type of performative art has revealed that the relationship between artist, his work and the public has become unpredictable and malleable, influencing both the creative process and the control exercised over the same process [15]. Digital performance places special emphasis on interactive and real-time performing arts such as dance, theater, music, and circus, which makes performative arts and digital art increasingly integrated [14]. Digital technology associated with the digital performing arts raises issues related to the notion of identity, origin and temporal linearity, which transforms production into reproduction [16], but the virtual and the real do not oppose but converge, since the experience of the virtual is real and as we inhabit this reality, we are even more human [17]. William Forsythe presented in 1999 a pioneering tool, in CD-ROM format, developed in ZKM, for the analytical vision of dance, using technologies of overlapping of graphic elements on an image with a moving body, where there was a follow-up of positions of the body, generating dashes, points over time [18]. Digital performance, according to Skjulstad, Morrison, and Aaberge, is concerned not only with the application of technology but also with its potential for creative expression and is therefore considered the most active field of digital performance [19]. Jacquelyn Ford Morie refers that many critics of virtual reality describe that participants enter the virtual world and leave their bodies 'behind'. However, the author argues that the participant's body is synchronously incorporated into the virtual self that enters the world within the screen, which is created from what the body experiences [20]. That results in a visualization, an increasingly imperative aspect in a perspective of the public sharing of the result of objects that, from a geographical point of view, incorporates a certain invisibility in the production of art or artistic expressions [21].

Development and representation of the body in Co: Lateral

In the next sections, we will present the developments in the construction of the Co:Lateral performance.

The body traced in time

In Co:Lateral, the image capture process is performed through a set of depth cameras, and tests were performed with various camera models [22] [23] [24], and software developed specifically for the interactions, using *openframeworks* development libraries [25], *Processing* [26], *OpenCV* [27], *Unity3D* [28], applying various computer vision technologies, such as background subtraction [29] and the optical flow technique [30], with

the aim of capturing with good definition the silhouette of the performer, and the directions of movement of parts of the body, respectively. This contour is a set of sequential x and y coordinates, which form a closed polygonal blot corresponding to the figure being captured. Locations X and Y of these points were exploited in order to apply techniques of generative procedural movements, with selective randomness, using algorithms of controlled random generation [31]. It is, therefore, a generative drawing that follows the original silhouette. Although different from the original drawing, there is the notion of preserving the human form. Through the Lucas-Kanade algorithm [32], the movement acceleration of the body's parts is detected, thus enabling a better perception of the movement in real time. Throughout the presentation of the performance, there are different visual moments. The contour of the silhouette attracts some points. This attraction causes a greater concentration of points along the contour limits, which makes the concept of the human figure to be perceived during the simulation [33]. The movement of these points, although largely influenced by the attraction of the figure, is also random [31]. Since the silhouette of the figure is a sequential and structured set of points, graphical explorations can then exist from these points, where a set of white straight lines arises from silhouette points and ends at a randomly chosen point in space.

crucial to the body's experience, performance, and training in the improvisation of dance and movement. Blom and Chaplin [1988] describe kinesthetic awareness as a primary perception and self-awareness of the moving body [34].

During the process of developing and testing the Co:Lateral performance, these techniques have been tested several times and truly explores the possibilities of the application of digital art in dance in its various dimensions, such as space and time, suggesting and reinforcing that time and context of the piece are more than framing dimensions for the art experience [35]. An environment in which the authentic or inauthentic expression of the persona requires that we distinguish between context and transcendent authenticity [36], and the necessary prototypical nature of such creations, situated as they are in a field of interactions in which continuous connection is desired [37], it converges to the part Co:Lateral the desired fluid character. According to this concept, the computer, as a random access memory device, allows us to 'incorporate' the capture into a non-linear format, allowing not only a structural approach to how this data can be retrieved but also the ease of computing new recombines that result in the generation of new data that has never actually been recorded [38].

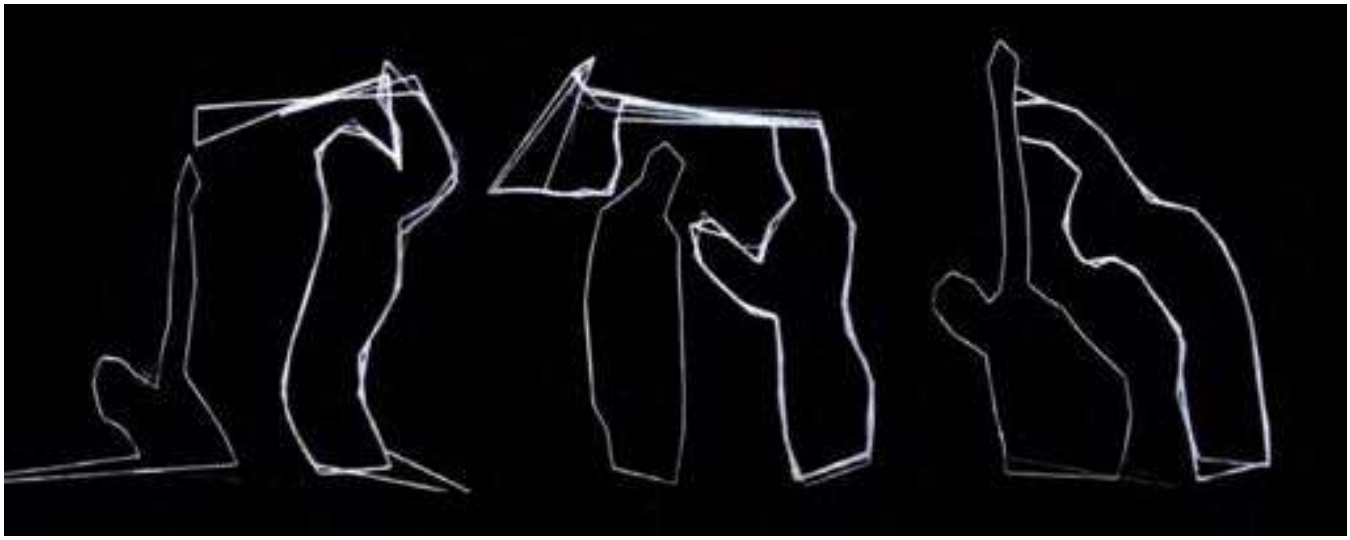

Figure 3: Virtual doubles in Co: Lateral.
The same performer interacting with himself in space and time (2018). Photo: Raul Sousa (Balleteatro)

One of the most peculiar moments of the performance is the simultaneous visual representation of several different points in time. Here time is explored in dance and space. We keep a few seconds of movement that occurred immediately in previous moments, and we confronted the performer with them in the sense of having a kinesthetic awareness of interaction (Figure 3). The kinesthetic sense is recognized as

The body extended in depth

The emerging work of dance performance in virtual reality began to develop new types of practice using specifications of virtual technologies [39]. The images and scenes in Co:Lateral are triggered by the movements of the performer, using virtual reality technologies. Nowadays the definition of virtual reality is associated with the use of equipment that is placed in front of the users' eyes, called HMD (head mounted displays). One of the inventors of this technology

was Ivan Sutherland, who stated in 1968 that the fundamental idea behind the three-dimensional display is to present the user with a perspective image that changes according to their movement [40][41]. Since then, and especially in recent years, virtual reality technology is evolving rapidly, making the definition of virtual reality precocious regarding specific devices, as they may fall into disuse in a short time [42]. The base configuration of the Co:Lateral piece provides for an audience-level virtual reality experience, in the midst of total darkness in a showroom, with a transparent display between the audience and the performer. This screen is not seen in the dark but reacts if images are projected, causing an illusory effect that the image is floating in the air. The performer and the audience come in the same image, and the reflex of the performer's movements is projected on the transparent screen, a kinetic environment with which the performer is in continuous body dialogue with the image in front of him. One of the central questions in cognitive science is how we experience ourselves in a body that interacts continually with the environment, and experiencing our self as being within a body and more specifically a body that feels 'ours' which moves according to our intentions, obeying our will [43]. In Co:Lateral the three-dimensional body is captured in real time, using multiple cameras, using point cloud technology [44].

Figure 4: The movement of the performer's amrs, captured over time, and a generative trait has a letter N (of 'no'), drawn by the performer Sónia Cunha. Photo: Raul Sousa (Balleteatro)

In the first visualizations of the piece, only two-dimensional representations of the moving body (figure 3) are projected, but in certain specific moments, we turn to the Z coordinate, which allows us to obtain more information, such as the body part closest to the camera. Jaron Lanier was one of the first artists to use gestures in electronic art with a device called Z-Glove [45], using the hand in virtual environments to manipulate virtual objects that appeared in an image, suggesting, at the time, a wide spectrum of possibilities of representing objects in virtual environments of interaction. In figure 4 we see a moment in which the performer develops, literally in the air, a gesture that materializes the letter N (of the word "no"), projected between the performer and the audience. In Co:Lateral, throughout the performance, the gestures are analyzed continuously, and specific scenarios are taking into account for the interactive narrative of the piece. Figure 5 shows an important moment, where the performer gently 'touches' many white vertical bars, bars initially well marked, rigid, symbolizing a prison, but which, after interaction, project and react smoothly to virtual touch, immaterial, in fact, but real in the imaginary of the audience. With time and stronger movements, the bars end up forming a volumetric image of the moving body.

Figure 5: The performer body is represented volumetrically in a curtain of white lines. Photo: Raul Sousa (Balleteatro)

The representation of the body is often divided into two aspects: body schema and body image [46]. In addition to perceiving the world, we also perceive ourselves and perceive the effects we have around us. We can, therefore, differentiate between two types of self-attribution: body property and agency. Essentially, we can define the property of the body as the feeling that something is part of our own body, for example, knowing that my arm is mine, being the agency, and on the other hand, the sensation of directly causing changes in the environment [46]. In figures 6 and 7 we present the volumetric body under different capture points.

The Sound in Co:Lateral

A sonority was developed, present throughout the performance, with the concern of establishing an aesthetic correspondence between the images developed. We out-encoded sound algorithms, synthesized in SuperCollider software [47]. Besides, real-time sound algorithms were created and triggered at specific times throughout the narrative, or triggered live by the performer's movements. These sonorities were developed in Pure Data software, whose patches were incorporated in the performance software, using the ofxPd library [48] and *libPD* [49]. The development of this particular sound benefited the performance, due to its reactive nature.

Conclusion

The Co:Lateral project is characterized by a permanent duality in the dialogue it establishes with the public. The duality between the real image, the artist who is physically

Figure 6 and 7: Depth representation. The body is presented in volumetric points. Photo: Raul Sousa (Balleteatro)

present on the stage and the virtual image that is being projected. The performance's configuration presents the projected image on a transparent canvas, which makes in the dark, the virtual forms are appreciated in an almost holographic format, between the performer and the audience. The use of images or light systems is a normal technical procedure in dance. The application of images, projected on the stage, allows the choreographer to create the correct visual environment for the transmission of the idea at work. This technique allows the placement of certain scenographic environment that would be difficult to build physically on the stage.

With the increasing use of projection techniques on stage, we observe a relevant factor to consider, the attention that the viewer makes available to the various visual elements on the scene. In this context, the problem arises that Katie Mitchell called 'attraction of the screen' [50], being the projected image a very present component in the performance. In some informal inquiries to the audience shortly after the various presentations, made last year, some viewers only noticed the correlation between the dancer and the virtual image in the middle or at the end of the performance. Throughout the development, we chose to put moments without visual projection halfway through the performance, slightly increasing the light on the stage, informal breaks without technology, that configure a better perception of the spectacle by the public. Digital technologies are constantly evolving, and their growing exploration in performance has been very prominent. The constant emergence of new and advanced motion capture devices, combined with the progressive power of real-time computational processing, offers the possibility to exploit these technologies for visual, auditory and kinetic artistic creation.

The dialogue between digital art and performance allows us to generate a communicative space that challenges the limits of choreography and recaptures gesture and movement, creating a space for experimentation with new performative possibilities. In all the procedural regime in which the interactivity is translated, between the performer and the digital creation, we can highlight a potential and singular gesture. In the device in which the performance happens, the gesture acquires a unique impact in its expansion and displacement. The micro, minimal dimension of a given action, acquires a determining function in the narrative construction of the performative object. It materializes, thus, the impossibility of return, as well as, the degree of visibility that becomes practically total. The dimension of the imperceptible, inherent in much of the action on the scene, shifts exclusively to the metaphysical dimension of poetics under construction. What is done happens without flight or absence, but it is precisely for this reason that the fragility and error of the gesture in progress are exhibited. We are never as fragile as in a place where at our minimum gesture everything is exposed. In part, Co:Lateral, turns out to be a narrative about the impact of existence: it makes other plans and segments of the gesture exist; is an absolute presence as an immediately visible consequence of the gesture.

On the other hand, Co:Lateral gives us the double, gives us the memory, gives us the life and the infinite expansion of that memory. Although the play calls death and imprisonment through images, visualizations and even music, it is the complement of the life in question: the presence and its eternal repercussion. The performative comes to exist only in this dimension of production of virtualities where they play expanded and displaced forms of the gesture and, above all, of the generative gesture. The concentration in each point of the body, which the interaction between body and technological device promotes, realizes and renews bodily consciousnesses, gives new life to the gesture.

Video excerpts from the Co:Lateral performance can be viewed at the following link: http://jmartinho.net/colateral-isea-publication/

Figure 8: Final interactions in Co:Lateral. Photo: Raul Sousa (Balleteatro)

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