
Symbiosis of Tele-Immersive Environments with Creative Choreography

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Abstract

In this position paper we present a symbiotic creative system, consisting of creative dance choreographers and 3D tele-immersive environment (TI) technologists feeding off each other in terms of creativity and innovation. We will discuss this symbiotic relationship within the context of Creative Systems Theory by Charles M. Johnston. We will show how TI 'feeds' the creativity process in dance choreography and how choreography 'feeds' the innovation process in TI technology.

Keywords

Symbiotic Creative Systems, Dance Choreography, 3D Tele-immersive Environments.

Introduction

The 3D tele-immersive (TI) environments offer new platforms for creation and evolution of dance choreography. As our prior experiments have shown [1], the dynamic combination of 3D TI technology and choreographic process makes a strong vehicle for creative development and exploration within both fields. The interdependent relationship creates a highly charged, specifically driven work environment where

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both parties rely on each other's feedback to continue research in terms of new forms of creativity and innovation. Exploring dance choreography with TI technology is a template for the future of interdisciplinary research because it embodies a truly collaborative and symbiotic relationship between the arts and technology. They together create a **symbiotic creative system**. In this position paper we will show how choreography feeds of TI technology and vice versa.

Background

In this section, first, we describe the *Creative Systems Theory*, developed by Charles M. Johnston [7], that serves as the conceptual basis for modeling of the creative process in the symbiotic creative system between dance choreography and 3D TI technology. Second, we briefly discuss the *3D TI technology*, especially the individual technological components relevant to the symbiotic relationship of the creative system.

Creative Systems Theory: Johnston perceives creative systems in stages where "each stage in the creative cycle is associated with a particular way of ordering reality, a particular "mode" of intelligence." The theory identifies four stages: (1) *Early-axial reality*, where we deal with somatic/kinesthetic intelligence. It means we have the capability of sensing something. (Early Axis) This stage represents incubation of the creative process surrounded by mystery and unknown entities and expectations. At this point the creative process ideas are more felt than formed. Sensing the possibility within a project is the important characteristic of this state. Within the collaboration this is the time in the creative process to follow one's

instincts and physically try ideas or sense what others might think about ideas brought forth to the collaboration. (Early Axis) The forming of ideas, "ideas budding off" experimentation using the senses and/or the body or movement are important during this phase. At this point in the process brainstorming is often used to form unformed thoughts into more cohesive wholes. These buds of ideas are then ready for the next stage of the creative process, the testing and trying out the ideas. (2) *Middle-axial reality*, where we deal with emotional and moral intelligence. In this stage we test out theories, the logic of "right and wrong" and make decisions about what is being created. At this stage, feelings can come into play or gut responses. The creator works through the problems, taking a stance about where to go next with a project, and making decisions based on a hunch or the desired outcome. Within this collaboration experiments are set up based on predictions, collaborators take a stance about what they feel is important to explore, and the work of the project really begins. Testing, re-testing, practicing protocols, making more rigorous the systems used in the collaboration, practicing dance choreography, etc are important elements to this stage in the creative process. (3) *Late-axial reality*, where rational/material intelligence comes into play. In this stage we are concerned with cause and effect of the creative process, empirical knowledge, final appearances or outcomes. The overall creative process is brought to completion. Facts are defined, rational and provable data is presented. At this stage in the creative process, the early explorations are complete and the "work" of the project is complete. What happens at this stage is the culmination of the material, the gathering of the proven facts and protocols. Documentation is presented to people outside of the project, a performance is

completed, papers are presented, etc. (4) *Integration phase* brings the realities together, meaning and purpose is questioned regarding the work that has been done. The creator brings all ways of knowing into this phase. At this stage, it is time for remembering and using outcomes and findings from previous stages. One has to ask: What has been learned?; What wisdom was gained through the process?; What is “alive” from the creative process?; What will be carried into other creative ventures and/or integrated into one’s life or work? We will examine in our ‘Position’ and especially ‘Application’ section how the individual stages of Creative Systems Theory have been observed in our symbiotic creative system of choreography and TI technology.

3D TI Technology: A TI environment consists of geographically-distributed, Internet2-interconnected dancing sites where each site has a network of 3D cameras, surrounding the dancer. This multi-camera network enables to capture, reconstruct in real-time three dimensional (3D) representations of dancers. Because of the 3D data representation, the system is able to integrate 3D dancer video representation with other 3D data either as a varied background (e.g., the dancer may be placed into Rome or New York scene) and/or with dancers from other geographically remote sites. Visual data is then integrated and synchronized with music or voice as desired by the choreographer. Figure 1 shows the overview of a TI system technology.

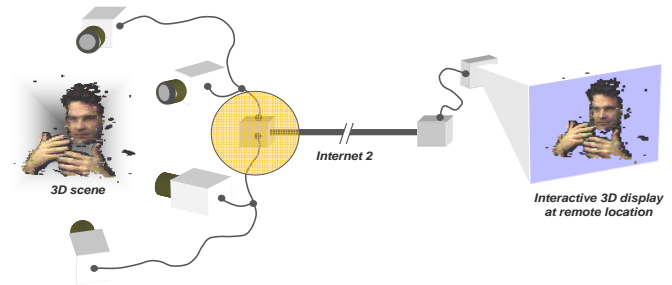


figure 1. Overview of the TI System

The advantage of TI systems in contrast to video-conferencing systems and other collaborative technologies is that: (a) full bodies are captured via visual technologies in real-time and in 3D, (b) captured 3D video data can be integrated with any other 3D data either synthetic or real 3D images acquired elsewhere, (c) 3D video data allows dancers at geographically remote sites to be rendered into a shared virtual space so that they have a strong sense of shared presence and can interact with each other virtually (d) viewers/audience of dance performance has the full capability to view the live performance in stereo and from any viewing angle using standard 3D mouse, (e) choreographer has interactive capability during the dance performance, (f) the dance performance can be easily archived, (g) web-casting capability of the performance for broad audience is available, and (h) dancers can utilize multiple displays to view their performance from any desired viewing angle (mimicking mirrors in training).

Position

Our position is that the exploration of dance choreography and its creative process is altered in the virtual world of TI technology. Furthermore, the creative process in the choreography and innovation in the TI technology are in a symbiotic relationship and strongly resemble Creative Systems theory, developed by Johnston.

Application

We will show step by step the symbiotic relationship between the dance choreography and the 3D TI technology as well as relate them to Creative Systems Theory discussed above.

Dance Choreography 'Feeds' of 3D TI Technology:

The TI experience resonates on a completely different level from the traditional dance choreography. The live experience of dancing with a partner is dependent on the neurological mechanism of touch and sensory awareness, but the experience of dancing with a partner in the TI environment introduces the novel concept of "virtual touch". The feedback mechanism for touch is completely altered when one relies solely on visual information to simulate a physical relationship with another body in space. This induces a heightened spatial awareness of self and a more internal sense of the partnering experience. Furthermore, this translated to teaching and improving physical ability for both dancers and non-dancers.: virtual instruction allows the dancer full attention and care but is a very independent experience. Choreographing on a geographically distant partner, one is challenged to think outside of the traditional lexicon of dance movements and presentation. Suddenly there are new elements and possibilities to embrace and overcome. Between

negotiating what registers visually as touch, understanding the spatial relationship between locations, and discovering the possibilities of a virtual space with a physically invisible but conceptually present partner, the mind and body are challenged in ways that are un-reproduce-able outside the 3D TI environment. The questions raised from the TI experience fit into the web of ideas regarding haptic perception, somatic practices, phenomenology and semiotics, offering an unexplored world of potential with physical therapy, choreography for dance and philosophical questions about self-identity, human cognition and the concept of reality. The limitations of a proscenium stage and the audience perspective become irrelevant in a world where the angles, depth and perspective can shift from aerial to eye level with the click of a mouse. Suddenly, the audience has an element of control and specificity in relation to the movement that is not available in live performance. This control is equally available to the choreographer, who can determine the audience's vantage point throughout the presentation.

Analyzing our Dance Choreography experiences in TI environments through the Creative Systems Model, the possibilities for how dance is conceived, created and presented, are full of potential for altering current conventions for live performance. The TI-augmented dance choreography is currently going through a combined **pre-axial and the early-axis creative stages** where the choreographer gains insights, and the dancer must extend herself. The creative language becomes metaphoric and a language of imagery. The choreographer is dreaming up ideas, and inner visions since the play happens in the virtual space. As our early experiments in TI environments show, inspiring ideas

bud off and begin to become differentiated. We are seeing the improvisation and play with these ideas as well as new possibilities. Especially, the improvisation is currently strongly prevails due to the imperfection of the TI environments.

3D TI Technology feeds of Dance Choreography:

The TI technology provides “digital options” to the dance choreography to enhance the creative process. Examples of the digital options are remote connectivity between dancers in geographically distributed places, abilities to change the scale, view, size, number of people in the virtual space, background for cyberspace participants to allow “physical interactions” to take place in real time [1,2].

In order to achieve the digital options for support or creative process in dance choreography, new TI algorithms and tools need to be designed. All of these digital options require modifications of existing approaches or new approaches in computer vision and graphics algorithms, camera calibration and distributed network protocols to allow for high quality and synchronized perception among remote parties when a new creation is put in place. Besides new creativity in vision, distributed system and networking algorithms, we must create new human computer interfaces for two types of users: (a) the dancers, who are the recipients of the symbiotic creative process, and who learn in real-time a particular set of movement choreographies; (b) the choreographers who are the dance creators and who need to observe, manipulate, resize the dancers, background, views, etc in the cyberspace. In essence, we need to create new digital options and capabilities for the dance choreographers and dancers. The dance choreography is challenging the creativity of TI

technologists as never before since (1) we (the technologists) need to create new virtual worlds that do not exist on real stage, (2) we need to create concepts, algorithms, protocols, tools, interfaces that allow the choreographers to manipulate the virtual world and the dancers to interact with the technology intuitively and easily, and (3) we need to deliver all the digital options and capabilities of the 3D TI environments in real-time and robustly, so that dance creative process can occur smoothly which is the hardest challenge in the symbiotic creative system.

Analyzing the TI technology from Creative Systems Theory point of view, the TI technology is in the **early-axis to middle-axis reality stages**. The reason is as follows: A lot of the early TI ideas have been designed and tested for the past 5-8 years, even though not specifically on collaborative dancing. The TI technology is in the middle-axis reality since we are testing out existing theories and approaches on a new domain of collaborative dancing. We are seeing which TI technology components work and which need to be revisited. Hence, with the new symbiosis of dance choreography and TI technology, we are going back to the early-axis creative stage, since new ideas bud off in the dance domain and new digital options get improvised to assume new possibilities.

Preliminary experimental results of our symbiotic creative system:

Over the last 12 months, we have conducted several laboratory experiments [2,3] and one public performance [3] of the Collaborative Dancing in the TI environment, called TEEVE (Tele-immersive Environment for Everybody), developed by the University of Illinois at Urbana-Champaign (UIUC) and University of California at Berkeley (UCB) [1].

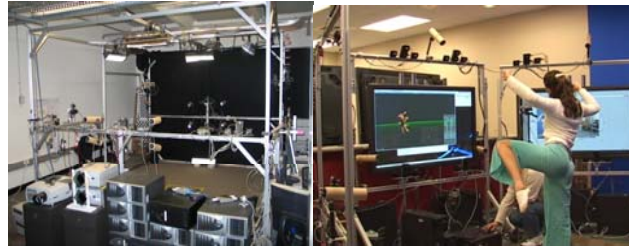


figure 2. UCB (left) and UIUC (right) TI Labs Connected via Internet 2

The TI sites as shown in Figure 2 are surrounded by multiple 3D cameras. For the experiments, we have invited professional dancers to the TI site of each university. The 3D representation of dancers was captured in real time, then streamed and rendered in a common virtual space. The process did not require the dancers to wear any markers or head-mounted devices, which gave the dancers the affinity to a normal dancing environment allowing continuous creative movements. Meanwhile, our multi-view and multi-display system helped the dancers to conveniently view from an arbitrary angle and coordinate their body movements.

Unlike the co-located dancing, dancing in cyber-space has to accommodate certain technical limitations such as frame rate and transmission delay, what makes the synchronization of movements more difficult. Therefore, one of the aims of the experiments was to understand how this mismatch between the real world and the virtual world would affect the coordination between dancers. The dancers' feedback was gathered in terms of synchronization performance, visual media continuity, 3D representation resolution and responding time. Overall, the rating of the technology was positive when dancers moved slowly

and with the capture rate of the TI technology. What was surprising is that the rating of synchronization performance was even better under medium and higher movement speed than slow motion. One dancer commented that if she can easily recognize skeleton of the other dancer, it makes her fall naturally into the coordination even though she cannot grasp the full body detail [2].

In summary, our first experiments helped us to learn initial interfaces between the dancers and the technologists, i.e., how the TI environment influenced the techniques the dancers usually use when dancing on the same stage, and what was the influence of the technical limitations on the dancing choreography. However, they also presented many new and much deeper questions that we believe the inter-disciplinary communities should answer and we would like to discuss them at the proposed workshop.

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