

Merging Research Modalities: TED (Tele-immersive Dance) Collaboration Offers a Model for Performance-Based Research and Creative Development

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ABSTRACT

Tele-immersion is emerging as a new branch within the field of computer science, encompassing computer graphics, computer vision, operating systems, networking, and HCI. In a similar way, TED (Tele-immersive Dance) offers the field of Dance a unique performance/collaborative environment and tool which takes aspects from many branches of dance modalities. Unique to both disciplines, TED offers an environment with myriad possibilities of creative applications including creativity support in dance composition, building a computational model for human creativity, and dance archival and teaching functions. In addition to the value as an environment and application in itself, the process of developing the tele-immersive environment is a model for performance-based research and multi-disciplinary research collaborations. The merging of creative processes with such a multidisciplinary team reveals how productive it can be to look at creativity through the lens of another discipline.

Author Keywords

Tele-immersion, collaboration, dance, composition, creativity support tool, creative process, performance

ACM Classification Keywords

Networking, HCI, Computer Graphics, Computer Vision

INTRODUCTION

The tele-immersive environment enables multiple remote users to share a virtual space where they can interact in real time, viewing fully reconstructed 3D images of their bodies (not avatars) on a large display while they work. Separated by thousands of miles, these bodies can create a duet with a

strong sense of shared space, complete with “virtual” touch. (Figure 1) There are also digital options offered within the tele-immersive room. Graphical objects such as a geographic terrain provide the user with a virtual object for interaction, which influences their movement choices and qualities. In addition to digital options such as graphical objects, size manipulation, self-duplication, and pre-recorded sessions which allow the user to “dance with themselves”, a Wii Remote control is used to seamlessly change the vantage point shown on the display screen. The Wii allows the dancer’s movements (when they affect the position of the Wii) to determine the point of view on the screen. The symbiotic relationship of creativity and design within the system is central to the continued development of tele-immersive environments. The recently coined TED (Tele-immersive Dance) environments (Advancing Interactive Collaborative Mediums through Tele-immersive Dance: A Symbiotic Creativity and Design Environment for Art and Computer Science *ACM MM 08*) is a highly specific creativity environment for dancers to collaboratively work across distance. It is a novel movement experience thanks to the remote partner as well as the multiple digital options provided by TED. This paper focuses on the dynamic relationship of research modalities that exist between the collaborators (artist and computer scientist) and how performance-based research methodologies can be valuable to the development of science and art alike.

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Figure 1. The Tele-immersive Setup.

CREATIVITY

Discipline Specific Definitions

Because there is no authority on the ultimate definition or quantifying process of measuring creativity (perhaps it is only qualitative?), each discipline tends to identify creativity for its own purposes. Information Technology has absorbed “creative IT” as part of a newer set of objectives yet “creativity” has always been a named component of art, and dance choreography is no exception. Whether labeled or not, creativity is essential to problem solving, both in the every day and in the highly specialized tasks of jobs across disciplines. It is only recently that we are formally identifying creativity and acknowledging its presence. According to Wikipedia, creativity is “...the generation of new ideas or concepts, or new associations of the creative mind between existing ideas or concepts.” Wikipedia makes a point of distinguishing a scientific creativity where “the products of creative thought are usually considered to have **both** originality and appropriateness.” Later in the article it talks about creativity within the context of art and literature as only requiring “originality” but not “appropriateness”. Perhaps this is an indication of the many challenges that exist with art/science collaborations: the language barriers, data collection expectations, and methods of evaluation.

Creativity in the Body: Laban Movement Analysis

Working with dancers in tele-immersion fully utilizes and pushes the limits of the system. If the objectives of tele-immersion are communication and collaboration across distance with remote users, then what better way to test these parameters than with users who seek specific, intimate, relationships through movement in the body?

We are all capable of utilizing our bodies to explore creativity. Movement is a universal form of creativity with an extensive, cross-cultural history. A choreographer may talk about a movement “signature” meaning that each person has typical movement patterns that are revealed in everyday life that are particular to that individual. They are identifiable and consistent and can be notated through Laban Movement Analysis (LMA), a system of categorizing movement with four main components: Body, Effort, Space, and Shape. LMA is the theory of human movement, providing, among other things, a bridge

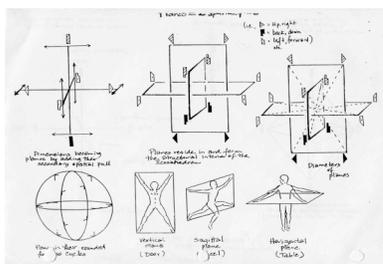


Figure 2. LMA symbols for Space.

between the ephemeral, often nonlinear world of dance performance and the codifiable world of science. Through LMA, we are able to notate and define movement choices that happen within a session thus providing a way to track movement. These movement choices reflect human creativity and have the potential to help build a computational model.

MERGING/REDEFINING THE CREATIVE PROCESS

In the context of this research, we have found that creative challenges and the need for creativity have surfaced in many unpredictable, yet very productive ways. Because of the performance-based research approach, each discipline involved has shared with each other respective concepts of creativity and the underlying objectives of “research.” This dialogue has revealed the moments of potential discovery in unexpected situations and allowed us to truly collaborate on the common goal of making a tele-immersive environment that supports-- and understands-- creativity.

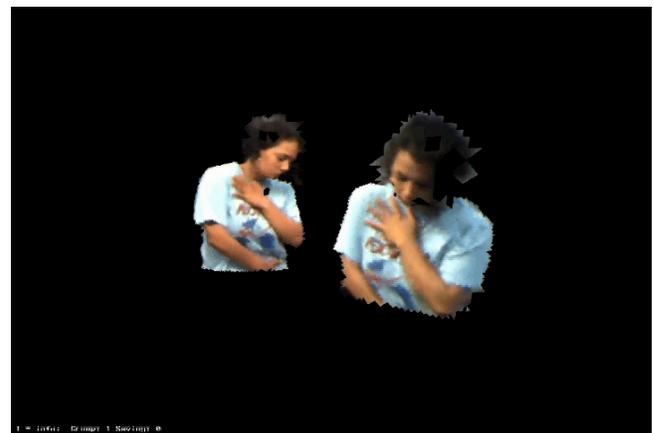


Figure 3. The new, improved image of TED achieved in late 2008.

Art Informs Science: The Value of Error

Moments when the technology seemingly “failed” (ie the camera synchrony between top and bottom cameras was misaligned), provided an exciting opportunity for the dancer. Suddenly the top half of her body could be disengaged from the bottom half, and an interesting study in canon followed. It is in these moments of supposed technological mishap, that the value of error, which is so important in the artistic process, was also valued in science. Responding to error introduced a spontaneity and “human-ness” to the technical experience of tele-immersion. Many technical factors can unexpectedly affect the system: bandwidth limitation, light conditions, graphics, all play a role in what kind of image is rendered. Instead of looking at these factors as negative limitations, we are able to incorporate them into the creative process by acknowledging their potential and figuring out how to use them to our advantage. Ultimately, the goal is to increase frame rate, and compress data so no quality is lost, and already we are achieving a frame rate of 25 fps (originally it was 5 fps) (Figure 3). How this becomes a part of the

creative challenge is discussed in a later section. This approach allows us to acknowledge and strive for goals which are significant for computer science while remaining actively engaged in what the current system can offer in terms of creativity support. Our productivity is not dependent on one ultimate objective, and along the way we are discovering how we can tweak the system to challenge and inspire the user.

Because we have continuously engaged the dancers with the tele-immersive environment, testing each new digital option as it became available, we have been able to truly integrate the technical developments (how we can push the boundaries of what creative IT can offer) with the creative uses in art (how this environment can enhance the creative process). As the dancer's creative needs were discovered and clarified, the tele-immersive environment was able to adapt through program modifications (which includes user interface design, digital options, wii remote etc) to better support and inspire the creative process in ways that would not have been conceivable without this open-ended dialogue. The result is a computer science based research project that takes on some of the creative approaches more commonly found in dance making.

Science Informs Art: The Value of Data

Just as the value of error was realized as a creative tool for computer science, data collection became an unexpected aid in the art-making process. Data collection and ability to clearly present results is highly valued in science and somewhat unnecessary in the arts where the creative success of research (ie a performance piece) is not measured objectively. However, part of this collaboration required questionnaires to help determine which features were most valuable for the creative user.

The dancers were asked to articulate in quantifiable terms what digital options were useful to them during a movement session. The TED systems offered several digital options which included graphical objects (floating stars that circulated in the virtual room), graphical environments (a geographic terrain), and the ability to view from different vantage points via a Wii Remote control. The dancers made it clear that the expectations for the artistic user had a different set of priorities than computer science. The visual quality (an obvious high priority for someone in computer vision) was not at the top of the list for the dancers who appreciated the "monet-like", impressionistic quality of the picture (*ACM MM 2008 listed previously*). However, the Wii Remote (a relatively simple programming step) was considered highly valuable because of its inherent connection to the user's movement. The Wii Remote provided a dynamic, movement based relationship between the virtual world and the user—a feature that was not expected to be so highly evaluated by the dancers. This is a prime example of how two research objectives require compromise and a shifting of perspective. The dancer s

identified for themselves the challenges of adjusting to the TED space which required a heightened visual kinesthesia.

Artists do not typically look at data in order to further understand their creative choices but the use of questionnaires require a certain degree of explaining the "why" behind their choices and preferences within the system. This raises important questions for the artist about personal artistic biases that relate to their movement signatures. Also, there is merit in the fact that typically a dancer does not create movement within the structure of scientific experimentation. A two hour session in a computer science lab with options to play with certain graphics and ways to manipulate their image is a surreal experience for a dancer. It is like doing live video editing in a dance for the camera piece and yet the user is also partnering with another dancer who is actually thousands of miles away. The dancers (and composers) felt very strongly that TED was like working with another partner, like it had a life of its own (Table 1 and 2).

"This experience of composing music (in TED) is unforgettable milestone in my composition pathway. It reminds me Martha Graham's new conception – modern dance has become more realistic. The dancers' body movements...serve as a tool expressing what the choreographer intends to tell. From this composing experience, I learn how to work with two collaborators – dancers and TI system, how to approach the choreographer's ideas with different genre, as well as how does the TI system and technology affect the atmosphere."

Ping Hhsin (February 2008)

Table 1. Excerpt from a composer who created a sound score influenced by the tele-immersive environment.

"Out of many things that we learned was the... notion of reality vs. virtual reality. The dancers worked looking at themselves (and) were transmitted and transformed into the computer screen. The reality was transmitted to the virtual reality. In other words, it can also mean that the dancers were interacting with the computer system as if it were alive. The dancers were controlled by the capacity of the technology. In reverse, the dancers autonomously interacted with their self-images in the screen. These virtual images somehow manipulate the dancers' bodies in reality, too. Also, the body in reality was often forgotten, being manipulated by the virtual images. Most of the time, the conscious was in the screen. The dancers were dancing with themselves reflected into the screen."

YoungSun Lee (February 2008)

Table 2. Excerpt from a dancer working in TED.

PERFORMANCE BASED RESEARCH

Benefits

The performance based research model provides a dynamic relationship between the dancers and computer scientists throughout the development process. The development

process is rich with discovery and immediate application: there is creative merit in the work produced artistically even when the system is not yet performing at the highest technical level. This continuous engagement ensures the development of a system that is genuinely geared towards creative use. Because this research in TED crosses boundaries of disciplines, the possibilities of finding useful applications of LMA, for example, were discovered. Without the dance collaboration, this project would have taken a very different form. Without the TED system, the dancers would never have experienced the altered sense of self and new movement possibilities.

Challenges

The point of departure (between art and science) in performance-based research is revealed once the development of the technology has successfully been completed. Here the discrepancies between the ultimate research goals become more significant. Where science is seeking solutions to problems, art is expressing a personal statement with emotional context. There is a definable transition from development to solution, from the time a technology is in an experimental phase to a time when the technology becomes an accessible application. In dance, although a work may premiere and be considered finished, the final product of a choreographic work does not offer the same linear progression. The “product” is a seamless continuation of the process.

Another challenge for the computer scientists is scalability in terms of digital options, number of sites (and dancers) in virtual space, and the amount of sensory information available to each dancer at each site (ie synchronize digital options). For science to support art there are tradeoffs and compromises that introduce adaptation to the process because of limited resources. For example, with 5 dancers at 5 sites, the sensory information might be smaller (less streams per site) since there is only finite amount of bandwidth in the Internet. Hence this network resource limitation may introduce unexpected effects for the dancers and will definitely require some creative adaptations.

Lastly, the LMA, although a valuable bridge between the two worlds, remains a challenge to translate. The semantics and language used in research is often specific to a particular field. We are searching to find a way to align dance language with technological language.

CONCLUSION: THE FUTURE OF TED

The current focus of TED is for creativity support with human movement to develop a new venue for performance and collaboration in dance without geographic limitations. Now that we have established a portable tele-immersive system (“Panorama” held at Berkeley in November 2008), we are also hoping to create the possibility of multiple tele-immersive environments so that three or four sites can simultaneously interact. This movement research in TED will hopefully lead to the beginnings of a computational

model for human creativity, offering an example of how to translate movement into signal and symbol.

The potential applications for the TED system in large scale internet collaboration is exciting. We have conceived of projects that would get senior citizens in nursing homes interacting (and moving!) with each other and with the younger generation, perhaps family members who are many miles away. There is potential use for a student in a rural community to get valuable instruction in ballet from a master in New York. A famous choreographer from Belgium can interact with a student performing his work in Italy. Business meetings between country leaders can occur with a level of shared space not available in 2D webcam devices and a risky surgery in Iraq can happen under the guidance of the top surgeon at Mayo Clinic.

The multi-disciplinary research model will continue to produce solutions and possibilities for how we support and utilize creativity. In performance-based research especially, this multi-disciplinary approach allows for new possibilities with existing research methodologies and for exciting discoveries when these modalities are merged together. With computer scientists approaching technology like art, there is an openness to the human factor, to the value that human error (and technological error!) can offer. For an artist approaching the creative act within a technological computer-based system, there is something new to learn about the self and other. Especially within TED, where the concept of self becomes very philosophical: does the self exist in both the physical and virtual world? In this context, humanness is revealed in science and challenged for the artist--demonstrating a shifting of objectives and a merging of thought and creative approach.

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REFERENCES

1. Zhao, Liwei, 2001. Synthesis and Acquisition of Laban Movement Analysis Qualitative Parameters for Communicative Gestures, *Thesis Dissertation in Computer and Information Science*, University of Pennsylvania, PA.
2. Nahrstedt K., Bajcsy R., Wymore L., Sheppard R., Mezur K., *Computational Model of Human Creativity in Dance Choreography*, Association for the Advancement of Artificial Intelligence, 2008.
3. Renata M. Sheppard, Mahsa Kamali, Raoul Rivas, Morihiko Tamai, Zhenyu Yang, Wanmin Wu, Klara Nahrstedt, Advancing Interactive Collaborative Mediums through Tele-immersive Dance (TED): a Symbiotic Creativity and Design Environment for Art and Computer Science, ACM International Conference on Multimedia (MM'08), 2008.

