Moderate Recursion: A Digital Artifact of Interactive Dance

Celine Latulipe[1(✉)], Berto Gonzalez[1], Melissa Word[2], Sybil Huskey[1], and David Wilson[1]

[1] University of North Carolina at Charlotte, Charlotte, NC, USA
`{clatulip,agonza32,sdhuskey,davils}@uncc.edu`
[2] High Museum of Art, Atlanta, GA, USA
`melissa.word@gmail.com`

Abstract. In this paper, we describe the process and technology behind the creation of a video art piece, 'Moderate Recursion,' that is a by-product of the dance performance, 'Heavy Recursion.' The original inter-active dance work was part of the Dance.Draw project and was a reflection on the role of technology in our lives. The resulting video art piece, 'Moderate Recursion,' uses a combination of recorded videos of the projected visualizations and of the dancers on the stage. This paper presents the emergence of this new visual art piece. This demonstrates how ephemeral instances of interactive performance art can be captured for broader audiences to experience, through a permanent video artifact.

Keywords: Video art · Dance · Interactive performance
Digital artifact

1 Introduction

The Dance.Draw project was an interdisciplinary project spanning four years, in which choreographers, dancers, technologists, and artists worked together to explore how technology could be used to augment dance performances, engage audiences and support the creative process as a whole. One of the interactive dance productions that was created as part of Dance.Draw was called 'Heavy Recursion.' It is out of this particular production that the researchers created a unique artifact that captures the essence and aesthetics of the production.

In a world where our senses are overloaded with information, we can miss an opportunity to capture exquisite art. If not for the attention of a group member, we may not have noticed that the compelling visualizations created by our inter-active dance were art pieces in themselves. The video art piece that we describe in this paper, 'Moderate Recursion,' is not just the work of the artist-technologist who designed and programmed the visualizations, but it is also art created by the dancers, who controlled the visualizations with their motion, as well as art created by the choreographer who defined the dance movements. In this paper,

we explore the idea of using archival video and recordings of interactive visualizations made during a live dance performance to create a form of digital art that stands on its own and subsists as a memory of the live performance.

2 Background

There is a long history of integrating technology into choreographic rehearsal and live performance processes in a wide variety of ways: as a creative process tool, as an audience response measurement or engagement tool, or as a part of live productions either to augment or to make performances interactive.

Some of the earliest work that integrated technology into the dance-making process involved the use of animated figures in the DanceForms system to digitally plan choreography [1,7,8] and the application of systematic notation for choreography [5]. Various tools, such as 'The Choreographer's Notebook', [32] and the 'Creation-Tool' [6] allow choreographers to annotate dances in progress. The Delay Mirror is a digital video system that plays back a video stream of dance movements with a slight delay to allow dancers in a dance studio to pay attention to details of movement [23]. Recently, Ribeiro et al. used 3D data capture and point cloud visualization to capture the dance-making process [27].

There are also technologies for helping to analyze and represent performance, such as in Forsythe's *Synchronous Objects* work [14]. The Synchronous Objects web-site has videos that present visualizations of the performance, many of which have their own artistic merit. BalOnSe is a web-based digital ontology system that allows search, annotation and analysis of existing dance works [11]. Recently, Peeters et al. studied the use of forms to represent the temporal and expressive movement qualities of tango [25].

In addition to understanding the performance, researchers seek to understand how a dance, drama, play or other type of performance might be perceived and understood by an audience. For example, in part of the Dance.Draw project, we used audience sliders to study the effectiveness of a real-time rating system based on galvanic skin response sensors [16]. Other researchers have since developed more sophisticated systems for audience response [20,28,33]. Bio-sensing has also been used with participants in interactive dance performance [29].

As a performing art, there are intriguing issues of presence in dance, and the use of technology can serve to either augment, obscure or diminish the presence of a performer [2]. Interactive dance technology provides new areas of exploratory collaboration between choreographers and technologists [10]. There have been numerous applications of technology to the dance performance [9,12]. In 2001, Faver used live video of dancers behind other dancers [13]. The use of motion capture, silhouettes and video filters in dance can be seen in the work of Mandilian [19] and Meador [21]. Various longitudinal projects have involved bringing technology into multiple dance productions, as in our Dance.Draw project [15], and the Association of Dance and Performance Telematics (ADaPT) Project [3]. Loke has investigated how ritual can be used to design interactive and participatory performance art experiences [17,18]. These examples demonstrate that the use of technology in dance is varied and complex.

Documentation and archiving are topics of discussion within performing arts. A performance can be characterized as being ephemeral [26], existing momentarily before disappearing. We see this paradigm in contemporary post-modern dance, where each night of a live dance performance is thought to be unique and self-contained. Recordings are often made for archival purposes, but they never fully represent the live performance. Interestingly, to some critics, attempting to contain the original performance [30] within transcripts, video, or other forms of archival, declassifies it as a performance [26]. In contrast, Rebecca Schneider challenges us to think beyond the problem of performance and disappearance; to consider how a performance remains different [31], possibly through the 'lived experience' and audience members. If we consider the whole gestalt, the performance is encapsulated not only by the live staging, but by the playbills, video recordings, and personal memories that keep the performance alive. A video art piece created from the videos of a live performance could exist as both a separate art piece and a remnant of the original performance thereby keeping it alive.

Video art is not itself a new art form. In 'The History of Video Art' [22], Meigh-Andrews, a video artist, outlines the progression from early art films and the impact of art movements such as Fluxus on the development of avant-garde cinema. He covers the digitization of video forms, through the increasing availability of digital video editing tools to the mass market, and the increasing use of video in art installations, both interactive and passive. Bizzochi has coined the term 'Ambient Video' referring to video art that is meant to be part of an environment, sustaining, but not requiring audience attention [4].

Our video art piece, 'Moderate Recursion,' is neither ambient video, nor is it interactive or simply an art documentary. It is unique in its generation from a combination of different media streams that were created as part of a live dance performance. Media streams that on their own, are often left tucked away in cabinets and are seldom unsealed except for retrospection by their creators. They exist only as echoes of the original performance. Video art pieces like 'Moderator Recursion' bridge the gap between archive and live performance. They are both an extension of what was and something new.

3   Heavy Recursion

'Heavy Recursion' was staged in 2011 as part of the Fall Dance Concert at the University of North Carolina at Charlotte. The theme of the performance was the relationship and impact that technology can have in our lives. Using an overhead camera and a k-means algorithm, the positions of dancers on the stage are used to control components of visualizations projected behind the dancers (see Fig. 1). Spoken words by the dancers and the musical accompaniment were also used as sources of input to create circles or splashes based on the volume or pitch of the sounds (see Fig. 2). Another dancer-controlled technique was to use a gradient-threshold of movement to determine when dancers made drastic changes in their movements (e.g., stop). This was used to create lingering silhouettes that appeared when dancers slowed down momentarily (see Fig. 3). During

Fig. 1. Photo showing the dancers and the projected visualization of a tree structure branching toward the dancers.

Fig. 2. Visualizations tracking dancers and responding to sound (left) and a dancer putting tape down to create a box around other dancers (right).
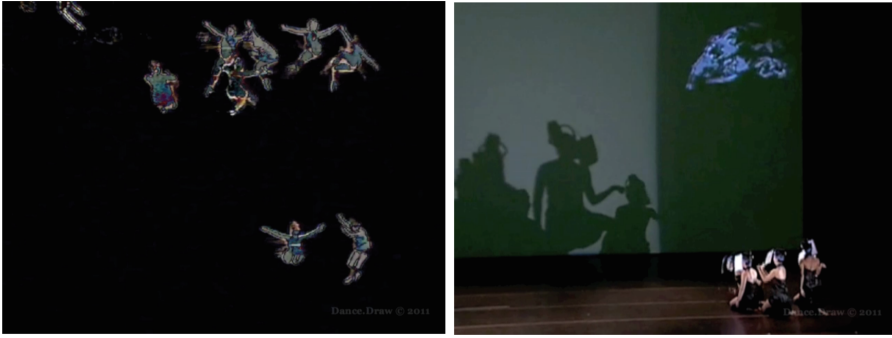
Fig. 3. Dancers leaving frozen silhouettes as they move (left) and shadows of the dancers are projected onto the screen (right).
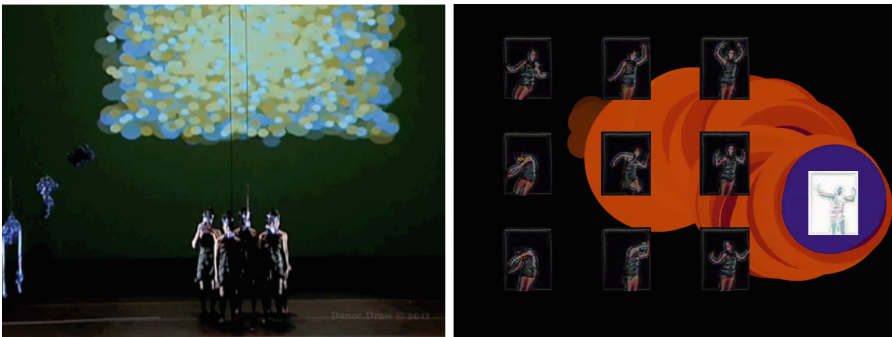
Fig. 4. Splashes of colors responding to dancers crumpling and chewing paper (left) and captured snapshots of the movements of the dancer in the box (right). (Color figure online)

the live performance, the team recognized just how compelling the projected visualizations were and decided to separately record the projected visualizations and musical accompaniment.

As part of the Dance.Draw project, audience surveys were conducted with each performance [15]. Surveys were distributed in the Dance Concert program and an announcement was made about the surveys being part of an ongoing research project, to encourage audiences to respond. Surveys were anonymous and were dropped into boxes in the theater lobby. The surveyed audience for 'Heavy Recursion' found the projected visualizations to be a very compelling component of the performance. Our survey data indicated that 70% of the audience members spent a good portion of their time watching the images of the dancers projected onto the screen with 90% of those people indicating that they enjoyed watching projections of the dancers. The results from audience member survey responses further validated the teams' insights on these very compelling components of the performance.

4   Light Recursion

A recorded video of the visualizations was created using QuickTime Pro's screen-capture feature during three of the five performance nights. Audio of the accompaniment, spoken word of the dancers, and prop noises were recorded from the audio board during two of the performance nights. The audio and video were merged using iMovie to create 'Light Recursion.' In choosing which visualization video from three of the performance nights to use for 'Light Recursion,' several questions were raised: Can we mix together sections of the dance from different nights? Should we trim parts that seem long? Part of the novelty of 'Light Recursion' is that most of the video art content was created by the dancers and their movements. A change in a dancer's footing, stage positioning, or the intensity or cadence of their voice led to interesting and different side-effects. In one instance, the sound-responsive visuals appeared too early because of a noise from the audience. With live performances, there are often nuances that make each night of the performance slightly different, though this usually goes unnoticed by the audience. In the end, we decided to keep the video as unedited as possible and only reduce one section where the visuals were static for nearly 30 s while a dancer was clearing the stage.

As we evaluated and discussed 'Light Recursion,' we recognized that there were portions of the art piece that lost some of their impact or meaning without seeing what the dancers were doing on stage. In order to provide viewers with the contextual information necessary to convey the art's intended purpose, it was suggested that we incorporate footage of the live performance into 'Light Recursion'. We thus created the hybrid video art piece, 'Moderate Recursion.'

5   Moderate Recursion

'Moderate Recursion' is a video art piece created when an interactive dance performance was interlaced with video of the live performance in segments where the context of the stage helps the viewers to understand how the dancers, visuals, and technology fit together. The video is 15 min in length, reflecting the full length of the dance performance. In the terminology of Nam June Paik, we are essentially keeping input-time equal to output-time in our video artifact [24].

'Moderate Recursion' opens with video of four dancers in various static positions. A fifth dancer starts to tape a square around the four static dancers. After she lays the first line, we move to a visualization of grey circles appearing in response to the sound of tape being pulled off the tape roll, with circle size mapped to the volume of the sound of the taping. A white square then appears on screen when the dancers inside the box start to move. As they leave this box, their bodies are represented by white silhouettes. After a short time, one dancer re-enters the white square and begins removing the outline. Two of the other dancers then join her. Every time their movements slow, they leave frozen silhouettes in the space where they dwelled. The term ghosting was sometimes also used, to represent the dancers leaving a part of themselves behind as they moved across the stage.

After the dancers leave, the screen is black until a series of rigid green lines (inspired by printed circuit boards) begins to expand across the screen. After filling the screen, the lines erode away and a series of branches, in shades of blue and green, begin to grow and twist across the screen towards the dancers. These branches were inspired by perfboards, where the wiring isn't as clean as printed boards, especially as an electronic prototype becomes more complex. Eventually everything fades to black.

The dancers emerge as silhouettes, which continue to freeze based on their movements. We fade to video of the live performance. The dancers are kneeling together in the corner with their silhouettes appearing behind and above them on the screen. Shadows of the dancers, from a theatre light downstage-left, are being cast onto the screen. There is a co-existence here between the digital projection, the 'analog' shadow projection, and the live dancers. After the dancers perform gestures on the floor, they make their way to the center of the stage. The theatre light turns off, the dancers stand, and a microphone descends. The live video fades out, and we return to seeing only visualizations. We hear voices that speak in 'programming' language and the visualizations react to the pitch and volume of the voices. As the voices fade, we return to the live video and see the dancers crumpling and chewing paper (see Fig. 4 left). The visuals behind them are bright and large with the noise of the crumpling. After they spit out the paper, we fade to a visualization of five sound responsive dots in a circle. We are then left with one dot that moves and paints along the screen. We briefly return to the live video to see a dancer creating a new square on the stage using blue tape.

There are four dancers on stage, but only one is controlling the visualizations. She explores entering and exiting the taped box, revealing a new white square that appears and disappears in the visuals. As she falls gracefully into the box, the video returns to the visualizations. These visualizations keep a timeline of her movements in the form of color-inverted images (see Fig. 4 right) that are displayed or replaced when there is a dramatic change in the amount of motion occurring within the box. The music changes and the screen goes white with a small rotating ticker, similar to the loading timer on many digital devices.

In the final section, the music picks up and we fade to a live-overhead video feed (unfiltered) with five dots at the top (see Fig. 5). As dancers enter, they 'grab' these dots and begin to paint with them. Every so often, the screen cuts to the rotating ticker, during which the dancers drop to the floor and mimic the 'restarting' ticker movement. After a few seconds, it disappears and the painting is cleared. The dancers stand up and begin painting all over. In the final scenes, we fade to the live video where the stage begins to fade to black. The rotating ticker does not disappear this time, and the dancers are stuck in what appears to be an endless recursion of movement. Upon seeing the spinning ticker, some audience members thought the technology had really failed. Being able to view the dancers during this critical final moment, better enables the viewers of 'Moderate Recursion' to experience the connection between technology and themselves.
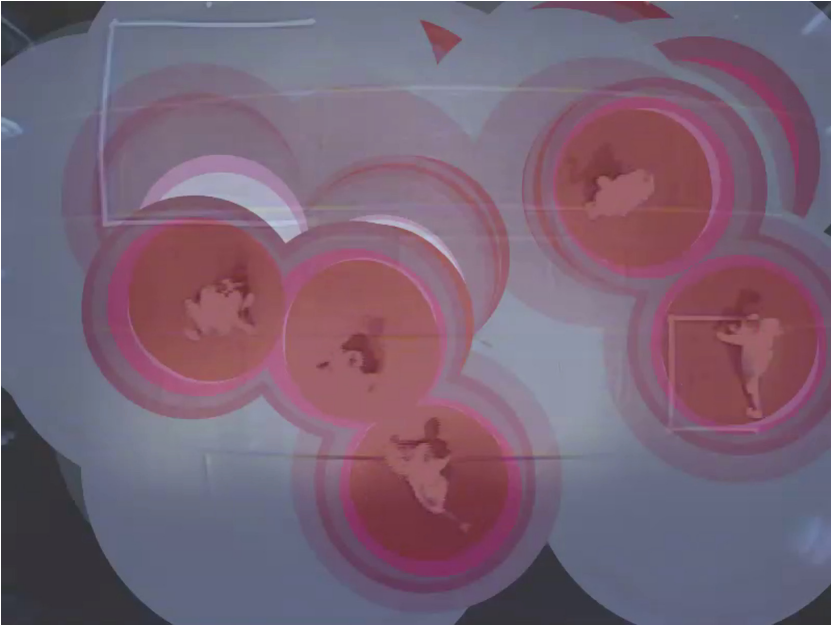
Fig. 5. Sound responsive dots following the dancers.

6   Discussion

'Moderate Recursion' is an artistic artifact through which the community can reflect on the role of technology in our lives, but also experience an interactive dance in a unique presentation format. This is neither live performance nor a filmed dance, but rather a unique art piece created through digital interaction.

It is interesting to consider how other newer technologies could be appropriated to capture live interactive dance and create artifacts that have their own merit. The Delay Mirror, for example, while intended to help dancers study their own movements, could create interesting and thought-provoking artifacts [23]. Current use of social media technologies such as SnapChat could also be used to create stories that become incorporated as new artifacts by both audiences participating and artists involved in the creation of interactive performance.

References

1. DanceForms 2.0 - Credo Interactive Inc. http://www.credo-interactive.com/products/danceforms/index.html. Accessed 26 May 2011
2. Birringer, J.: Dance and media technologies. PAJ: J. Perform. Art **24**(1), 84–93 (2002)
3. Birringer, J.: Interactive dance, the body and the internet. J. Vis. Art Pract. **3**(3) (2004)
4. Bizzocchi, J.: Winterscape and ambient video: an intermedia border zone. In: Proceedings of the 16th ACM International Conference on Multimedia, MM 2008, pp. 949–952. ACM, New York (2008)
5. Brown, M.D., Smoliar, S.W.: A graphics editor for labanotation. SIGGRAPH Comput. Graph. **10**(2), 60–65 (1976)
6. Cabral, D., Valente, J.G., Aragão, U., Fernandes, C., Correia, N.: Evaluation of a multimodal video annotator for contemporary dance. In: Proceedings of the International Working Conference on Advanced Visual Interfaces, AVI 2012, pp. 572–579. ACM, New York (2012)
7. Calvert, T.W., Bruderlin, A., Mah, S., Schiphorst, T., Welman, C.: The evolution of an interface for choreographers. In: Proceedings of the INTERACT 1993 and CHI 1993 conference on Human Factors in Computing Systems, pp. 115–122. ACM, New York (1993)
8. Carlson, K., Tsang, H.H., Phillips, J., Schiphorst, T., Calvert, T.: Sketching movement: designing creativity tools for in-situ, whole-body authorship. In: Proceedings of the 2nd International Workshop on Movement and Computing, MOCO 2015, pp. 68–75. ACM, New York (2015)
9. deSpain, K.: Dance and technology: a pas de deux for post-humans. Dance Res. J. **32**(1), 2–17 (2000)
10. El Raheb, K., Ioannidis, Y.: From dance notation to conceptual models: a multi-layer approach. In: Proceedings of the 2014 International Workshop on Movement and Computing, MOCO 2014, pp. 25:25–25:30. ACM, New York (2014)
11. El Raheb, K., Papapetrou, N., Katifori, V., Ioannidis, Y.: BalOnSe: ballet ontology for annotating and searching video performances. In: Proceedings of the 3rd International Symposium on Movement and Computing, MOCO 2016, pp. 5:1–5:8. ACM, New York (2016)
12. Farley, K.: Digital dance theatre: the marriage of computers, choreography and techno/human reactivity. Body Space Technol. **3**(1), 39–46 (2002)
13. Faver, C., Stein, G.: Toward a digital stage architecture: a long-term research agenda in digitally enabled theater. IEEE MultiMedia **4**, 6–9 (2001)
14. Forsythe, W., Palazzi, M., Zuniga Shaw, N., deLahunta, S.: Synchronous objects for one flat thing, reproduced. In: 2009 Website Installation or On Line Resource, Columbus, Ohio. The Ohio State University and The Forsythe Company (2009)
15. Latulipe, C., Carroll, E.A., Lottridge, D.: Evaluating longitudinal projects combining technology with temporal arts. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI 2011, pp. 1835–1844. ACM, New York(2011)
16. Latulipe, C., Carroll, E.A., Lottridge, D.: Love, hate, arousal and engagement: exploring audience responses to performing arts. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI 2011, pp. 1845–1854. ACM, New York (2011)

17. Loke, L., Khut, G.P., Kocaballi, A.B.: Bodily experience and imagination: designing ritual interactions for participatory live-art contexts. In: Proceedings of the Designing Interactive Systems Conference, DIS 2012, pp. 779–788. ACM, New York (2012)

18. Loke, L., Robertson, T.: Studies of dancers: moving from experience to interaction design. Int. J. Des. **4**(2) (2010)

19. Mandilian, L.E., Diefenbach, P., Kim, Y.: Information overload: a collaborative dance performance. In: Proceedings of the 1st ACM International Workshop on Semantic Ambient Media Experiences, pp. 57–60. ACM (2008)

20. Martella, C., Gedik, E., Cabrera-Quiros, L., Englebienne, G., Hung, H.: How was it?: Exploiting smartphone sensing to measure implicit audience responses to live performances. In: Proceedings of the 23rd ACM International Conference on Multimedia, MM 2015, pp. 201–210. ACM, New York (2015)

21. Meador, W.S., Rogers, T.J., O'Neal, K., Kurt, E., Cunningham, C.: Mixing dance realities: collaborative development of live-motion capture in a performing arts environment. Comput. Entertain. (CIE) **2**(2), 12 (2004)

22. Meigh-Andrews, C.: A History of Video Art. A&C Black (2013)

23. Molina-Tanco, L., García-Berdonés, C., Reyes-Lecuona, A.: The delay mirror: a technological innovation specific to the dance studio. In: Proceedings of the 4th International Conference on Movement Computing, MOCO 2017, pp. 9:1–9:6. ACM, New York (2017)

24. Paik, N.J.: Input-time and output-time. Video art: an anthology, p. 98 (1976)

25. Peeters, J., Trotto, A.: Designing expressions of movement qualities. In: Proceedings of the 2018 Designing Interactive Systems Conference, DIS 2018, pp. 679–690. ACM, New York (2018)

26. Phelan, P.: Unmarked: The Politics of Performance. Routledge, London (1993)

27. Ribeiro, C., dos Anjos, R.K., Fernandes, C.: Capturing and documenting creative processes in contemporary dance. In: Proceedings of the 4th International Conference on Movement Computing, MOCO 2017, pp. 7:1–7:7. ACM, New York (2017)

28. Röggla, T., Wang, C., César, P.S.: Analysing audience response to performing events: a web platform for interactive exploration of physiological sensor data. In: Proceedings of the 23rd ACM International Conference on Multimedia, MM 2015, pp. 749–750. ACM, New York (2015)

29. Rostami, A., McMillan, D., Márquez Segura, E., Rossito, C., Barkhuus, L.: Biosensed and embodied participation in interactive performance. In: Proceedings of the Eleventh International Conference on Tangible, Embedded, and Embodied Interaction, TEI 2017, pp. 197–208. ACM, New York (2017)

30. Schechner, R.: Between Theater & Anthropology. University of Pennsylvania Press, Philadelphia (1985)

31. Schneider, R.: Performance remains. Perform. Res. **6**(2), 100–108 (2001)

32. Singh, V., Latulipe, C., Carroll, E., Lottridge, D.: The choreographer's notebook - a video annotation system for dancers and choreographers. In: Proceedings of the 2011 Conference on Creativity & Cognition, C&C 2011, pp. 197–206, New York (2011)

33. Yan, S., et al.: Exploring audience response in performing arts with a brain-adaptive digital performance system. ACM Trans. Interact. Intell. Syst. **7**(4), 16:1–16:28 (2017)