dAnCing LiNes

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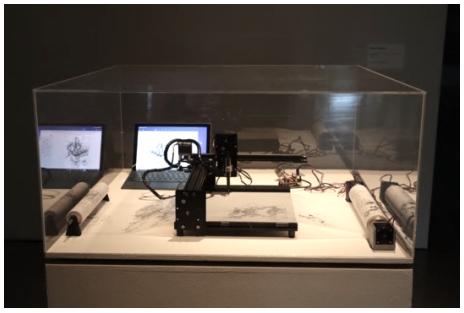

Figure 1: *Robotics Drawings*, dAnCing LiNes, at the James Hockey Gallery, UK, November 2023

ABSTRACT

dAnCing LiNes explores how dance can generate a choreographic view of drawing through mediated representation. Capturing choreographic scores and task-based instructions, the act of drawing is interpreted as a choreographic activity through data visualisations. Through cross artform partnerships with dancers, choreographers, drone and robotics specialists, new artistic methodologies have been deployed to reinterpret five multi-participant live choreographed performances in public locations.

The resulting installation which comprises the projections of the five data visualisations, and a robotic CNC Drawing Machine, brings attention to the dancers' patterns and formations, revealing sightlines and perspectives that cannot be seen simultaneously during the live events. The addition of ambience sound specific to each location facilitates the creation of an immersive environment that echoes the specificity of each location.

Becoming a 'collaborator' of the art making process, the CNC Drawing Machine transfers the choreographic patterns and formations back onto a roll of unfolding paper 'live' in the gallery space, offering a further iteration of the translation of dance into drawing.

CCS CONCEPTS

• **Applied computing** → Arts and humanities; Arts and humanities; Media arts, Robotics;

C&C '24, June 23–26, 2024, Chicago, IL, USA

ACM ISBN 979-8-4007-0485-7/24/06
https://doi.org/10.1145/3635636.3660502

KEYWORDS

Dance, Choreography, Drawing, Flockings, Lines, Space, Immersion, Data Visualisations, Digital Mark-making, Intermedia, Drone Capture, Robotics

ACM Reference Format:
Ella Emanuele, David Hunter, Zach Duer, and Simon Birch. 2024. dAnCing LiNes. In *Creativity and Cognition (C&C '24), June 23–26, 2024, Chicago, IL, USA*. ACM, New York, NY, USA, 5 pages. https://doi.org/10.1145/3635636.3660502

1 INTRODUCTION

dAnCing LiNes concludes a period of research into the relationship between body and line. Exploring how the agency of dance moves from the performative to the visual via technological means by using combinations of established computer vision techniques from OpenCV [1] like Optical Flow, Blob Detection, the artwork developed for dAnCing LiNes investigates performative drawing beyond notions of gestural traces of the body in movement.

Using the model of flocking, a group of twelve dancers strive to move as 'one body' and actualise a collective consciousness of movement that responds to public spaces or environments through the assertion of choreographic scores that explore the extension, reorientation, and variation of the dancers' bodies in dynamic dialogue with the environment. Examining how the body continues beyond its physical boundaries into real space, the dancers' movement is coordinated by rule-based instructions that dictate their movement on the macro scale. The resulting live events (five in total) in different locations explore interaction and group dynamics, raising questions on how people are considered - individually or as a group, politicised and/or socialised. These consider how dancers

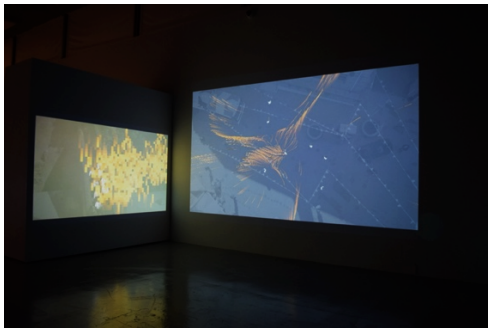

Figure 2: dAnCing LiNes, Jacob's Ladder, The Moor

Figure 3: dAnCing LiNes, Gyllyngvase Beach

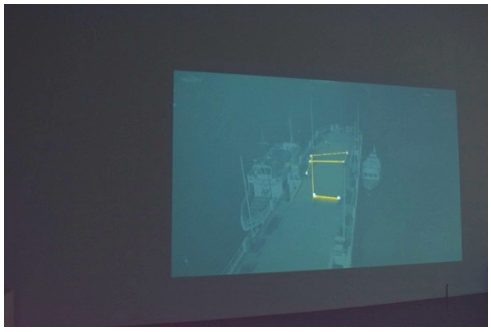

Figure 4: dAnCing LiNes, The Pier

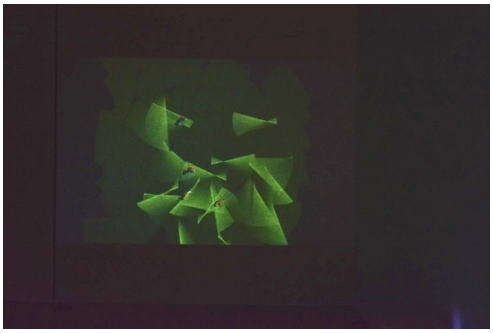

Figure 5: dAnCing LiNes, Pendennis Field

interact with inhabited/uninhabited environments and how performance transforms and forces group dynamics to adapt to external events and audience reaction.

The iteration of dAnCing LiNes' live events through the use of data visualisations reinterprets through mediated representation these choreographic activities, revealing the rules of the underlying choreography in each location but also computationally play with and exemplify those rules on a per location basis (five in total).

Establishing a set of relations between the trajectories of the moving bodies, the organization of movement in space and time, the data visualisations in dAnCing LiNes bring the attention to the dancers' patterns and formations revealing a visuality of perception unavailable during the live events. Approaching the act of drawing through choreographic activities that emphasise the potential for abstraction of the dancing bodies, these diagrammatic representations offer a single field of vision for that which cannot be represented simultaneously in the live events. Although retaining a connection to the live events, dAnCing LiNes' visualisations have their own unique identities which reflect the characteristics of each location. This is an important distinction because it leads to considering the visualisations as system-based relational drawings rather than merely documentation of the representation of choreographic movements of the dancing bodies in space during the live events. In this respect the data visualisations in dAnCing LiNes, despite evidencing a residue of the live activities, do not provide a means of possible future reconstruction. A further iteration of this process transfers the choreographic patterns and formations onto paper through the use of a computer numerical control (CNC) drawing machine which once more translates the codes back onto paper. Resulting in a series of live drawings (5 in total) generated with a computer numerical control (CNC) drawing machine from vectors files that follow the same instructions used for the data visualisations.

2 ARTWORK DESCRIPTION AND PROCESS

How did we capture and interpret a multi-participant choreographed performance in a large, open, dynamic, and public space? Capturing chorographic scores with digital technologies, the data visualisations of dAnCing LiNes explore how the agency of dance moves from the performative to the visual via technological means. The concept of allographic instructions, understood as a set of instructions enacted by another, reverts to the machinic through the use of data visualisations and robotics.

The use of data capture technologies extends the scope of the documentation of the live events, testing out how the movement of dancing bodies in space can be reimagined. The inter-relational processes of choreographic activities in dAnCing LiNes manifest themselves through a methodology of simulation. It is the use of digital technologies that unleash this methodological approach whereby the choreographic activity in the live events is reinterpreted as new ways of drawing through the diagrammatic.

For example: the scores that the dancers performed during the live events became a directive interpreted via a coding system

which has been created following the same instructions. This is a procedure that evidences the choreographic intentions: a kind of mechanical simulation of the scores which in the first instance is extracted and then superimposed back onto the footage of the live performances.

The data visualisations of the live actions and the surrounding spatial conditions, developed in post- production, reinterpret the locations where the live performances took place. The intention is to test how the dancers' movement in space can be reinterpreted through a mediated representation; in this respect the data collection and visualisations have not been intended as a means for documentation but as a tool for new artistic production which took on a new physical form.

The principles behind the artworks developed in post-production have been based on transforming the information gathered during the live performances into diagrammatic arrangements of material. This approach allowed the exploration of the relation between drawing and movement through the lens of the diagrammatic. A methodology that offers not only the possibility of re-interpreting the choreographic configurations of movement in space but also of expanding the potential of audience engagement by disseminating the data visualisations through alternative platforms.

These diagrammatic representations provide a structure for that which cannot be represented simultaneously in the live events; as such, they establish a set of relations that capture the trajectories of the moving bodies and the visualisations of the of the various locations as a single field of vision revealing a visuality of perception unavailable during the live events. Digital technology allows the generation of indexical diagrams that record information drawn directly from the group dynamics of movement and the surrounding spatial environment. The resulting video interpretations highlight not just the movement of the dancers, but also visual the abstract instruction models that guided the movement generation. The cumulative effect of information of the live events gathered through the range of digital devices and subsequently elaborated in post-production filters any excess information to produce a graphic trajectory of the group dynamics. Tracking the dancing bodies through a range of devices in dAnCing LiNes results in the production of images that sit between an index and a diagram. Representation is abstracted from a context, whereby notions of embodiment and subjectivity are removed beyond a phenomenological understanding and experience of the body in movement.

Converted using algorithms into lines, points, and coloured block shapes, the data collected during the live events generate an imagery that sits between an index and a diagram which echoes the colours of the surrounding environment and the different times of the day. The inclusion of ambience sound allows the environment to creep into this computationally interpreted world emphasising the specificity of each of the location.

When animated digitally, these images make visible that which occurs simultaneously in terms of movement in the same way a set of marks that have been laid out on a paper determine form.

Exemplifying and playing with the underlying rules and task-based instructions of the choreographic on a per location basis, the visualisations evidence the choreographic intention by computationally simulate and reinterpret the chorographic scores. Using combinations of established computer vision techniques from OpenCV [1] like Optical Flow, Blob Detection, and image thresholding based on the colour of participant outfits, we could computationally highlight the participants and use their position and movements to generate drawings and animated visualisations (Figure 2). For this we created a series of visualisations in Processing [2], the popular creative coding application. These tools allow some flexibility and control to interpret and visualise performances in such dynamic environments. Passing members of the public, vehicles, and architecture meet the criteria for being used in the drawing and contribute to the visualisations. The visualisations not only reveal the rules of the underlying choreography in each location but also computationally play with and exemplify those rules on a per location basis.

A further iteration of this process of simulation is offered by a computer numerical control (CNC) drawing machine whereby the choreographic patterns and formations is transferred onto paper 'live' in the gallery space (Figure 1). Here it is the robot that becomes the 'collaborator' of the art making process. The resulting drawings reinterpret the data visualisations generated with the same instructions given to the dancers, through the use of digital vectors files. Playing with different visualities of perception that move from the performative to the visual each of these iterations contributes to extending the scope of the shifting landscape and evolving relationship between dance and drawing within contemporary art discourse.

2.1 Moor

The choreographic rules are around social distancing. To this point, particles are generated by dancer movements in the direction of their movement. The dancers' presence creates repulsive forces that move the particles away from their point of origin and avoid other dancers (Figure 6), just as the dancers avoid each other.

2.2 Pier

In this choreography the dancers trace the underlying structure of the pier they perform on. This visualisation looks for alignment between dancers, connecting them as a temporal structure (Figure 7).

2.3 Jacob's Ladder

Dancers move up and down the staircase according to a changing rhythm and in reaction to other dancers. Computational performers are generated by movement of the dancers who carry out the same rules in their own "space" (Figure 8). Each computational performer moves down or up with side steps and must avoid clashing with other performers where possible.

2.4 Gyllyngvase Beach

The rule of six, series of squares are marked on the sand the dancers can move from square to square, the rule being, no more than two dancers in one square at a time; so, if a third dancer arrives one dancer is displaced. The visualisation (Figure 9) applies video filters

Figure 6: Still images from The Moor visualisation - https://youtu.be/e4YkLn67kMU

Figure 7: Still images from *The Pier* visualisation - https://youtu.be/dqomMtuPctI

Figure 8: Still images from *Jacob's Ladder* visualisation - https://youtu.be/toZtKmGpQeY

to highlight the motion of the dancers and the squares that are created and abandoned throughout the performance.

2.5 Pendennis Field

The dancers work in pairs. Two belts are linked together to create a loop, which is placed round the waists of each couple. The couples move together keeping the belts in tension. The couples are instructed to constantly move forward, circling around each other as they traverse the space. Similar to Jacob's ladder, computational performers follow a version of the same rules (both ludic and physical) that applied to the dancers. The generated dancers rotate around each other while attempting to move upward, stay in the middle of the performance area, and avoid other dancers (Figure 10).

2.6 Robotics Drawings

Live drawings with a computer numerical control (CNC) drawing machine generated from vectors files that follow the same instructions used for the data visualisations (Figure 11**, Figure 12**).

Figure 9: Still images from *Gyllynvase Beach* visualisation - https://youtu.be/PrTMZItZjZE

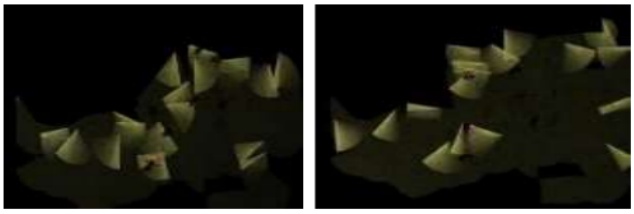

Figure 10: images from *Pendennis Field* visualisation - https://youtu.be/L-5xqu3APyY

Figure 11: *Drawings*, CNC Drawing Machine, Arduino motor, marker on tracing paper - https://youtu.be/EIFaHIhV-gY, https://youtu.be/FwVPSpflCCg, CNC Drawing Machine exhibited https://youtu.be/EIFaHIhV-gY, https://youtu.be/FwVPSpflCCg

3 IMPLEMENTATION

For exhibiting the five videos in a gallery setting the installation would requires: five projectors, five media players with USB connectors, five speakers, one for each projection (test with and without speakers on situ). Please note that if the gallery space can accommodate the 5 projections playing in a loop, the positioning can be apart from one another. Alternatively, the work can be shown sequentially on a single screen though the immersive nature of the project in relation to the physical space of the gallery and the intermingling of the sounds is not fully experienced with this set up. For the drawing machine in terms of equipment this installation requires: a CNC Bachin A4 drawing machine, a plinth, a monitor, tripod, extension leads for CNC drawing machine, arduino rolling device and HDMI Live USB Video Recording Camera HD.

4 FUTURE WORK

dAnCing LiNes Phase 3 - following the findings and output developed through the Arts Council England (ACE) research and development grant, I aim to submit a proposal for a grant with the Arts and Humanities Research Council (AHRC) via Falmouth University in collaboration with Virginia Tech and University of Colorado.

In future iterations, we will build a tool for choreographers to control the capture, interpretation, and visualisation themselves. Code alterations are possible to visualize using real-time video feeds, whereas this artwork used pre-recorded video from the drone. There is an opportunity to further explore Machine Learning for dynamic performance capture. With situated performances such as dAnCing LiNes Augmented Reality presents an interesting interface to experience performances that could be asynchronous or translocated. There remains the artistic open question on how much (if any) should the environment and context be included in the visualisation, or should visualisations be restricted to the performers themselves?

ACKNOWLEDGMENTS

dAnCing LiNes artwork was funded by the Arts Council England Research and Development Grant, the University for the Creative Arts Research Funds and Falmouth School of Art Research and Innovation Grant. Additional support in kind has been offered by AMATA at Falmouth University, Dance & Choreography department and Virginia Tech. Many thanks also to Cornwall-based photographer and drone pilot Graham Gaunt and Ben Green of the Robotics Department at Falmouth University.

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