

dAnCing LiNes

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ABSTRACT

How do we interpret a multi-participant choreographed performance in the public domain through digital technologies? In collaboration with data visualisation expert David Hunter from University of Colorado at Boulder, and visual artist Zach Duer from Virginia Tech, dAnCing LiNes explores how dance can generate a choreographic view of drawing through digital representation. In this respect the artwork produced for dAnCing LiNes is not intended as a means of documentation of the live events but as a tool for new artistic production. The intention is to rethink performative drawing beyond the gestural trace of the body in movement through the use of data visualisations. Capturing choreographic scores and task-based instructions through digital technologies, the data visualisations explore 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 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 (five in total).

CCS CONCEPTS

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

KEYWORDS

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

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1 OUR MOTIVATION

Expanding perspectives on the relationship between dance, choreography and drawing, the body in movement becomes the focus for an investigation in contemporary drawing practice (Figure 1).

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dAnCing LiNes concludes a period of research into the relationship between body and line [5]. 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 performative live events explore interaction and group dynamics, raising questions on how people are considered - individually or as a group, politicised and/or socialised.

Establishing cross artform partnerships with dancers, choreographers, data capture, and drone specialists, new artistic methodologies have been developed in regard to the activation of spaces and audience engagement. These consider how dancers interact with inhabited/uninhabited environments and how performance transforms and forces group dynamics to adapt to external events and audience reaction.

2 ARTWORK DESCRIPTION AND PROCESS

How did we capture and interpret a multi-participant choreographed performance in a large, open, dynamic, and public space?

In collaboration with data visualisation expert David Hunter from University of Colorado at Boulder, and visual artist Zach Duer from Virginia Tech, new methods for engagement with targeted audiences have been tested through drone data surveillance. Capturing choreographic 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 [4], understood as a set of instructions enacted by another, reverts to the machinic through the use of data visualisations. Interpreting drawing as a series of diagrammatic graphics of the dancers’ patterns and formations, the imagery developed for dAnCing LiNes brings attention to the organisation of movement in space and time. 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 reimaged.

In dAnCing LiNes’ data visualisations the act of drawing is reinterpreted through mediated representation as a choreographic activity [3]. 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

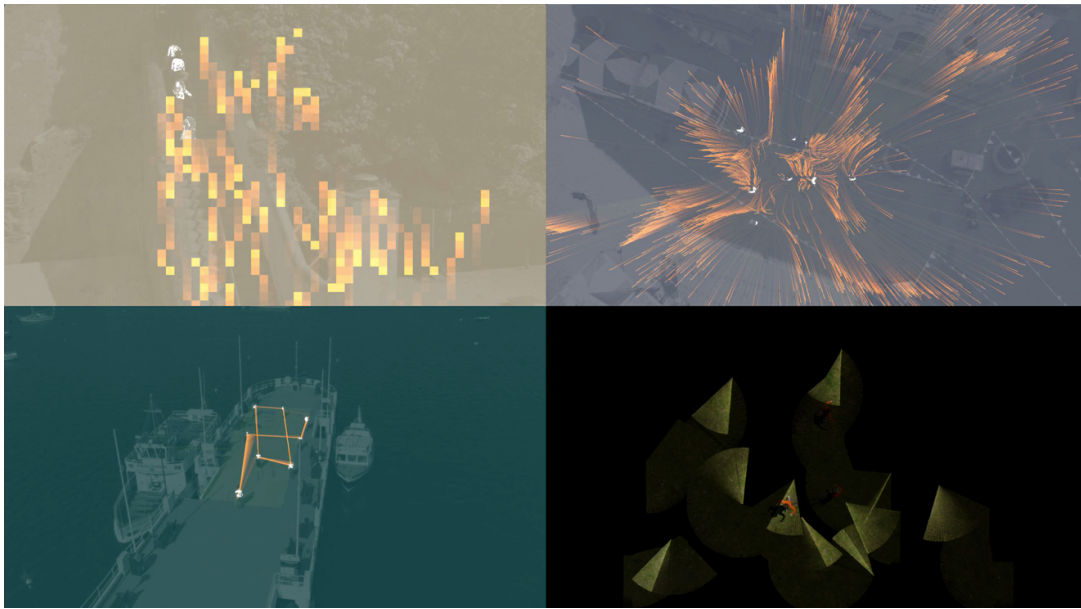


Figure 1: Still images extracted from four of five video visualisations of dAnCing LiNes performances.

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 movement of the body in space can be re-activated 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 visibility 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 echo the colours of the surrounding environment and the different times of the day. 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.

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. Machine Learning tools were also tested but proved difficult to accurately extract participant presence and pose or identify humans from overhead drone footage. Nevertheless, even with these methods for selecting and filtering video to create data, the environment creeps into this computationally interpreted world. Passing members of the public, vehicles, and architecture meet the criteria for being used in the drawing and contribute to the visualisation.



Figure 2: Process image showing dancers identified as forces in yellow and optical flow to track dancer movement and direction in red, with generated particles.

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.

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 3), 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 4).

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 5). 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 6) applies video filters to highlight the motion of the dancers and the squares that are created and abandoned throughout the performance.

2.5 Pendennis Point

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 7).

3 IMPLEMENTATION

For exhibiting the five videos in a physical space we would like to present the videos simultaneously on five screens. If this is not possible, then we would show the videos sequentially on a single screen. For an online experience if multiple videos can be embedded and playing simultaneously that would be preferable otherwise a single video player looping through the five videos sequentially.

4 FUTURE WORK

dAnCing LiNes Phase 2 - 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

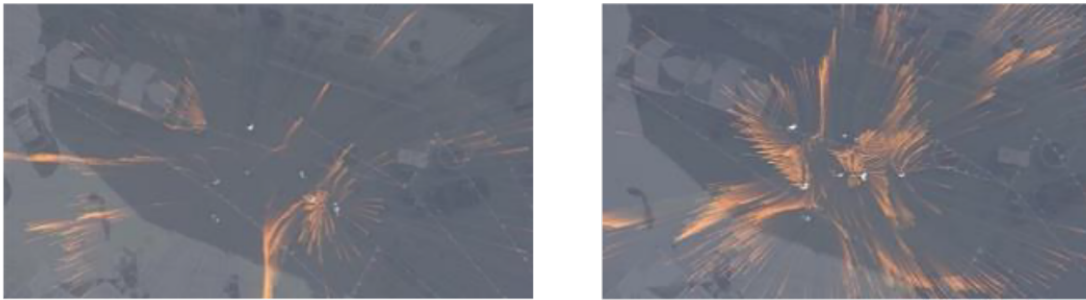


Figure 3: Still image extracts from the Moor video visualisation.



Figure 4: Still image extracts from the Pier video visualisation.



Figure 5: Still image extracts from the Jacob's Ladder video visualisation.



Figure 6: Still image extracts from the Gyllynvase Beach video visualisation.

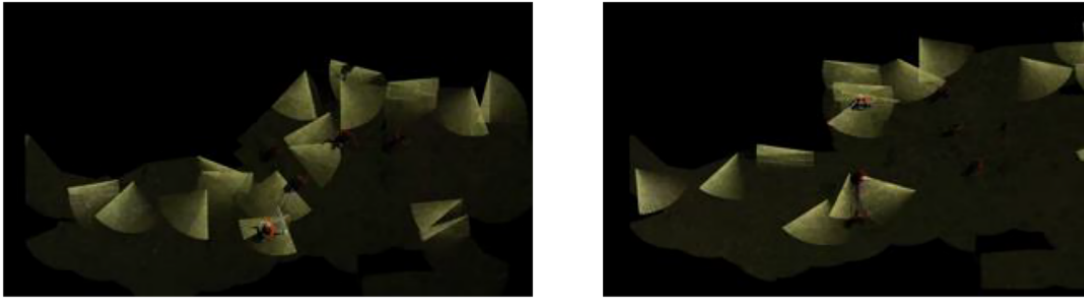


Figure 7: Still image extractts from the Pendennis Point video visualisation.

University in collaboration with Virginia Tech and University of Colorado.

In the next iteration, 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?

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REFERENCES

- [1] Cansik (no date) Cansik/opencv-processing: Opencv for processing. A Creative Coding Computer Vision Library based on the official opencv java API, GitHub. Available at: <https://github.com/cansik/opencv-processing> (Accessed: January 20, 2023).
- [2] Welcome to processing! (no date) Processing. Available at: <https://processing.org/> (Accessed: January 20, 2023).
- [3] Forsythe, W. (no date) Synchronous Objects, Synchronous Objects Media Site. Available at: [https://synchronousobjects.osu.edu/media/inside.php?p\\$=\\$gallery](https://synchronousobjects.osu.edu/media/inside.php?p$=$gallery) (Accessed: January 20, 2023).
- [4] Foa, M. *et al.* (2022) Performance drawing: New practices since 1945. London: Bloomsbury Visual Arts.
- [5] Emanuele, R. (no date) Rossella Emanuele. Available at: <http://rossellaemanuele.com/portfolio/graphics-traces/> (Accessed: January 20, 2023).