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Latent Spaces

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For a long time, artists have attempted to capture data relationships from the world that surrounds us and place them in aesthetic discourse. *Latent Spaces* is an audiovisual piece that converges with this significant body of work as much as it diverts from it. Instead of using data in a way to reflect the physical world, it deals with data as an autonomous observable object. In this context, the question “what does data represent” becomes irrelevant. The focus is shifted to the hidden spaces data can exhibit. Seeking to explore these spaces, the work uses visualization and sonification techniques of algorithmic processes. It hopes to discuss aesthetics not in terms of data sources but in terms of data dynamics.

Description

The original space that describes data is often multi-dimensional, and therefore visually inaccessible to humans. A hidden (latent) space results when this multi-dimensionality is compressed in two or three observable dimensions. The unfolding of this process creates interesting aesthetic implications which are explored in *Latent Spaces* through the intertwinement of computer graphics and sound.

The piece demonstrates four different datasets undergoing dimensionality reduction through t-SNE, a popular algorithm used for this purpose. By using t-SNE, the multi-dimensional space of each dataset is compressed to three dimensions while maintaining its inner structure (Van der Maaten and Hinton 2008, 2579). This gives us the opportunity to observe the relationships among datapoints through the way they organize in space; similar datapoints are clustered together, while dissimilar ones are pushed further apart. This dynamic process forms the narrative for each of the four parts/studies that comprise *Latent Spaces*. The resulting point trajectories are sonified using parameter mapping sonification and freely composed material (Grond and Berger 2011, 363-365). In studies 1 and 3, sonification forms the main body of the sonic aspect, while in study 2 sound was composed and arranged freely, always in accordance with the visual action. In study 4 a combination of the two approaches was followed. The sonification was realized by treating the changing point positions and velocities as control signals driving various parameters in sound generating algorithms, from simple additive, subtractive and FM synths to granular samplers.

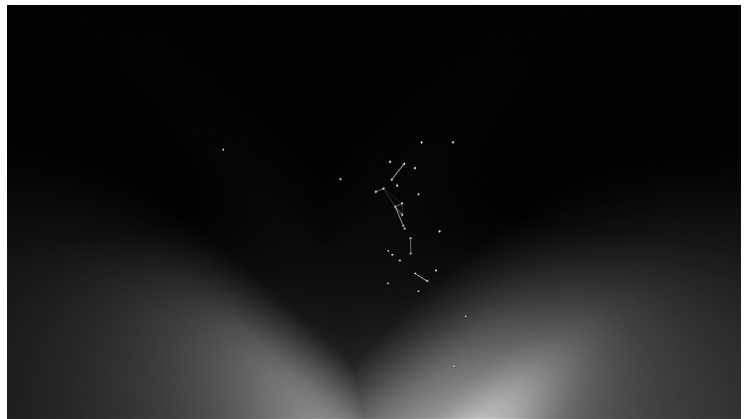
Each study employs a dataset of different size which in turn affects the magnitude of the space dealt with in the study. The studies/spaces are ordered by size. As we progress through them, attention is shifted from inner details and microactivity to larger forms and gestures. The goal of the piece is to remove the associative examination of data and pose the question of whether data relationships can be treated as an object with its own aesthetic qualities. For this reason, the sounds used for the realization of the work were mostly synthetic, with a few exceptions which were heavily transformed to prevent obvious real-world connections (Merino 2019, 15). Similarly, the visual part is focusing on the space emerging from the organization of datapoints, hence the lack of surrounding objects. Connecting lines among points are used for two reasons: to group together the points which present similarities and to create solid gestalts out of sparsely organized points (Droljc 2018, 21-22). The hidden spaces of data are

presented independently of their sources, and the only information provided is the size of the dataset and the number of different classes (clusters) within it. Below is a short description for each of the studies in the piece.

Study 1: Connectedness

The first study deals with a small dataset. We observe how t-SNE is rearranging the point positions attempting to cluster them together according to their degree of similarity. During this process, connections among neighbouring (ergo similar) points are formed. The connections grow in number and intensity as the algorithm is recognizing the structure of the data more and more. A dipole is formed, with clearly separated elements on one side, and sparse textures on the other. From individual points and connections, a unified object gradually emerges.

Fig. 1. Snapshot from *Connectedness*.



Study 2: Coalescence

The points and their respective connections increase. They cannot exist as autonomous events anymore, forming instead an unstable whole that comes together and falls apart in a struggle for coherence. Individual points seem to play an important role still, however there are moments where they seem to vanish as a single homogenous unit prevails. As the connections stabilize, what was before a floating sonic texture now becomes a quasi-solid rhythm. From an amorphous cloud of points, structure and clear relationships are established. The algorithmic process is examined under the light of another dipole: noise against structure.

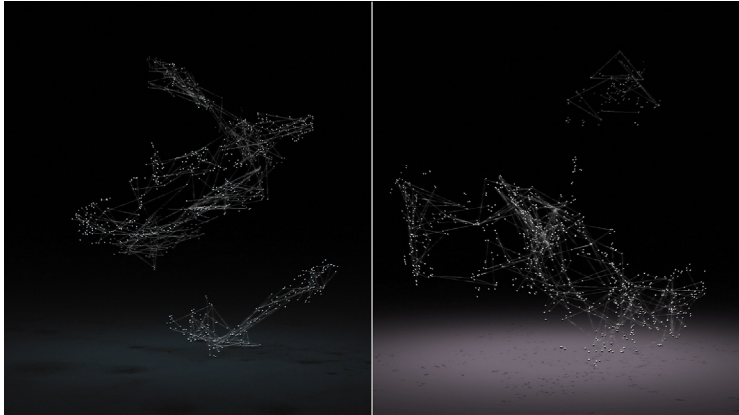
Fig. 2. Snapshot from *Coalescence*.



Study 3: Ecosystematicity

Two executions of the algorithm are juxtaposed. Operating in different timelines and placed against each other in an almost conversational manner, each of the instances is being treated as a malleable material that stretches, twists and bends while it reaches for equilibrium. The result appears once more unstable. Is each instance simply the sum of its parts, or does it extend beyond, as a self-contained entity? Does the co-existence of the two imply an ecosystem? This time, the algorithmic process is seen as dialogue. On a higher level, this dialogue takes place between two similar processes running side by side, exchanging textures and gestures. On a lower level, the dialogue becomes an inner mechanism of each entity, resulting in transition between activity and stasis.

Fig. 3. Snapshot from *Ecosystematicity*.



Study 4: Entirety

In *Entirety*, only vestiges of microactivity can be witnessed. The study deals with the biggest dataset in the piece and brings forth the qualities of a large object that unfurls and reshapes until it reaches its definitive form. Once it does, clearly formulated clusters can be distinguished. Unlike the previous studies where a spatial reference was provided (for example the rectangular container in *Coalescence* or the ground in *Ecosystematicity*), in *Entirety*, space is the unbounded void. During the ending section, a distant and a close-up shot co-appear in split screen. The contrast between macrocosmic form and microcosmic detail, supported not just visually but sonically as well, serves as a conclusion for the entire piece. What started out as the product of individual relationships among (data)points, gradually agglomerated to gestalts that defy reduction to their constituents (Harman 2011, 8-10).

Fig. 4. Snapshot from *Entirety*.



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References

Droljc, Tadej.

2018. "Composing with Isomorphic Audiovisual Gestalts". PhD diss., University of Huddersfield.

Grond, Florian,

and Johnathan Berger.

2011. "Parameter Mapping Sonification". In *The Sonification Handbook*, edited by Thomas Hermann, Andy Hunt and John G. Neuhoff, 363-398. Berlin, Germany: Logos Publishing House.

Harman, Graham.

2011. *The Quadruple Object*. UK: Zero Books.

Merino, Elías. 2019.

"Thingness: Compositional Strategies for Emerging Virtual Sonic Objects". PhD diss., University of Huddersfield.

Van der Maaten, Laurens

J.P. and Hinton, Geoffrey E.

2008. "Visualizing High-Dimensional Data Using t-SNE". *Journal of Machine Learning Research*, no. 9(November): 2579-2605.