
On Figures and Point-clouds

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Abstract

This article traces creative research on 3D scanning, that we – Maria Kyrou in collaboration with Jiawen Wang (Student Assistant, study program Art & Media) – developed in the context of the *InKüLe* Project (*UdK Berlin*) during the winter semester 2022-23. Following an associative and process-oriented approach, we pursued a creative exploration of 3D scanning, while illuminating both conceptual and technical aspects. This case study had a double scope: to experiment with the possibilities of different 3D scanning workflows for the creation of hybrid artistic formats and to reflect on ways of relating to emerging digital media, in order to facilitate their critical integration into a learning process for students and educators alike. 3D scanning serves thereby as a ‘Leitmotif’ for a broader inquiry on how mediators may learn.

Our project focused on the 3D capture of human figures, creating an interplay between scanning method and captured form. As an experimental exploration, the results of 3D scanning were interpreted through intuitive associations stemming from different art fields and visual media. Exploring both static and dynamic forms of 3D capture, the idea of movement became central as the creative process unfolded. Considered from the perspective of experimental media didactics, the article concludes with the definition of two pairs of qualities, which were central in its development and relation to emerging digital media.

How do we form a relation to emerging tools and processes for an innovative arts education?

1. Tracing questions

How do we form a relation to emerging tools and processes for an innovative arts education?

How do we sustain a conceptual thread in the exploration of digital media?

How do we learn and explore digital media in order to promote a critical and insightful understanding?

What kind of documentation can be chosen?

In contemporary art education, applied digital media evolve constantly and rapidly – how can then our learning process become an ongoing creative exploration?

2. Initiating the process

How did this experiment start?

The idea of fluid transitions between the physical and the digital realm emerged early on in the context of the *InKüLe* Project, as one of the most intriguing aspects of correlating emerging digital media with the traditional disciplines of the arts. When it comes to the exploration of the space between the Analogue and the Digital, 3D scanning is a powerful, creative medium.

Broadly, the term refers to a process of digitization, during which a physical space or artifact is captured in the form of a three-dimensional, digital copy. Contrary to two-dimensional representation techniques, like a photograph or an illustration, a 3D scanned artifact can be examined in the digital space interactively, much in a similar way that one would examine an object in the physical space. This digital 3D artifact can then be edited further through different software, and digital workflows, opening up a rich spectrum of creative possibilities. It is exactly this creative realm that our research sought to highlight and explore. (link to the scankit here)

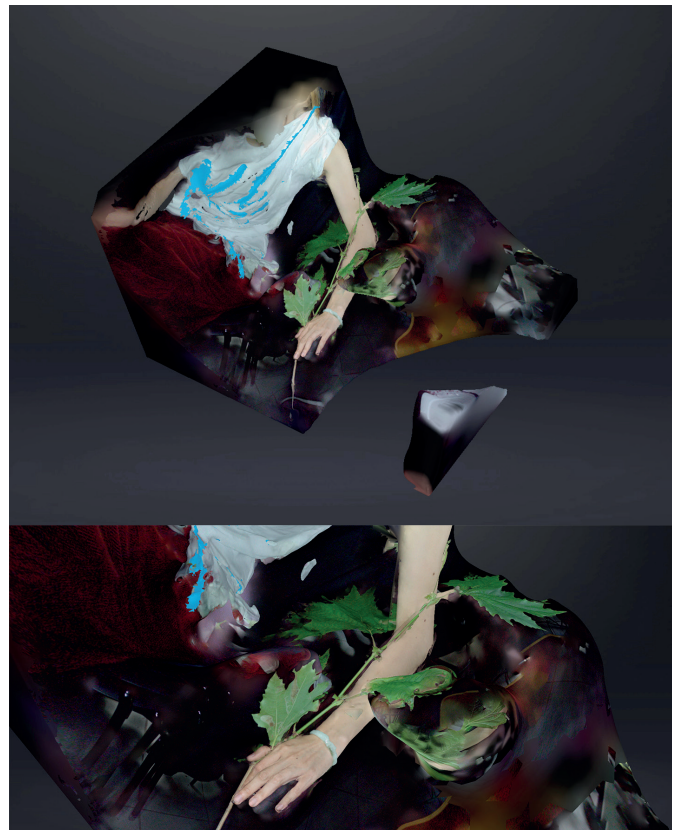
3. Exploring 3D scanning in relation to our bodies (Phase 1)

3D scanning can be performed through different devices and workflows, where the specific choice of software and hardware massively affects the results. At the beginning of our exploration, we chose a scanning device that is renowned for its accuracy in scanning bodies: a handheld scanner, that is used among others in medical context for the creation of prosthetics.

Bringing the new technology in direct relation to our bodies transformed this learning process into an almost tactile exploration. This time, however, our bodies are not just exploring, but they are themselves being explored: their own form, texture and surface are all turned into a field that is 3D scanned, and thus digitally seen and interpreted. In this sense, the accuracy of technologic representation is directly linked to an observing eye, and therefore, to different ways and attitudes of seeing: voyeuristic, scientific, romantic, and exploratory.

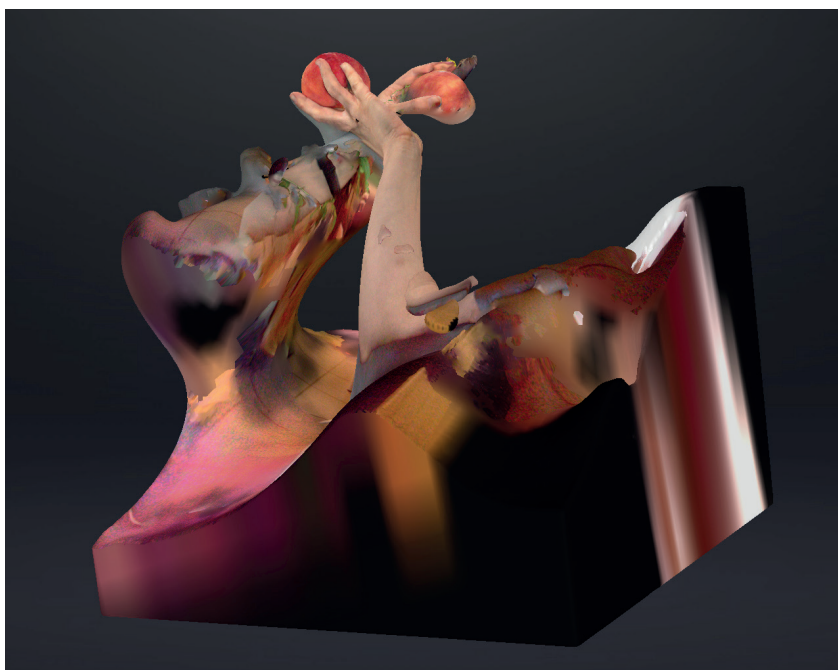
This interpretation connects 3D scanning directly to the visual arts, their histories, and modes of representation. We chose i.e. references to art history by incorporating themes and forms in our scanning process: an arm holding an apple, with early spring flowers weaved around the wrist and fingers was a reference to Sandro Botticelli's *Primavera* painting (c. 1482), as well as to themes of the Pre-Raphaelite Brotherhood. (1)

Some of these associations also occurred unexpectedly, as a result of direct experimentation with the medium. Meanwhile, simple technical applications were completely transformed, when considered from the perspective of the arts. Our processed, 'encased' forms resembled sculptural reliefs or even sculptures only partly curved out of stone in the style of non-finito. This interplay of scanning method and interpreted form slowly became the backbone of our creative exploration. (2)



(1) Close-up of 3D scanned assembly of body intertwined with leaves

What happens when a 3D-scanning medium, is challenged to capture movement?



(2) 3D capture 'encased' in the bounding box is shown here. The hand-held scanner is used in combination with dedicated software, where the processing of the 3D captured objects takes place. This software also prepares the scans for other workflows, like 3D printing, where it is important to have 3D objects with a uniform and closed surface. To achieve this, the software creates a bounding box around the captured form, where its open edges are encased.



(3) Close-up of 3D scanned assembly: Adding increasing amounts of movement during the capturing process

What happens when a 3D-scanning medium, is challenged to capture movement?

4. Breaking the workflow

However, our exploration of 3D scanning was not limited to art-inspired interpretations. It was exactly when we became proficient in the use of the scanner, that we realized that we did not wish to limit ourselves to the medium's niche but to 'hack' its technological efficiency through creative curiosity and artistic intention. Beyond a mere application, we were keen to explore the limits of our scanning medium and to see how it would perform in workflows that are completely different from its initial scope and intent.

We wondered: What happens when a 3D scanning medium, which is so attuned to capturing 3D form with accuracy, is challenged to capture movement? Is this even possible, and if yes, what are the results of this unexpected and un-optimized process? (3)

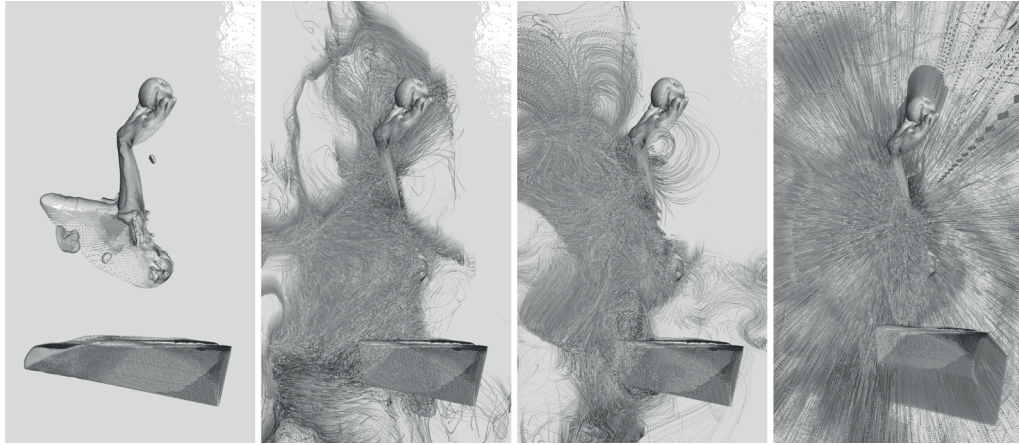
This question was not only derived from our stance towards digital media but also from an attentive observation of our own process: already in some of our first body scans, small movements (body relocation) were unintentionally captured. In turn, this made us curious whether we could develop the accident into a creative exploration.

We started by intentionally adding increasing amounts of movement during the 3D scanning process when the captured objects were supposed to be still. And to our surprise, it was indeed possible to capture a body between 2 different poses, as long as a relatively big part of the overall posture was maintained. The lighting conditions, textures, and captured material all became a part of the balancing equation that made this possible. While such observations are usually noted in the effort to make scans clearer and precise, in our case it was glitches and mistakes that were most sought-out and intriguing. Contrary to the clarity and the complete form of our other (still) scans, these 3D artifacts occasionally featured unexpected gaps, cracks on their digital surface, and rough (low-poly) fringes. However, their high resolution was still maintained, resulting in fused aesthetic expressions with nuances of the 'unheimlich' or even the grotesque. Another accidental quality concerned the scans' textures. During the processing stage, the colours, and materials of the different objects would be unexpectedly mixed, resulting in hybrid, almost chimeric forms, where the limit between object and body is uncertain. (4)

Most of these scans were too heavy to even export out of the scanner's native software, while similar assemblies can easily be achieved with dedicated 3D modeling and sculpting software. Yet, neither speed nor efficiency were the target of this exploration, but the conscious desire to challenge the prescribed limits of the medium and explore what creative possibilities might lie beyond them.

(4) Exploring limits: Intentional movement during the normally static 3D scanning process





(5) 3D scans used as a base from which a point-cloud was emitted

5. Introducing an additional medium

In the following, we used the derived scans in a post-processing creative workflow. Instead of transitions between the physical and the digital realm, our focus shifted to experimentation in an exclusively digital format while combining the scanned artifacts with other digitally generated forms.

For this exploration, the software *TouchDesigner* was used. This software is a node-based visual programming language, which allows the real-time transformation of digital content and is therefore able to support the presentation of time-based artworks and different forms of audio-visual performance. Within the software's interface, the 3D scans were used as a base from which a point-cloud was emitted. Simple manipulations of parameters could then affect this point-cloud's overall form. This included the point-cloud's density and its movement, through variations on the points' number, shape, speed, and trajectory, by applying noise and turbulence to their path of movement. (5)

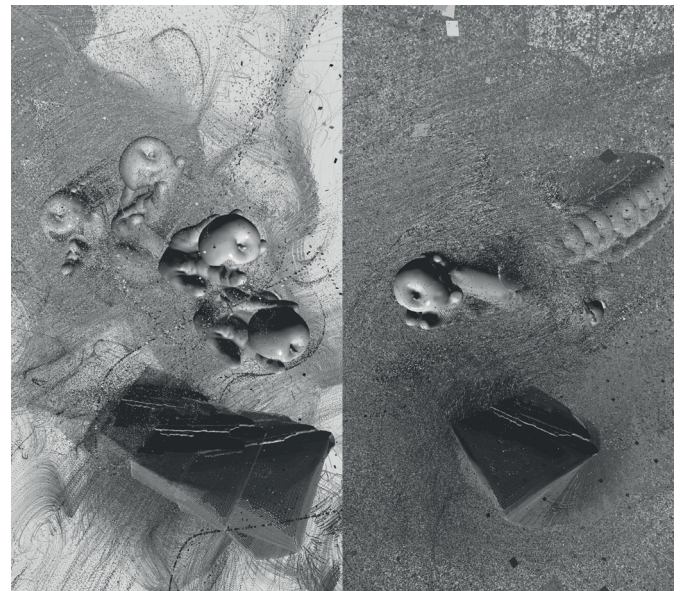
As a formal element, the point-cloud was intriguing, because it was not figurative: its animated form expands in space, and while some of its formal qualities could be directly edited or controlled, the form itself evades a single interpretation. For the exploration of this step, all color or texture information was discarded, leaving behind only the interplay between two elements: the geometry of 3D scanned

body fragments and the cloud of points – creating densities of lines, revealing, obscuring and occasionally hinting to, but never itself becoming a form. This allowed for another kind of intuitive association to enter our process, across different visual cultures and media. For Jiawen Wang, the results of this step shared elements of the *shān shuǐ* (山水) style of Chinese landscape painting:

The image stays between the tension of being formed and collapsed, solid and fragmented, full and empty. The digital medium helps us thus discover an instinct of creativity, unlimited space, and constant movement without boundary.

Additionally, another kind of movement was explored: a virtual camera moved within the software's 3D space, capturing 2D views of the emerging form. Even when the digital artifacts were still, the camera followed a cinematic pathway through and around them, therefore, imitating the effect of movement and capturing this into video. With multiple views overlaid, the creative possibilities for the production of 2D images were also explored. Here, movement was expressed as the palimpsest of multiple such moments, 3D views, which were captured sequentially in the digital space. (6)

How do we learn and explore digital media in order to promote a critical and insightful understanding?



(6) Creating the illusion of movement through the overlay of consequent image captures

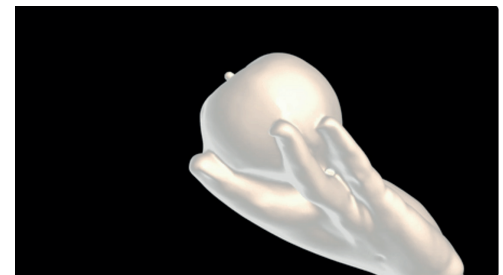
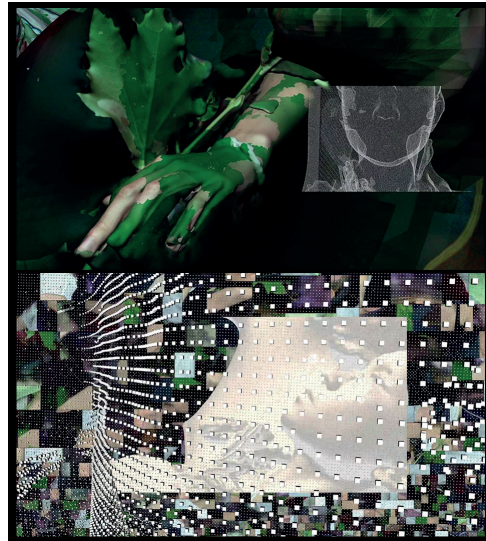
What kind of documentation could be chosen?

6. Considering forms of documentation

To capture the open and exploratory character of our process, we sought to define a documentation format that is neither explicit nor merely descriptive – like i.e. a tutorial would. Instead, it was important for us to leave space for interpretation, and to make documentation itself an aesthetic experience – as you can see in the two videos with different visual languages and media narratives.

The need to document arose quickly in the context of this project. On the one hand, this was because of the sheer volume of digital artifacts that we had started to assemble. These included not only 3D scans and generated forms but also 2D graphics and by-products of the scanning process, like the texture maps of the scanned geometries, which had their own distinct visual character and value. On the other hand, this project was never only an experiment for its own sake. In the overall spirit of the *InKüLe* project, our research was also understood as a precursor to sharing skills and illuminating creative possibilities for others – students and educators alike. (7-8)

For every part of our 3D scanning exploration, we selected an image or small video that signified a certain step of the process. This could be, for example, the close-up image of a 3D portrait, swarming point-clouds, or selected texture maps. Following a loosely linear order, this material was then brought together in a video collage, as a palimpsest of animated digital artifacts. Both images and videos were always saved with a transparent background, allowing each artifact / procedural step to visually blend and mingle with the previous one. (9)



(7-8) Image captures of video A documenting the first phase of experiments
View: www.inkuele.de/files/inkuele/journal_media/8.gif



(9) Video A: Documenting the first phase of the creative research focused on 3D scanning
www.inkuele.de/files/inkuele/journal_media/9.mp4



7. Acknowledging movement as a core element of the process (Phase 2)

Eventually, we came to realize that movement is the central tenet of our process:

We had started by training ourselves in the moves and pathways that allow a 3D scan to emerge. Then we sought to paraphrase and hack this scanning workflow, by adding movement to supposedly still bodies. And afterward, we explored the derived objects through the swarm movement of digitally-generated points. We let this realization drive our next steps. The environment of *TouchDesigner* remained in our workflow, but the handheld scanner was replaced by *Azure Kinect*, a device that could natively support the capture of volumetric movement.

At this point, three aspects of our previous work came together: The 3D capture of bodies in motion, the generative process that transcribes it, and the documentation video, all became part of one continuous workflow with only minimal post-production. This was achieved by connecting *Kinect's* live capture directly to *TouchDesigner*, and making the video recording from there.

On this basis, different variations of movement were explored, and the way that these were 'seen' by *Kinect*. For this experiment, just one camera was used, therefore, the resulting capture had only a limited 3D depth. This technical limitation, however, was transcribed into a creative approach. We focused on a frontal posture and loosely arranged our movements on the plane that was most exposed to *Kinect*. After some experimentation, we realized that a fluid, continuous movement was best captured by the camera. Moreover, by adapting the infrared sensor's depth, we could literally move in and out of sight, by translating our figures backwards and forwards, by slightly rotating or overlapping them. This playful revelation and occlusion would not have been possible through our previous scanning method, as it always needed to maintain a minimum, basic reference to the scanned form. (10)

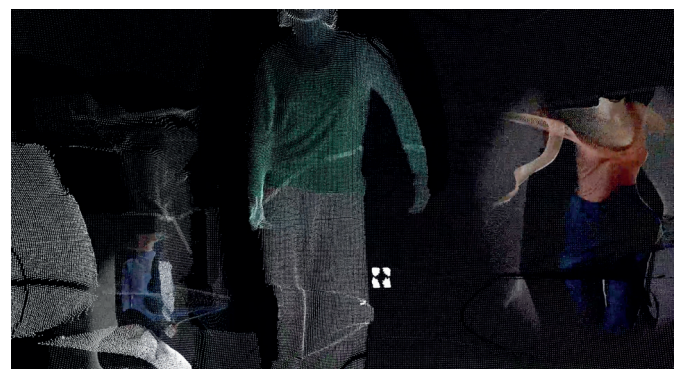


(10–11) Image captures of video B, documenting the second phase of experiments
View: www.inkuele.de/files/inkuele/journal_media/11.gif

In parallel, the formal feature of generative point-clouds from our previous exploration was maintained, seeking to form a common thread in our research. The point-clouds were this time applied to the scanned figures in the form of isometric lines. In this way, the figures became visible only through the arrangement of points, like a three-dimensional map. Using *Kinect's* RGB camera, the color information of each such point was displayed, allowing some of the original texture of bodies and garments to be transferred to the abstract, digital realm. When the movements were smooth and fluid, the points would simply flow along them. When they became faster or more intense, however, a noise deformation was applied on the point-lines, thereby folding and twirling the moving form in space, until it would completely disappear. (11)

The result is a hybrid kind of gesture, rising from the interplay of movement and code. Set in an abstract background, the body itself became a figure in-between: emerging through the point-cloud and transforming into a landscape or abstract field. The final video documentation of this second phase combined a series of such experiments into one abstract choreography of points and fluid, transcending bodies. (12)

The result is a hybrid kind of gesture, rising from the interplay of movement and code.



(10–11) Video B: Documenting the second phase of the creative research focused on volumetric capture
View: www.inkuele.de/files/inkuele/journal_media/12.mp4

8. Reflecting and distilling the process

As a whole, the project was driven by a desire not to limit oneself to the medium's niche, but to 'hack' its technological efficiency through creative curiosity and artistic intention. To capture the open and exploratory character of this process, a documentation format was established that consciously leaves space for interpretation and makes the documentation itself part of an aesthetic experience. Considered from the perspective of experimental media didactics, two pairs of qualities can be featured:

Associative & process-driven

While none of the media applied in our process was explicitly novel, the current state of 3D scanning technologies is rapidly evolving, making the critical reflection of the emerging technical possibilities all the more important. Meanwhile, many of these new digital tools are developed for a specific goal or purpose and become available with this implementation already incorporated into their workflow. Yet, by predefining the workflow, they also determine a way of creating and thinking. In the context of design and artistic research, this needs to be critically questioned and meaningfully expanded. Open, conceptual, and process-oriented formats can greatly contribute to achieving such critical reflection.

In the case of the presented project, conceptual associations and aesthetic impulses became our guides, defining each next step of the journey. They bridged not only different themes but also different tools and technical applications, guiding our creative process through a palimpsest of digital media. By focusing on the broader processes of transcription, interpretation, and association, this conceptual approach allowed us to navigate and explore the possibilities of each consequent digital tool, yet not be defined by it. (13)

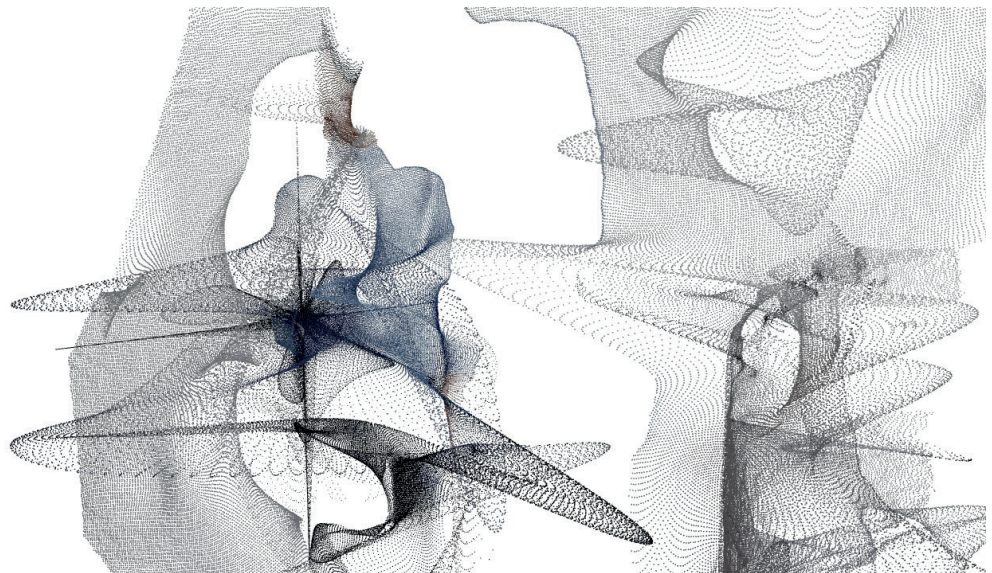
The diversity of media became a multiplicity of practice

Cross-media & transdisciplinary

The incorporation of different digital tools and the fluid transitions among them was a crucial element of this project. It had a great impact not only on the applied workflow but also on the mindset with which it was developed. As a start, it required a transdisciplinary set of skills to become a part of the project's development – combining 3D scanning with movement experimentation and generative art. When paired with a conceptual and process-driven approach, the diversity of media became a multiplicity of practice, opening up a versatile space for experimentation and inspiring connections between different creative fields.

Meanwhile, the tools themselves are not neutral but informed each time by a specific context and communities of practice. The used software, *TouchDesigner*, can serve as an example in this case. As a digital tool, it was certainly important, allowing the real-time generation and control of a complex, three-dimensional form. In theory, however, any other software/programming language could be used, as long as it supports a similar workflow. In retrospect, far more important is the way that the specific software is currently used in the context of our university: Audio-visual performances, which fuse the creation of analog and electronic music with the creation of computer-generated graphics. This is a community that already fosters transdisciplinary collaborations, and to which we consciously chose to relate, as a part of the *InKüLe* project's exploration of hybrid, artistic/educational formats.

Considering cross-media, artistic exploration as a unified field of experience.



(13) Figure dissolving into point-clouds



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