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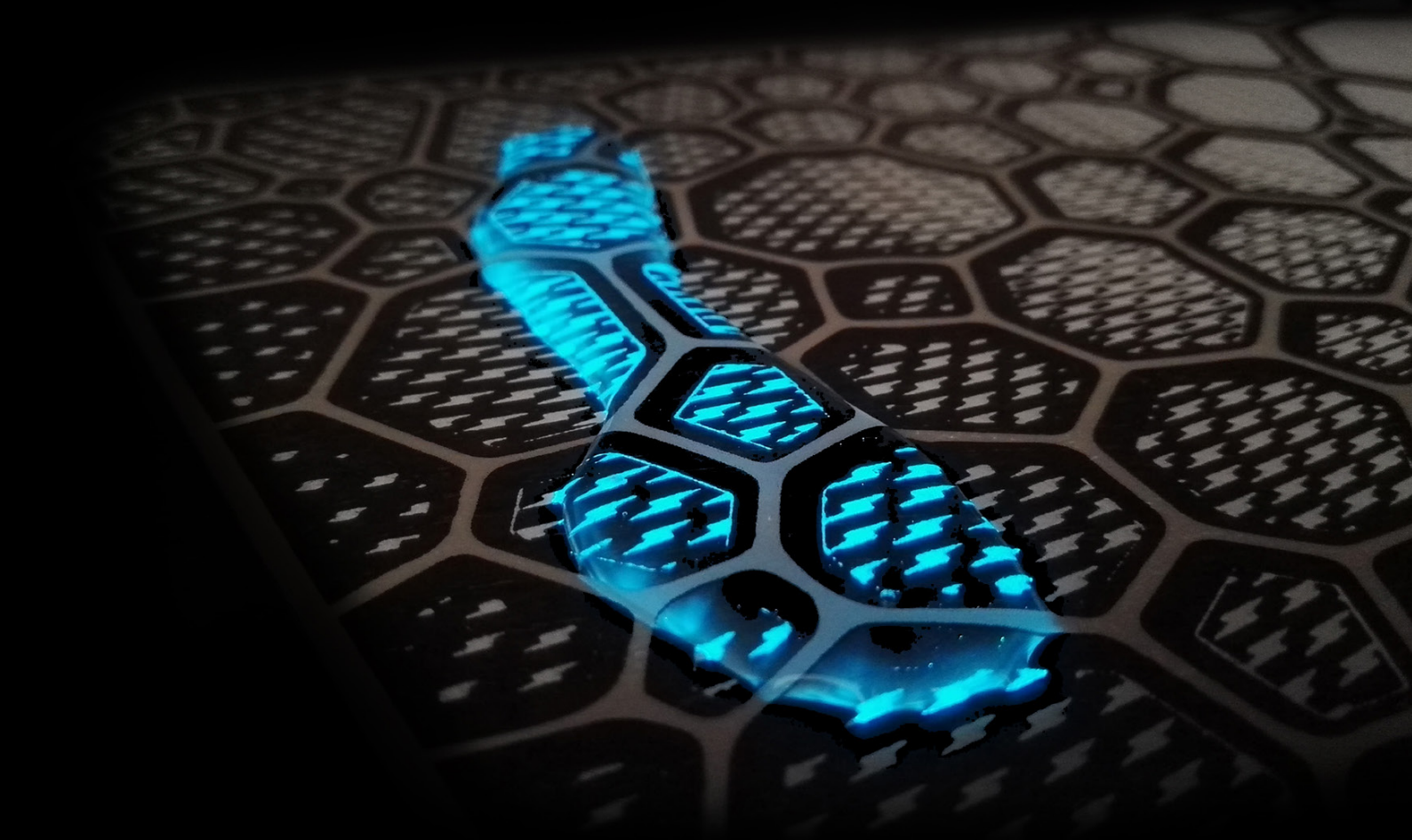

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Textile Choreographies: Bridging Physical and Digital Domains in the Context of Architectural Design

Marina Castán, Royal College of Art (RCA)

Daniel Suárez, Berlin University of Arts (UdK)

Keywords
Textiles Choreographies;
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Physical-Digital;

Abstract

This paper addresses the topic of material engagement in the context of textiles and architectural design. Our aim is to propose an integrative interface based on elastic and non-elastic textile materials that uses motion capture devices as tool to translate physical performances into a digital workflow. It is an attempt to embed the material at the early stage of the design process in order to have a better understanding of how such material behaves by identifying its nuanced expressions.

Exploring the material performance suggests a more integrative design process that extends beyond digital simulation of the material by understanding real-time performance. This performative process, enables the designer(s) to creatively interact with the material, manipulate it, perceive its logic, eventually transform it and ultimately fabricate it.

Introduction

The Role of Movement as a Matter of Design

For Latour (2005), materials have their own agency regardless of the maker. They behave in particular ways and hold an involuntary agency that escapes certain forms of control. Textiles can be understood as adaptive and responsive materials that can embed a surface or a volume (such as clothes). These qualities make them different from other materials that are hard and possess little elasticity. However, the pliable property of textiles is also what constrains them, as it is not possible to achieve a stable textile structure.

The performativity of textiles is connected with the idea of transformation, of the notion that something continues to develp in action (see Fig. 1). At the same time, the body works as an agent that triggers the movement of textile. In this sense, we can say that the textile amplifies the body action by materializing the echoes of the movement.

Fig 1. Visualization of one action echoed in time. Transformation is in continuous development.

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The idea of material as movement is not new. Several projects exist that address the topic of movement as material of designing interactive products or services (Svanæs; Schiphorst & Andersen; Jacucci et al.; Klooster & Overbeeke; Djajadiningrat et al.; Hummels et al.; Jensen; Larssen et al.; Fogtmann et al.; Antle et al.; Loke & Robertson; Ross & Wensveen; Wilde; Schiphorst; as cited in Loke & Robertson, 2011). According to Loke & Robertson (2011) such approaches include the use of the body to understand movement and communicate ideas, findings and to explore and evalute design concepts.

Our goal, however, is not to gain a bodily understanding of movement but to discover new spatial qualities when textiles are coupled with body movement. With the capacity to perform, textiles hold qualities of temporality that are transient, dynamic, and kinetic. As such, textiles can create architectural spaces that can be inhabited as they express a tactile spatial awareness shaped through the digital.

The value of movement in textiles also has to do with their capacity to adapt, to fold, or to create volume and shapes. This value is connected to the idea of textiles as a formless surface, as a shapeless material, that can become a structure as body movement gives form to the textile.

Considering Franz Erhard Walther's textile installations or Loïe Fuller performances, some evidence suggests that textiles can embed three-dimensional and spatial qualities through the body movement (Salter, as cited in Vallgårda, 2013).

Our research explores the spatial qualities of textiles to show how they might unfold a new kind of spatial expressions that has the potential to be adopted in architectural design. We propose a new method inspired by improvisational dance techniques, with the aim of suggesting new spatial expressions.

Bridging Physical and Virtual Domains Through Real Time Performance

Our method can be defined as a set of actions inspired in improvisation dance, motion capture and architecture computational design that provide us with both theoretic and practical ground from where to rethink both the textile design and architecture discipline. Loke & Robertson (2011) found that 'there is an interest in methods that focus on the felt experience or first-person perspective that are inspired by dance, performance or somatics'. Kirsch, 'argued that by exploring how we think through things, designs may draw upon our embodied, distributed, and situated cognition, and our 'physical-digital coordination' (in Hansen & Morrison, 2014, p. 29)

We started this practice-based investigation by engaging with textiles through body movement performances. The elastic textile neoprene (Fig 2.) works as a skin that embodies a shape, allowing for closer body interaction. We define this behavior as a skin structure. This textile works better when it is attached to a part of the body since its heaviness and stretchable properties tend to adapt to a surface. In exploring this textile, we sewed the edges of the piece of textile to create a sleeve for the arms to pass through, as we wanted to explore the choreography in groups of two people in order to grow in space.

Fig 2. Elastic textile neoprene

The lightweight textile polyester (Fig 3.), however, expands volume around the body, allowing for body interaction, which we define as a shell structure. This textile demands non-attachment to the body position, as it has the property to fill itself with air while moving around the body. Thus, it becomes more expressive when you hold it with your hands.

There are other similar methods described by researchers from different fields. Wilde (2010) describes a body-centric approach that places embodied experiences before language to propose a different kind of engagement with our bodies through a wearable device. Krish (2010) uses the body as a physical thinking tool.

Fig 3. Lightweight textile polyester

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Fig 4. Marcel Duchamp's Nude Descending a Staircase No. 2 (1912). Photograph by unknow.

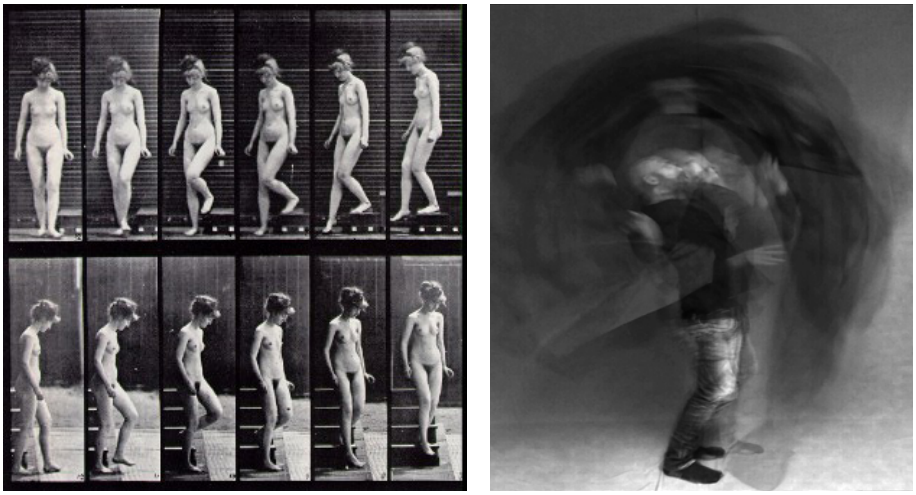

Fig 5. Eadweard Muybridge's Descending Stairs and Turning Around (left, photograph by unknown) compared to our own series of superposed frames revealing a hidden spatial textile-body movement (right).

Whilst Klemmer, Hartmann &Takayama (2006) investigate the role of the body in shaping human experience. In our case, the value of using the body within the design process lies on its capacity to perform movement and to express gestures in a very meaningful way in terms of form.

That potential of the body to express and to sketch forms in the space has been widely investigated by choreographers and architects as a way to inform their design processes respectively (Stathopoulou, 2011); Forsythe, Choreographic Objects, n.d.). However, little has been said about the potential of using textiles and the body in movement to inform an architectural form. Our findings suggest that each textile needs a different position in relation to the body in order to move and to express its spatial qualities (Fig 4. & Fig 5.).

Fig 6. Currently available 3D animation software allows us to echo action over time, hold it, and reproduce it as one single movement. As in Duchamp´s artwork, (Fig 4.) we attempt to depict the body in action.

Fig 7. Dancers interacting with the elastic textile neoprene.

Fig 8. Dancer interacting with the lightweight textile polyester.

Reflections on the Experiments from the First and Third Person Perspective

The value of using mixed perspectives within the design process has been acknowledged and defined by Smeenk, Tomico & van Turnhout (2016) as a novel framework for design that allows designers to use their own experience as a way to support the design process. We conducted a series of four iterations alternating between the first and third-person perspectives (Fig 9. & 10.) with the aim of understanding and revealing the architectural qualities of the textile-body performances. We understand the textile and the body as systems whereby both negotiate between each other.

Fig 9. A sequence of the first-person perspective.

As experts on body movement, we invited dancers to interact with textile materials through improvisational dance performances (Fig 6., 7. & 8). From their perspective, performing with a textile held or attached to them, makes them move differently as if they were not holding it. The qualities of the textiles such as elasticity, lightweight or pliability shape the way the body moves while at the same time, the textile mediates through the body when the latter inhabits the textile and creates a whole unit. As such, we define this interplay between the agenciality of the material and the agencialtiy of the body as a textile-body schema.

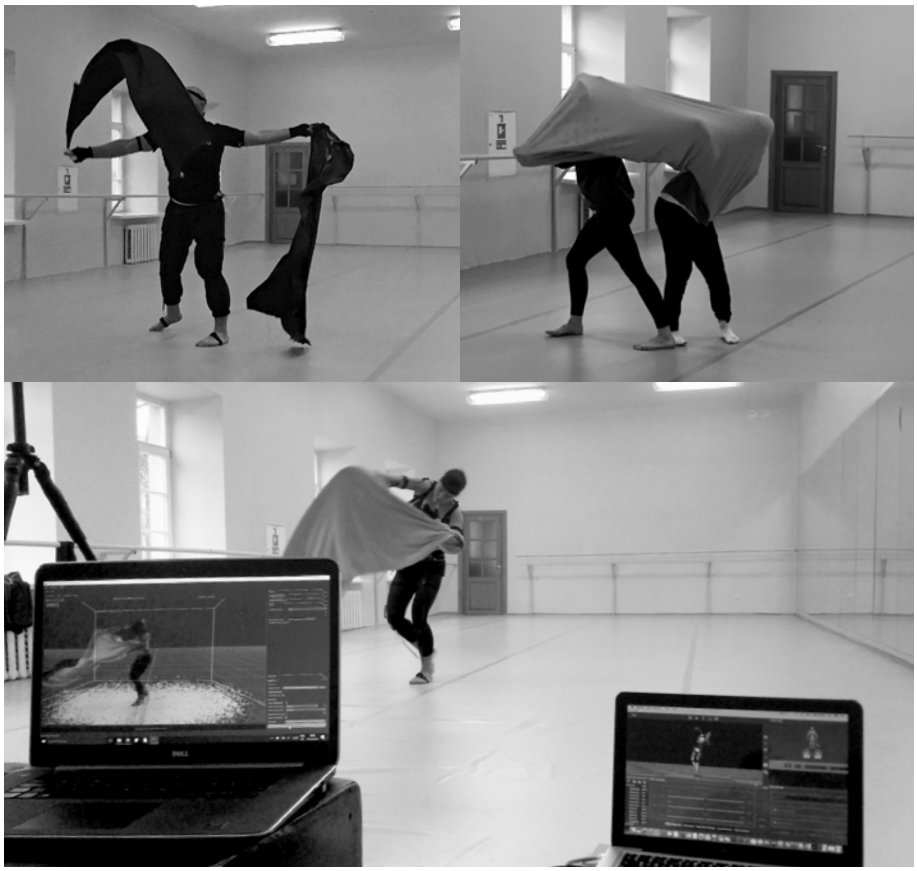

Fig 10. A sequence of the third-person perspective. Dancers interacting with both elastic and non-elastic textiles while being captured by the Kinect sensor.

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Reflections on the Architectural Implications of the Textile-Body Schema

The choreographic experiments we carried out showed the potential of new material expressions revealing the three-dimensional spatial qualities of textiles arised from the textile-body schema. We strive to provide a digital toolset for designers to appropriate themselves of any physical body-textile context for digital design and investigate which spatial expressions could potentially emerge.

Within our workflow (Fig 11.) we work with a dematerialized textile-body in the form of a tiny particle matrix (Salazar, 2015) that can be transformed into digital architectural explorations (Fig 12.). Our set-up blends motion capture techniques of body-textile schema choreographies with digital modelling tools to facilitate fluent interaction across physical and digital realms (Gannon, 2014).

We can engage physicallly and digitally with textile material at the begining of the design process, generating creative feedback between our digital creation and our physical inputs in form of body-textile motion. It presents the opportunity to explore possible spatial implications of the performed actions by linking a rational digital design process to a more embodied, organic and intuitive approach (Fig 13.)

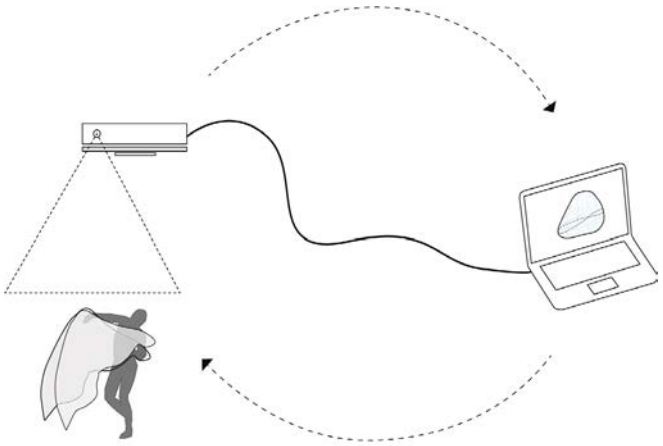

Fig 11. Motion capture set-up includes interface device mainly featured in the entertainment industry. The Kinect is used as a markerless sensor to translate motion into digital information.

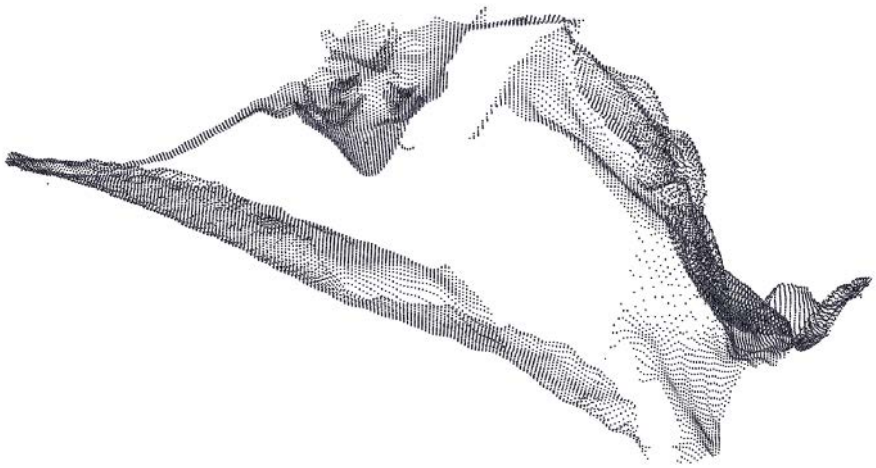

Fig 12. Data captured in the form of a point cloud (PC).

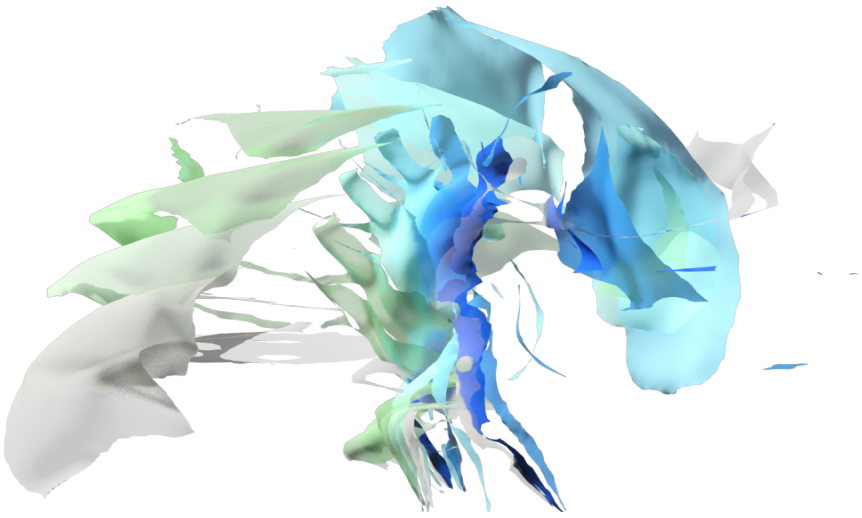

Fig 13. Digital visualisation of the movement echoed in one single frame.

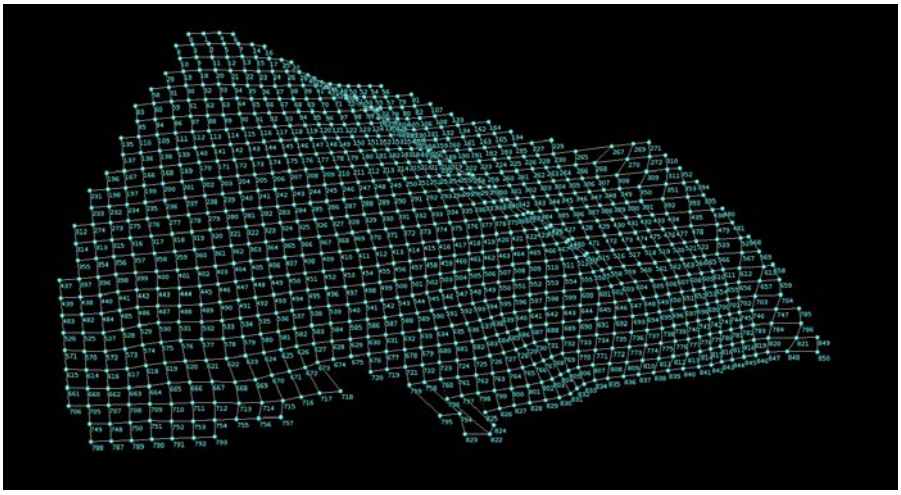

Fig 14. Point Cloud mesh obtained with Kinect and imported in SideFX Houdini. Digital information is manipulated to visualise textile-body expressions and analyse (right) them looking for architectural implications (below).

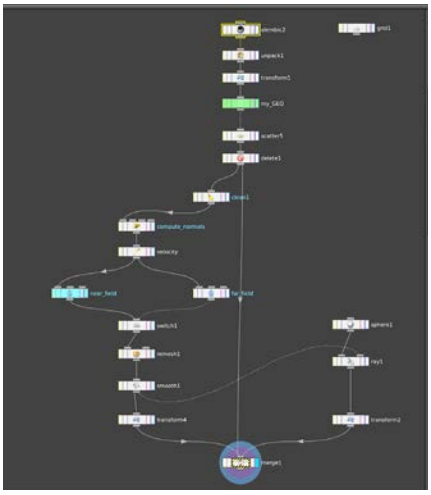

Fig 15. Houdini procedural pipeline defined to digitally model with the recorded data .

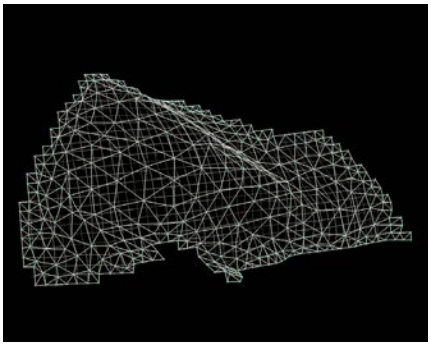

Fig 16. Original PCD-mesh parametrised with new scattered points.

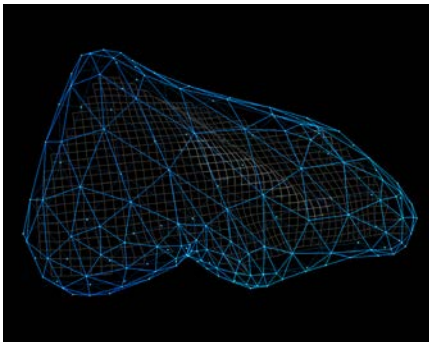

Fig 17. Volumetric modelling processes.

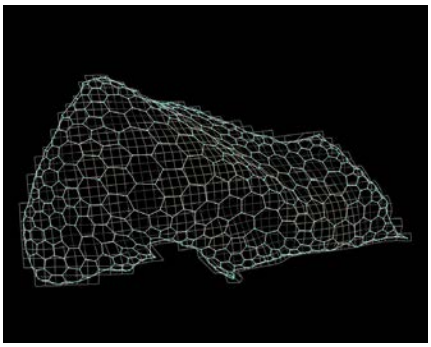

Fig 18. Retopology strategies.

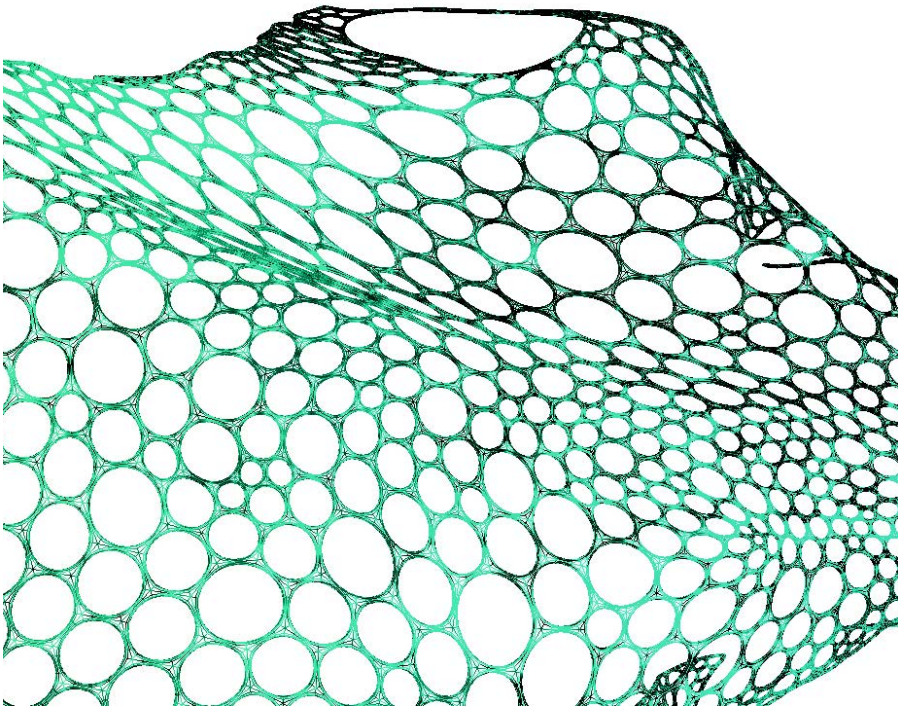

Fig 19. Retopologised mesh.

In the same way that textiles interact with the body in a specific manner, a particular digital technique needs to be defined in order to use the data as a matter of design. Procedural animation software SideFX Houdini offers the possibility to transform such motion data into volumetric or surface information. It produces a collection of morphologies whose generative conditions are explicitly linked to the performed textile-choreographies. This suggests that any action in the physical arena has a corresponding digital form that can be conveniently manipulated to make it architecturally meaningful.

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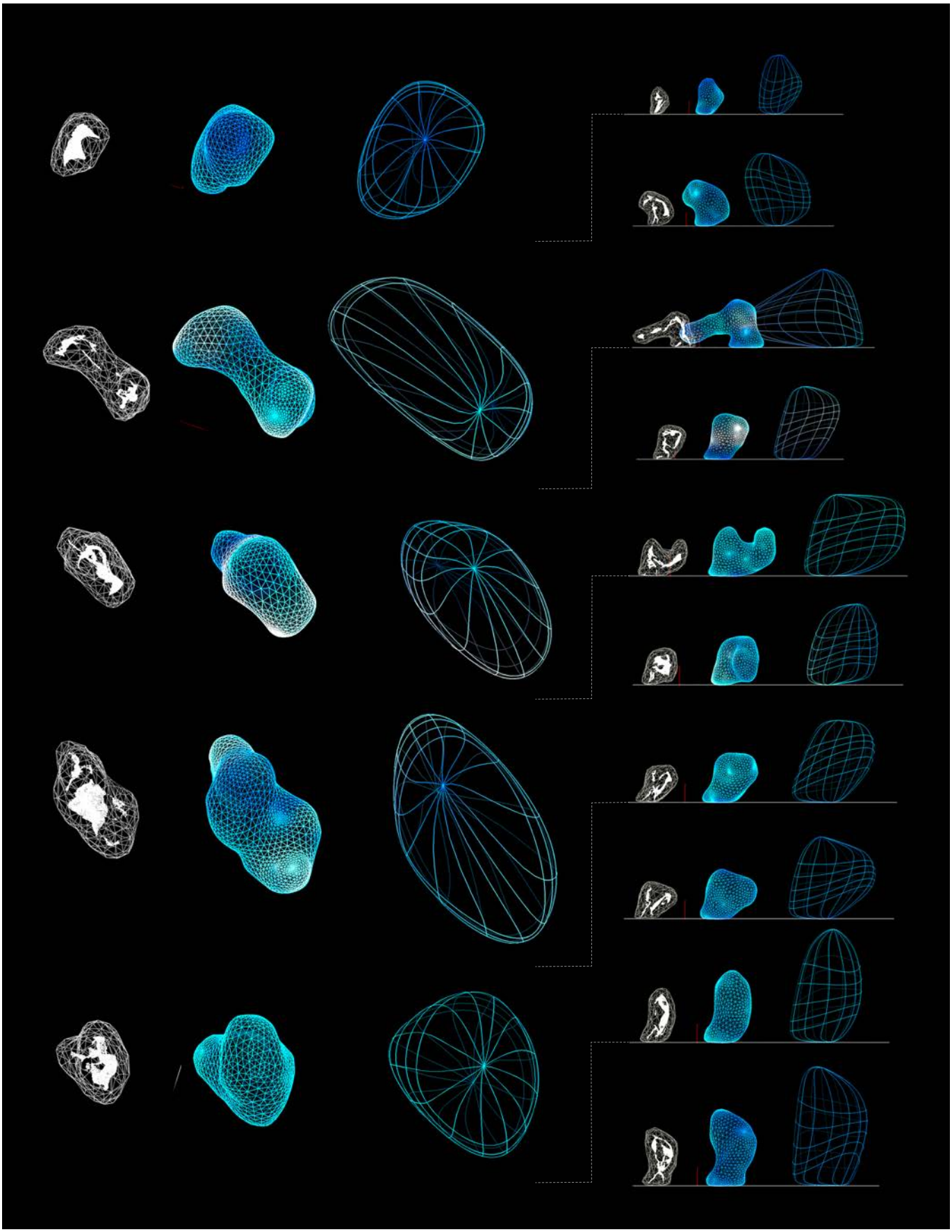

Fig 20. From physical action to digital morphogenesis. Textile-body performances captured are translated into a collection of morphologies by operating them at their near-field volumetric limits.

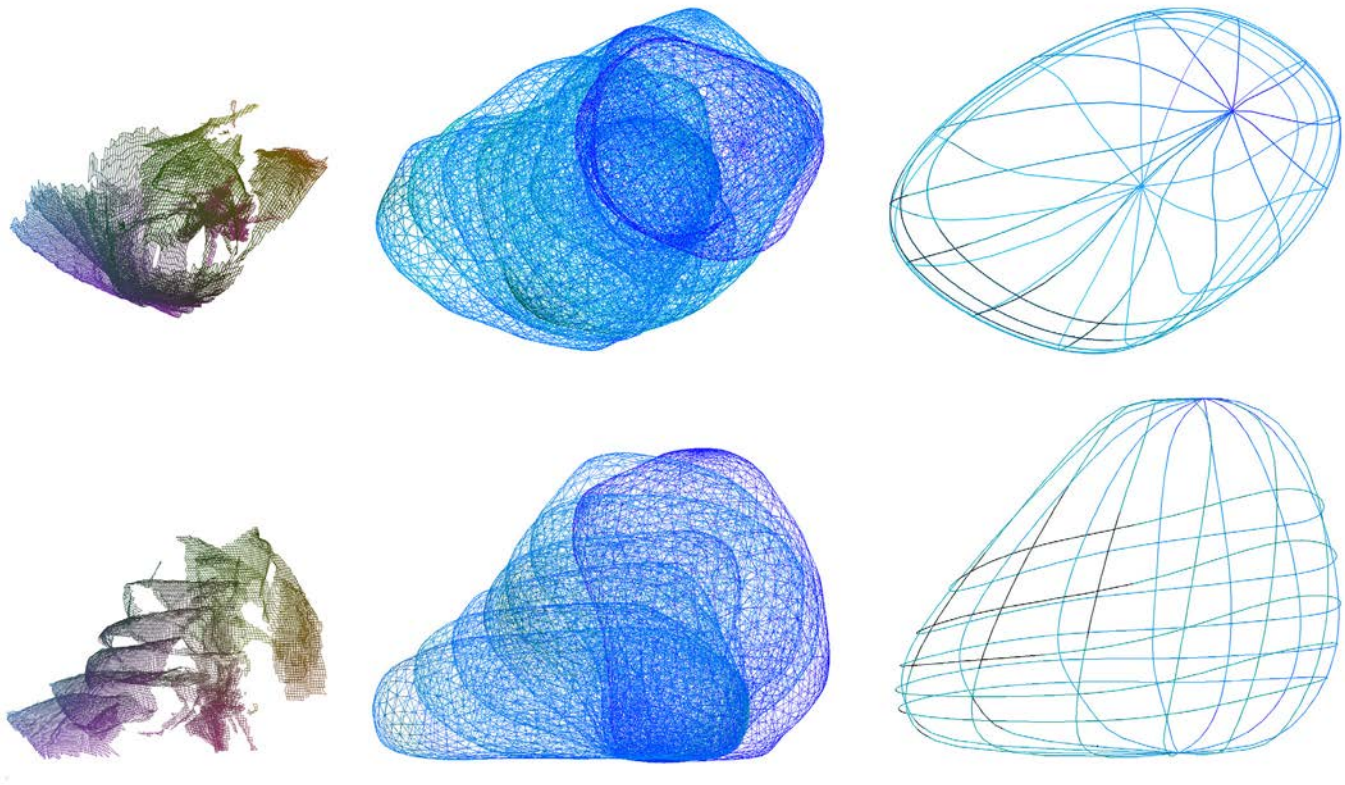

Fig 21. The proposed method presented in this paper offers the possibility to digitally shape not only a single moment of a particular action but a whole sequence of actions.

Discussion

We have presented an exploratory approach towards an architectural design that proposes an integrative interface, based on elastic and non-elastic textile materials, that uses a motion capture device as a tool to translate physical performances into the digital workflow.

The present approach offers a new perspective on how to engage with textile materials when combining the fields of textiles and architecture by introducing movement as an integral element of the design method. Other similar methods that use motion capture tools for the field of architecture and focuses on ‘the generation of form through movement and gestures’ (Hirschberg, Sayegh, Frühwirth & Zedlacher, (2006) do not contemplate the possibility of tracking the temporary and spatial qualities of textiles. We argue that our method fosters innovative understanding of textile spatial forms across physical and digital realms giving a voice to the material and the body while they collaborate in a form-giving process.

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Moreover, the choreographic experiments results validate the aforementioned described integrative interface to enact soft spaces that can be translated, analysed and shaped through the digital domain in order to generate data to be used as a matter of design. The outcomes are a series of digital morphologies that may inform a fabrication process for architectural design.

Additional research will provide the possibility of exploiting the textile choreographies by manipulating the surface of the textiles and their position in relation to the body. Textile design techniques such as pleating, draping and sewing can enrich textile expressions allowing for a more meaningful interaction, while we gain a deeper awareness of our physical actions through their digital analysis.

Further developments comprise of fine tuning the physical-digital toolset we describe in this paper and to contribute, consequently, to an explicit understanding of the architectural potentials that could be obtained, by digital means, from the textile-body schema. In this way, we intend to ultimately incorporate them into the process, in order to address a particular design motivation.

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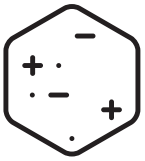

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