

# From scripts to scores – movement as an embodied material for digital interaction

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## Abstract

Today our environments are increasingly digitized and interactive. We generate data by the very way we move, from locative signals to accumulated traces outlining direction and intensity as well as computational and comparative information. These digital environments are currently being built, and ask us to decide which movements matter and which do not. In the design of movement-based digital interaction, movement becomes a material with which we may shape new expressions, functions and interactions. The borders and boundaries of decisions on movement that are set in binary code become a complex, meaning-making communication. I suggest that we need to visualize movement data together with movement expertise in order to harness an agency in movement itself, namely the kinesthetic, embodied sensation of movement as well as the relational ways we may move with data. I discuss several projects whereby code and the conceptualization of movement are explored jointly. The aim of discussing such processes is to find ways to tease out the rich communicative potential of full-body movement for digital interactions by enabling an explorative, creative engagement with movement data and, in turn, movement.

## Keywords

Full-body Movement, Materialization, Digital Interaction, Design, Communication, Boundaries, Scripts, Scores.

## Introduction

Today our everyday physical movements are increasingly tracked and traced by a variety of sensors, from simple signals registering time and location to accumulative records which in turn may feed back information. Software activates and instigates the dynamics between these: movement and sensors. This dynamic led Thrift to argue that today “software quite literally conditions existence” [22]. In particular, software requires a critical view on digital media in relation to physical movement. Pre-calibrated sensors can now track movement qualities such as direction and dynamics, posture and pace. Consequently, the scope of movement data is extending from registering the location of a person to tracking and analysing movements of the full human figure in real time [11].



Figure 1. Performing our everyday life entails navigating invisible or immaterial structures and digital environments, where we physically have to explore what is ‘seen’ © Lise Amy Hansen

The main concern for this paper is the materialization processes where there are choices made as to which movements are made to matter. In other words, how physical movement is conceptualised in order to be processed by a digital medium. I am interested in the decisions made when writing such inscriptions, as this is about the laying down, in written form, a human and machine readable signal or representation of human movement. As Wood observes:

A facet of digital technology, and of technology more generally, is not that they separate us from the world, but rather that they create within it distinct kinds of engagements [24].

We now live increasingly influenced by digital media. It is critical to understand the nature of movement data and the ways in which the data is set as code and how this code runs as software. As Kitchin observes, software actively shape “people’s daily interactions and transactions, and mediate all manner of practices in entertainment, communication, and mobilities” [17]. These issues are of particular importance now, as the role of software is not settled:

We are still laying down the infrastructure, structures and conventions, the uses, functions and ways of expression and communication [4].

Today programmers may alter the code and procedures for how we communicate; they can rewrite and implement a software’s functions and effects. New code can be written in ways that affect the actions and behaviors of many. New movement may also impact on the code devised.

## Movement material

Full-body movement is embodied in the sense that it requires a body. Thus it is cultural and conditioned, relational and gendered, lived and performed. It is also expertly perceived by others, acted upon and referred to. As a visual phenomena, full-body movement can be registered by digital media, typically to pre-set criteria. In effect, movement can be made digital in the sense that movement information is registered, calculated and stored disconnected from a specific body and thereby disconnected from a specific time and specific place.

Additionally, if we are to pick up such abstracted digital content referring to movement data, it must again be materialized. Following Blanchette, it must in some way or other be re-substantiated:

However immaterial [digital information] might appear, information cannot exist outside of given instantiations in material forms [4].

So how may we get to grips with digital movement material? Creative projects that explore movement and digital media are predominantly collaborative and rely on the collaborators' ability to see material, expressive and functional possibilities in the fields of others. In order for movement-based interaction to explore kinesthetic agency and physical developments in movement, one needs to understand not only the way we currently move, but also the potential for change and repetition as well as subversion.

Berry has argued that in order to understand computation, we do not need to understand the writing of code alone but to analyze the different layers that make the code become software [3]. This distinction is relevant because of the way we generate data is by way of software. The moving body as a communicative source scripted via code provides a rich and complex communication potential. Movement material has been abstracted and then re-presented digitally. We need to be aware of the many pivotal decision we take when we choose which data to pull up, which sections of the body to foreground, and which speeds of which limbs to trace etc.

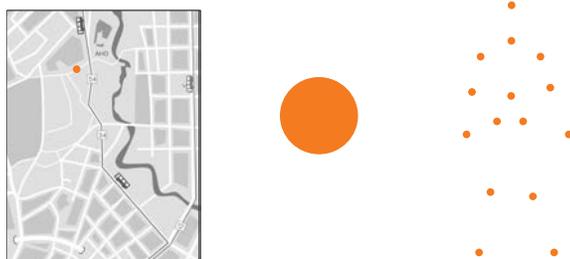


Figure 2. Granulation of movement data from the location of a singular dot marking presence in the world, to movement of a dot to several dots representing the body as a complex system  
© Lise Amy Hansen

These full-body movement centred perspectives are central considerations because data has no *necessary* form [9]. So for instance, the notion of age may be visually present in the way we move, or gender or culture and therefore may also be presented in the data. But if we do not look for ways of representing this as we work with the data, then we simply side step the issue of say, age and gender. Yet, we may write code based on assumptions on the intensity, the variety or the ability we have to move that in turn do hinge on notions such as age or gender or culture. Thus, a critical understating of how movement is formed is central for writing code that is based on or activated by movement.

## Materializing movement

Motivated by the richness of interpersonal non-verbal communication, I am interested in exploring the way we move with, for and through movement data. My interest extends to finding ways to identify the switches and glitches in what is often envisaged as a seamless digital realm, whereby averages become the guiding measurement. The abstract borders and boundaries in binary communication quickly become physical and personal as we navigate, appropriate and communicate based on algorithms (see Figure 1). An everyday example of this is the automatic voice recorder: we change our voice according to how we think we might be understood by the identifying script running the automatic voice and we usually adopt a tone of voice that we would rarely use to address a person. Another example is the technology behind an automatic door. Here a person is recognized by a system that renders the movement (a person walking into a given area) into code, which then instructs machinery to open the door. This simplicity however is at odds with the sophisticated ways we leverage our movements to communicate intent and ability, such as whether we intend to enter the building or just pass by, or whether we're in a hurry or would need more time to enter. Thus intent and ability may partly be accounted for by considering the two movement qualities direction and speed.

A body typically has 240 moveable joints, each with six degrees of freedom, yielding 1380 in total. Thus we may quickly generate a wealth of information and the selection or granularity of this data is central (see Figure 2). Yet, higher precision and more detail may not give the kind of information that communicates nor provide the tools with which to work with or understand movement. New media is being developed towards an increased resolution, precision and capacity, yet there is a need to critically discuss how today's available technology is applied and the possibilities that come from how these new media already are applied or could be developed. When we find new ways to construe movement, I argue that we need to be aware of how we categorize and apply it, in the sense that when we alter this digital media, we may move *through* and not just *for* the media.

## Switches & glitches

The ‘on-off’ character of digital information can take any form in the sense that digital files are indistinguishable whether they containing data from a movement phrase, a text document or an image. The digital properties of such media content come from the software used to create, edit, present and access this content [18]. In other words, we create the material simultaneously as we are figuring out how to create with it.

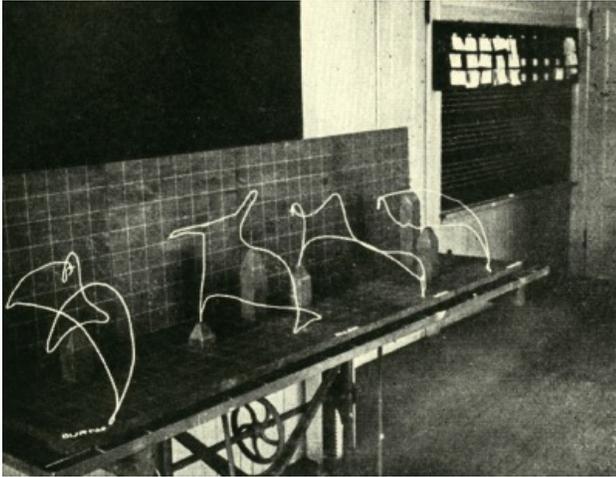


Figure 3. Gilbreths’ movement studies of factory workers’ routines in order to find unnecessary movements (Frank and Lillian Gilbreth, untitled motion models, c. 1913–14) Gilbreth Collection, National Museum of American History, Smithsonian Institution, Washington D.C.

### Temporal data: new traces

When the Gilbreths used light photography inventively they were able to show a trace of actual movement abstracted from the body and traced over time. These traces were reduced to a still (see Figure 3). Now computation enables us to devise an added layer of information, whereby registered movement may also be calculated, compared or connected and again be made visible in near real-time.

Computational tools tend to focus on a detailed mapping, however, as Sheets-Johnstone writes, a description of an object’s positions is not a description of movement [21]. Similarly, a music score does not contain information about the mechanisms or processes of performing beyond the ‘formal characteristics’ specifying the music to be realised [20]. A key question arises: What characteristics then do we need to find ways to represent in movement data?

Farnell points to a similar critique of representing a body when she asks Anthropology to consider the moving body, because ‘the way human agency works is in terms of the signifying enactments of moving persons’ [8]. In other words, the communicative qualities reflecting human agency occur temporally. This provides an impetus for the abstraction and conceptualization of these qualities also to be considered and represented temporally.

Dynamic visuals present time-based data the opportunity to be represented temporally and as there are aspects that otherwise would be lost in representing movement. We can now create expressions and functions around or for the way we *actually* move, rather than the way we *think* we would move.

### Elusive data: WYSIWYG

We cannot perceive digital content as data is stored beyond our direct perception “below the ‘threshold’ of representation itself” [12]. This emphasizes the importance of choosing the relevant data or appropriate parameters for computers to compute or sensors to sense.

Exploring the concept of WYSIWYG (what you see is what you get), the *Synchronous Objects*<sup>1</sup> project addressed the notion of communicating potential of a choreographic idea, specifically away from the body. The sheer variety of representation developed showed the complexity of representing potential of movement. The resulting dynamic visuals of movement data are sketches and as such can be seen as a material anchor [14]. Arvola suggests that for complex creative concepts and their implications, such sketches can hold the design in place and make it ‘stable enough to reason about’ [1]. Following this logic, I argue that a material approach to movement data shifts the focus in a design process from objects to the communicative agency of our bodies. This is a meaning-making activity that has seen limited research to date.

By focusing on the dynamics of movement as it is expressed over time, shifts the focus, from comparing it or building a general systems of signification, to exploring how we may generate an understanding of movement through movement data [e.g. 2].

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<sup>1</sup> <http://synchronousobjects.osu.edu/>

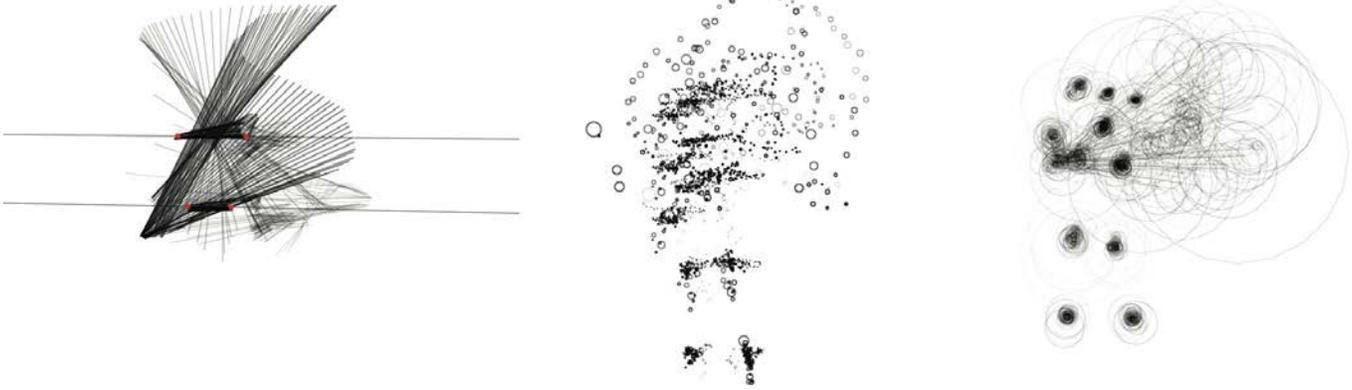


Figure 4. The *Sync* tool allows for movement data to be visualised live or repeatedly through recorded data. In this collage, a hand wave is visualised in three different ways. © Lise Amy Hansen

### Corporeal data: *Sync*

I have investigated this potential through the co-design of *Sync*, a digital application, a tool that allows designers to visualize movement data [10]. *Sync* was developed with Hellicar&Lewis<sup>2</sup> to explore how corporeal qualities and dynamics in movement data could be presented in dynamic visualizations. (see Figure 4). *Sync* gives near real-time visualizations of movement, with a comparative video feed of the movement. In this way, one may see which data was captured in comparison to the performed movement. We get access to the ways in which movement data is different from physical movement. ‘We always see less than is there [...] We also always see more than is there’ [5].

*Sync* currently draws on the data from Microsoft’s *Kinect* and makes no distinction between whether the movement or the rate of change occurs on the x, y or z plane. Equally, it identifies where there is less or little movement. It has an option to show history, which is a visual trace of a point. Thus with little movement, one gets a build up of visuals, creating a denser mark the longer there is stillness.

The *Kinect* software uses depth data, i.e. a body outline to calculate, identify and track the various points to make up a human skeleton. However, as has been pointed out by several in performance studies [e.g. 25], the representation is not a skeleton in the sense that it is calculated based on information about how a body’s outline changes – it does not act the way a skeleton acts.

There are further implications for creative practice here in that *Sync*’s dynamic visuals can be seen as a mapping of variety and variation, whereby they inform design briefs for future designs. Drawing on Cosgrove, ‘The map has a powerful recursive quality; it acts as a memory device that is also the basis for projective action’ [7]. I mention these concerns because the implications of movement data being different to movement means there are advantages to articulating the agency of each, rather than optimizing one to the other [e.g. 22].

<sup>2</sup> <http://www.hellicarandlewis.com/>

### From scripts to scores

Approaching digital movement as described above shifts the role of movement in creative processes of writing code from testing to co-designing. Or rather, the approach shifts movement from an ‘end-user’ role to a creative materials centred one, manifested in emerging material in and of itself.

### Relational applications

Discussing software and materiality, Thrift points to the normative effect whereby software guides and guides:

“human embodied experience – that experience which is still so often considered to be a constant even as surfaces like screens and software have questioned its reach and meaning – is being decisively changed. Key human affordances are now being altered” [23].

In these challenges lie individual agency and freedom. When they are anchored in code running our interactive environments, we need to understand how to build on the way we move.

*ReacTickles*<sup>3</sup> is a suite of applications that uses touch, gesture and audio input to encourage interactive communication (see Figure 5). These applications were developed in an inclusive design lab, with the overarching goal to generate ideas for technology interfaces that could engage and motivate people with poor verbal communication abilities, such as children on the autistic spectrum. Co-creating these various tools meant that important parameters, such as access and consistency, were identified as vital parameters in the design for engagement (as opposed to spectacle or immersiveness): “The simplicity and predictability of the application give the guests confidence that every action, however tentative, could be rewarded” [15].

<sup>3</sup> [somantics.org](http://somantics.org)

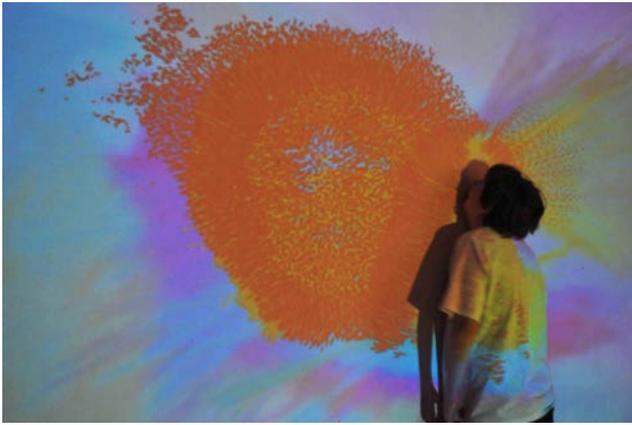


Figure 5. The Body Paint tool initiated an expansive variety of imaginative performances by the guests using their whole body movements and also clearly enjoying the calming sensory experience of the smoothing the projection wall © by kind permission Hellicar & Lewis

The project highlights that perception is not only about vision, but that it is also informed through our other senses as well as from the kinesthetic sensation derived from movement itself.

### Relational code

*The Reactor for Awareness in Motion (RAM) Dance Toolkit*<sup>4</sup> challenges the expertise of dancers as it extends their movement skills and the formalised practice of these through customisable visualisations. The toolkit provides visual information of how movement may be traced and the ways in which the scripted data can in turn generate new movements and new movement expressions. This is a creative coding toolkit which allows for the creation of a set of different environments called “scenes” for dancers, where movement data is visualised and is made available in real-time by a digital interpretant known as the “actor”.

The tool generates environments for enhancing ideas for dance and the variety of scenes provides comparison of how movement data can be played out, by way of scalable visuals or choice of couplings in the data, for instance. By teasing out ways to address variation in movement, by way of dynamic visualisations such as these mentioned, we may reconsider the role of movement in interactions and the body not only as a given and mapped object but as a sensate origin of action [8].

By exploring materialising processes - conceptually and practically - we may gain an understanding of what underlying motives are at play. As I have argued, this is important because with computational material, meaning is not a given – both the material itself and its meaning is continuously made.

<sup>4</sup> [http://interlab.ycam.jp/en/projects/ram/ram\\_dance\\_toolkit](http://interlab.ycam.jp/en/projects/ram/ram_dance_toolkit)

In a sense, then software is continuously re-scripted. Thrift writes of software as ‘a means of sustaining presence which we cannot access but which clearly has effects’ [24]. In order to understand how we shape and influence software, despite its inaccessibility in everyday life, we need language to address aspects, elements or qualities of software as well as tools to explore what is yet to be named or what may be addressed. This is particularly pertinent when it comes to movement, another phenomena resisting traditional descriptive modes such as the written word or through photography or film.

### Relational variables

With few conventions to rely on, there is a need to attend to what can change or what can be changed in regards to movement data and how it is applied through code. Exciting developments take the form of *Choreographic Coding Lab*<sup>5</sup> (CCL) focused on ‘translating aspects of choreography and dance into digital form and applying choreographic thinking by working with patterns, structures and movement through finding, generating and applying them. The results range from ‘prototypes for artworks to new plug-ins for working with dance related datasets’. The CCL format originates from *Motionbank*<sup>6</sup>, a research project of the Forsythe Company<sup>7</sup>.

The CCL, together with the examples above, *Sync*, *ReacTickles* and the *RAM Dance Toolkit*, provide an argument for a movement-sensitive approach to computer expertise. If new media is to truly draw on movement as a source of information and communication, then we need to find ways to communicate movement expertise. This is important, following Kirsh, as

we can interact with digital elements by gesturing and body movement, by manipulating everyday objects, and even by training brain activity to control interfaces. To understand the design principles of such a world requires that we become familiar with the ongoing developments in embodied, distributed, and situated cognition, and build closer relations to their research agenda [16].

### Everyday performance

In this paper I have outlined concerns and considerations of handling movement data a creative act. I argue, as No-land says, that

gestural routines of inscription yield a kinesthetic experience that is a resource in its own right, a resource of sensation capable of subverting institutions of inscriptions by promising new, unmarked material to record [18].

<sup>5</sup> [choreographiccoding.org](http://choreographiccoding.org)

<sup>6</sup> [motionbank.org](http://motionbank.org)

<sup>7</sup> [theforsythecompany.com](http://theforsythecompany.com)



Figure 6. By moving with the data and toying with the possible effect in the generated visuals whilst simultaneously being influenced by them, movement scripts can be acted out in real-time © Lise Amy Hansen

With real-time visualizing tools, temporal qualities may be viewed, identified and named as well as felt and experienced (see Figure 6). Today, we are being badly choreographed by digital media as we perform our everyday lives. If we are to understand what is at stake we need to not only look at the effect of current digital media, but to explore the material possibilities brought about by new digital media as this media is still pliable, and it is clearly still in the making. Through such a material approach, I suggest that it is possible to explore movement as a digital material and thus leverage our complex movement knowledge.

## Author Biography

Lise Amy Hansen is a Senior Researcher at The Oslo School of Architecture and Design (AHO) and a designer. She has a PhD in Interaction Design, an MA in Communication Art & Design, Royal College of Art, London and a BA (Hons) from Central Saint Martins (CSM), and has been a lecturer at CSM and AHO. Her research evolves around the role of movement as a material in digital interactions and how we may explore movement and an understanding of movement through design research.

This relates to both perception and performance, rather than allowing media alone to dictate or automate our movements. This development needs a critical approach, as Wood points out:

The numbers of technological interfaces that frame how we see the world are rapidly expanding their influence, and there are questions to be asked about who controls and creates those interfaces and for what reasons [23].

By exploring what is particular to full-body movement and what is particular to movement data, by way of digital tools, we may leverage the high resolution with which we perform and perceive movement and enable digital media to go from 'replacing reality to shaping reality' [6]. As Haraway proposes, by reflecting on where our seeing is located 'we might become answerable for what we learn how to see' [13].

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