THRESHOLDS: OBSERVATIONS ON MOTION CAPTURE

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Abstract

This paper theoretically situates research that explores motion capture data visualization using customized software tools such as MxCap.01. The value of software like MxCap.01 lies in its visualization capabilities including the ability to scale the re-presentation of the force, direction and intensity of movement but also do so within a temporal and emotive structuring.

Keywords: Animation, Dramaturgy, Motion Capture, MxCAP.01, Representation, Scale, Visualization.

Introduction

In many ways, the development of motion capture systems for biomechanics research in the first decade of the twenty-first century represents the technical pinnacle of the analysis of human movement begun over a century earlier by the pioneer photographers Étienne-Jules Marey and Eadweard Muybridge. As with these earlier studies, the motion capture suite is a unique framing system that mediates and modifies the way in which bodily movement is understood. The motion capture system approaches the same nexus faced by Marey and Muybridge; experiential and physiological data is graphically represented. This visual mediation cannot capture or represent every complex interaction and the experiential quality of movement. This perhaps explains why the graphic similitude of animated bodies in films and gaming possesses an uncanny disembodied quality. Thus, as with Marey's and Muybridge's two-dimensional studies, these systems have their own unique blind spots that delimit the quality of data 'between the frames'.

The representational accuracy of motion capture systems belies the fact that this data is extracted from its intended 'real world' context. There are two important mediating affects on the data. First, the system itself heavily influences the data one forms into information. This is because movement must accommodate the system. In this respect the requirement for the body to be 'suited up' is only one way in which the system modifies movement data. Together the technical specifications of the tracking devices, the spatial qualities of the suite and the lack of system 'portability' significantly reduce the capacity for this data to be truly situated. The second mediating affect is representational, where the lived, corporeality of embodied knowledge is folded into a visual re-presentation. Ironically, this 'knowledge of the body' is visually constructed to privilege what the eye sees. Accordingly, the technological and representational limits imposed on the body by the system not only affect data quality but also reduces the possibility of contextual feedback.

Decontextualized Data

There is a degree of conceptual equivalency with the decontextualization of the body in motion capture systems and the scientific methodology of inductive generalization. One of the key thinkers in Affect Theory, Brian Massumi, brings into question this use of the particular as evidence of the general because knowledge is based on objects alone and requires them to be extracted from the world [1]. The conceptual problem being that bodies are isolated from the context from which they emerge. This is important because Massumi, whose intellectual lineage reaches back to Spinoza through Bergson to Deleuze, sees the body less as something belonging to a discrete cognizant individual and more as the threshold being, both in the world and part of an individual. This notion is based on proprioception, which is defined as "the perception of the position and movements of the body" [2]. In reference to a range of separate scientific studies, Massumi argues that the independent functioning of proprioception from conscious thought means objects are simply the residual effect of the condition of being 'situated' in the world [3].

For Massumi, the shortcomings of scientific thought are revealed in the 'control', which operates through "closure and control" [4]. It is important to note that, as revealed in his essay *Too Blue*, Massumi has an aversion to the dominance of scientific thinking. However, the compelling aspect of his argument is that the emphasis on the object comes at the expense of a deeper knowledge of the contextual conditions of formation. The conceptual equivalency of the 'control' to the systemized isolation of the body suggests that this contextual estrangement ensures motion data is more simulated rather than situated. The issue created by the technical and representational mediation of motion capture data is that, like the scientific 'control', knowledge of the body requires the artificial extraction of the body from its context.

Massumi's argument does suggest that the extraction of movement from its context questions the claim that motion data is an authentic mapping of the moving body. The issues surrounding the decontextualization of the body are potentially exacerbated when this data is instrumentalized and used to design specific artifacts that 'solve' very particular design problems. This is not to say that the biomedical application of motion capture data is invalid, or that there are not cases where the data's veracity remains unquestioned. The argument being made is for an alternative mode of practice that appreciates and exploits the mediating aspects of motion capture technologies. In this sense there are many examples where the design of prosthetic objects or mimetic avatars maps data as if it were a natural re-presentation of the body in motion. Many prosthetic or mimetic design applications are obliged to make productive use of this data so that any ensuing mode of research or practice is geared towards ameliorating the mediating affects of the system. In doing so, the extent to which motion data can be claimed as an authentic basis for knowledge of the body must be questioned.

As previously observed, the representational translation of motion capture data in animation possesses an uncanny representational quality. This traces how the use of motion capture data is haunted by its technical and representational mediation. This is an issue with the instrumentalizing mindset, which places a premium on the data's validity by relegating the 'affects' of mediation. The supplementary use of interpolation and extrapolation not only
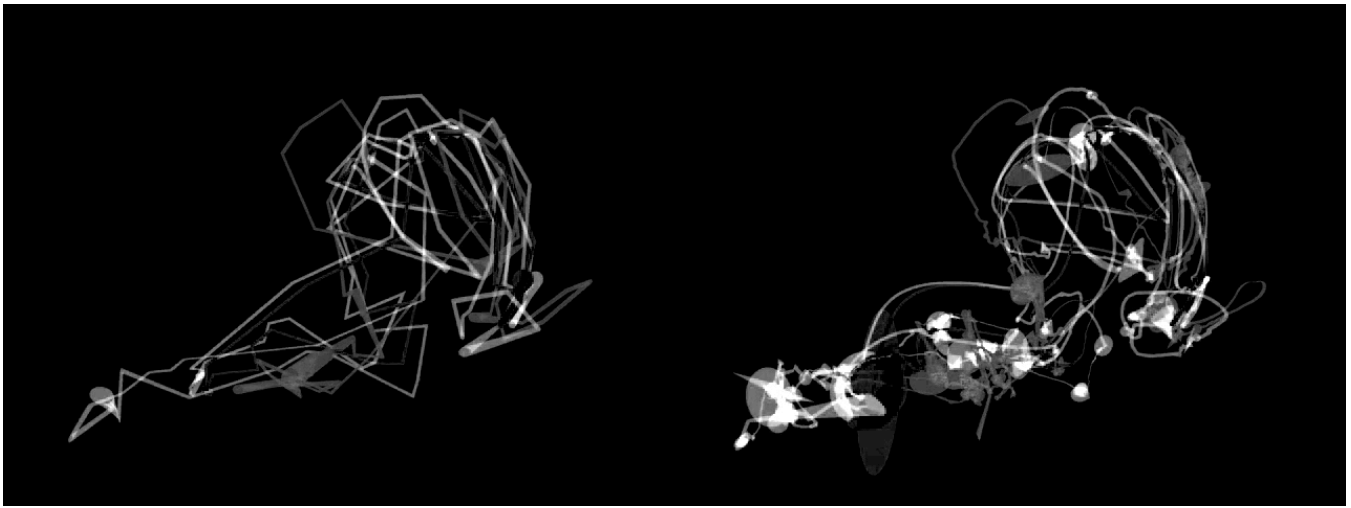
Fig. 1. Alternative Mx.CAP.01 Renderings of Mocap Data (© tranSTURM)

implicitly accepts the data's authenticity, but also deliberately applies these methods to 'overcome' this mediation.

Embracing the representational mediation found in motion visualization offers an alternative approach to the instrumentalization of motion data. This shift in the technology application of the drawn translation of data into information still enables the extraction and quantification of the body's kinesthetic knowledge and a revealing of the hidden aspects of movement. However, it also accepts the optical and graphic mediation of the data and a productive act that exceeds the simple problem-solution design paradigm. This questioning of the veracity of motion capture data exploits how the system re-presents embodied knowledge, and uses mediation to open an iterative mode of data feedback by which to develop new forms of physical expression. Importantly, the basis of this thinking is a conceptual openness to the way the mediation of the raw data can sponsor new modes of artistic practice.

Re-Drawing Movement

The interdisciplinary research group tranSTURM are exploring such non-conventional uses of motion capture data [5]. Central to this work is the development of a new digital software interface, MxCAP.01, which is a plug-in to the three-dimensional software Maya™ . Conceived as an interdisciplinary design visualisation tool and working almost in 'real time', the software is able to reconfigure the data from an optical motion capture suite [6]. The significant difference with MxCAP.01 is that it uncouples the data from its spatiotemporal location. This allows a re-visioning of movement data to generate new understandings of movement and forms of physical expression [fig.1]. This differs from most proprietary software interfaces, which effectively conform to the geo-temporal conventions underpinning the logic of the map. A second important difference with Mx.CAP.01 is that its functionality can be extended to incorporate other ways of reconfiguring data on an 'as needs' basis. This allows motion capture data to be easily appropriated within any of the disciplinary understandings existing within any interdisciplinary team. This ability to develop techniques and applications across different design disciplines allows for both the conceptualization and theorising of embodied experience as an immaterial and material spatial condition. These capabilities, plus the power to configure data in an almost spontaneous feedback loop, open an extensive array of modes of extraction and abstraction. Therefore, the value of MxCAP.01 is that it acts as an interdisciplinary design interface that facilitates the abstract rendering of gesture in ways that enable the discovery of new data inter-relationships between gesture, narrative and emotional exploration of body, time, movement, sound and space [fig.2]. The strategic deployment of the representational space of MxCAP.01 can be used to inform how the body might move.

It is the representational openness of MxCAP.01 that allows individuals to author unique movement hierarchies and logics that encompass everything from spatial and temporal constraints to expressive cultural forms. In fact, the ability to collect, collate, manipulate and process emotional and perceptive movement responses can inform performance design and foster better appreciation of three-dimensional spatial logics [7]. The software is neither deterministic nor discipline specific because it allows artists, designers and choreographers to map and reconfigure spatiotemporal data almost in 'real-time'. The ability of the software to enhance the data's malleability means that any resulting taxonomy provides an open interpretative space from which to view these gestural data sets. This not only opens up the research field of 'movement' taxonomies but also allows motion data to feed back and generate new interpretations and models of physical expression within design practices as diverse as sonification, visualization, motion design, animation and dramatization.

In late 2012, the tranSTURM group used MxCAP.01 to assess the gestural dramaturgy or performance language of Australian choreographer and dancer Meryl Tankard [fig.2]. This work, the

Fig. 2. Direct Mocap Mapping (© tranSTURM)
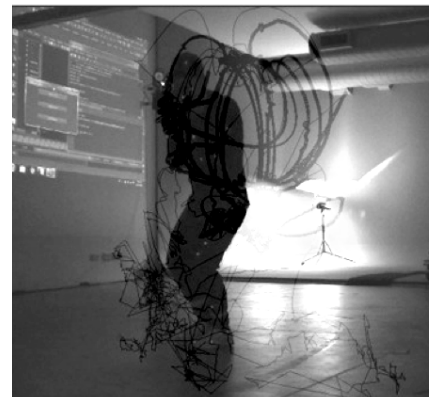
first in a series of studies undertaken with other choreographers, focused on transferring a set of specific moves into a set of abstract notational forms. The narrative framework on which to develop the choreographer's dance gestures was based on the two notions of 'order' and 'chaos'. The prescription of these conditions served several purposes. First, it established a common expressive and representational framework by which to compare the conscious and intuitive dramaturgical responses in different choreographic practices. The aim is to explore how hierarchies of human gesture can be understood in relation to spatial - temporal constraints. Such an approach is valuable because it offers the potential to develop a comparative set of 'expression taxonomies' by which to measure the unique responses of each choreographer. This should provide an opportunity for a more nuanced formal and temporal analysis of individuals' expressive languages. Ultimately, this work will fold into the gesture library currently under construction in the motion laboratory of German artist Holger Deuter. As such, the benefit of the MxCAP.01 interface is its capacity to extract and configure different information sets drawn from an extensive set of diverse forms of performance notation.

The second valuable aspect of the 'order' and 'chaos' narrative is that it creates a contra-point that helps the choreographer to re-imagine their practice. Here, the confine of the motion capture laboratory is integral to the design process, allowing the choreographer to explore expressive emotional and cultural forms of human gesture. MxCAP.01 enables a qualitative research methodology where participant observation, the testing of design interventions and the development of design decisions can be built around the organisation of movement data within new taxonomic scaffolds. The distinguishing aspect of software resides with the ability of the practitioner to reconfigure motion data without resorting to more conventional three-dimensional illustrative visualisations and prescriptive choreographic forms found in much contemporary motion-capture data analysis [8]. This disclosure of embodied knowledge through the representational lens of MxCAP.01 can, in fact, lead to new material outcomes.

Double World: Project Description

Double World is a current installation project that integrates the filtering motion data through MxCAP.01. Authored by the tranSTURM group, the project is a vehicle to use this reconfigured data as a way to generate synergies between the different languages operating within this interdisciplinary design team. The *Double World* project, a site-specific installation work to be exhibited in October 2013, explores motion capture data through a visual, spatial and sonic mediation. Working at the interface of performance, situated media and technology, the project harnesses the creative and experimental ambitions of creative teams operating in Australia and Germany. Using the text of Rainer Maria Rilke's *Sonnets to Orpheus* as the narrative framework, the exploration of 'order' and 'chaos' draws on Orpheus's two opposing god-halves Dionysus and Apollo. The installation pivots around the seminal moment in the Orphic Myth when Orpheus, leading his wife Eurydice out of Hades, breaks the condition not to turn around, thus losing her to the Underworld forever. The installation, to be located in Building 20 at Newington Armory, Sydney Olympic Park, seeks to create a visual and acoustic sensory environment for the audience to explore their own relationship with the narrative of the poem through the emotional and intellectual layers of the experience. This is an expressive and interpretive approach that avoids the reductive and deductive empiricism found in certain kinaesthetic frameworks. Instead, the MxCAP.01 interface ensures that the development of form is contingent on the mode of drawing, rather than something that is predetermined before drawing commences. This integrates all the conditions of representational mediation as a speculative, open and malleable mode of drawing. In this way MxCAP.01 can be used to reveal the latent, or even repressed, experiential aspects of movement.

Representation and Scale

The collaboration of transTURM and Meryl Tankard intended to use MxCAP.01 as an analytical tool to develop a taxonomic library of gesture and movement. This decision reflected the fact that 'intention' in Tankard's dramaturgy functions through the interplay between conscious and intuitive understandings of movement.

However, as the work produced in a 2013 UTS master class demonstrated, this is not a straightforward relationship. The disembodiment of the human figure and the ability to reconfigure this data allowed the potential for these movement libraries to be representationally open. The re-presentation of this data exceeded any explicit reading; thus refusing any unequivocal semiotic connection between gesture and meaning.

It is important to remember that MxCAP.01 does not disclose embodied knowledge, but merely re-presents scripted movement. Its ability to manipulate motion data insists that any library should be seen as a mediated visualization of the body in movement. Unlike more instrumental approaches, it requires an appreciation of the conditions of mediation and a willingness to exploit the technological protocols and functional limits of the system. The software opens an important conceptual shift to the issue of decontextualization by altering the representational functioning of the motion capture suite. Representation becomes an embedded mode of drawing in an operative and open way. This is very different to those practices where gesture is scrutinized to develop a semantic representational system linking gesture and meaning.

Clearly, digital technologies both provide unique ways to collect and re-present information and offer a greater facility to embed contingency in the design process. More significantly, as suggested in Walter Benjamin's canonical essay *The Work of Art in the Age of Mechanical Reproduction*, they potentially give rise to new material expressions. The technological discontinuity of the digital necessitates suspending established symbolic and experiential forms of expression. For Benjamin, the material predetermination of any form arsing from a new technology serves the conservative function of ritual and the politics of nostalgia [9].

In this respect, Brian Massumi's epistemology privileges movement precisely because he sees that predetermined form always operates within a representationally semantic structure. In this way 'meaning' prescriptively controls any knowledge of the body so that it can accord to a preordained and universalized set of traits and actions [10]. If the value of the digital is its capacity to represent the

interrelations and contingencies of context, form is something that emerges through the 'affect' of forces coming together [11]. In this schema, form is not the symbolic re-presentation of these forces, but simply the trace of action having taken place. The critical issue with this account is that the rejection of signification is premised on meaning always being semantic. The work undertaken with Tankard demonstrates that the MxCAP.01 system is inherently representational. However, the procedural inclusion of representation gives rise to forms that are anything but semantic. MxCAP.01 is an abstract digital 'mode of drawing' that suspends any prescribed meaning to movement. In the design disciplines, such representational slippages are unique because designers work directly on the object's materiality. The mode of mediated representation opened by transTURM's use of motion capture data has an affinity to Architecture because both practices solicit objects through the mediating affects of their respective modes of codified representation. The sublimated aspect of these representational modes means that they typically influence or 'affect', rather than 'effect', these objects.

This is, of course, the central thesis of Robin Evans' canonical essay *Translations from Drawing to Building*. In this essay, Evans calls to attention the unique trait of architecture where objects are affected by the discipline's representational forms [12]. This is a condition of affect because the codified representational modes are visualized as faithful presentations of the final object. Consequently, the formal effect of the drawing is almost always sublimed in the design act. Accordingly, drawings either fail to capture the quality of the final object or they create alternative conventions that contest existing material and technological expressions and forms. The capacity of these representational forms to infect architectural objects is crucial in creating anterior formal and spatial logics that are essential in reinvigorating the discipline.

Conclusion

The deception of motion capture visualisation is its apparent indexical relationship between image and experience. Yet the corporeality of information returning through the visual realm ensures motion capture data is a disembodied form of embodied knowledge. Accepting Robin Evans'

argument, MxCAP.01 enables a similar mode of visual translation of corporeality that underpins the design of architectural objects. The ability to scale the force, direction and intensity of movement, all within a temporal structure, is significant enough. Yet, as in architecture, it also opens a gap between image and experience that can be negotiated through scale. This enables a representational openness and 'affective' capacity of the drawing itself. In the realm of motion capture, it is this facility that marks the real value of software like MxCAP.01.

References and Notes

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2. Oxford English Dictionary Online, *The Oxford English Dictionary Online*, [electronic resource]. vol. 2011, no 27 April, (Oxford U.K.: Oxford University Press), <http://www.lib.uts.edu.au/sso/goto.php?url=http://www.oed.com%3E

3. Brian Massumi, *Parables for the Virtual: Movement, Affect, Sensation* (Durham, NC.: Duke University Press, 2002), pp. 29-31 & 58-61

4. Massumi [1] pp 226.

5. The tranSTURM group develops projects that theorise, hybridise and transcribe the personal and interrelated design 'languages' of architecture, performance, dramaturgy, sound, the moving image, and electronic art. It is, as such, an experimental crucible for the inter-disciplinary exchange of processes, data and ideas.

6. This software is presently in a beta version.

7. The authors referred to include William Forsythe, Merce Cunningham, Christian Ziegler, Brian Massumi, Kurt Hentschläger, Stelarc and the partnership of David Quayola and Memo Akten

8. An example is *Synchronous Objects* by William Forsythe found at: http://synchronousobjects.osu.edu/content.html#/TheDance and Piecemaker at: http://motionbank.org/en/piecemaker-2/

9. Walter Benjamin, W. and Hanna Arendt, *Illuminations* (New York ; London: Harcourt, Brace & World; Pimlico., 1999) pp. 217-252

10. Massumi [1] pp. 1-5

11. Brian Massumi (1998), <http://www.brianmassumi.com/english/essays.html>, *Sensing The Virtual, Building the Insensible*. Originally published in Hypersurface Architecture, Architectural Design Profile no.133, ed. Stephen Perrella, 1998.

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