The costume of MoCap: A spatial collision of velcro, avatar and Oskar Schlemmer

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Abstract

The rationale that governs motion of the organic in the cubical leans towards a transformation of the body in space, emphasizes its mathematical properties and highlights the potential to measure and plot movement – this is the work of a Motion Capture (MoCap) system. The translation in the MoCap studio from physical to virtual is facilitated by the MoCap suit, a device that determines the abstract cubical representation that drives first the neutral, and then the characterized avatar in screen space. The enabling nature of the suit, as apparatus, is a spatial phenomenon informed by Schlemmer's abstract 'native' costume and his vision of the *Tanzermensch* as the most appropriate form to occupy cubical space. The MoCap suit is similarly native. It bridges the physical and virtual, provides a Victor Turner like threshold and connection between environments, enacting a spatial discourse facilitated by costume. This collision of Velcro, Avatar and Oskar Schlemmer allows a performance *of* space, binding historical modernity to contemporary practice. This performance of activated space is captured by a costume that endures, in Dorita Hannah's words, despite the human form.

Keywords

Motion Capture

Performance Capture

Oskar Schlemmer

avatar

digital performance

camera array

Introduction

Aoife Monks in *The Actor in Costume* suggests that 'we need to approach the actor not as a given, real object, but as a process: a series of practices that are ongoing' (2010: 20). This article suggests that a series of practices central to the actor working in Motion Capture (MoCap) are similarly ongoing and are intimately bound to two modes of costume. The first mode is a physical costume, a MoCap suit, and the second a virtual costume that an avatar wears in screen space. While these two costumes do not need to be set in a binary relationship, a binary condition does exist when physical and virtual performance are co-located and discussed together. For this reason I separate the conditions of performance using MoCap into two modes. The first mode, MoCap, is central to capturing the unbiased motion of the actor, where the second, Performance Capture (PeCap), is a mode of performance that generates movement for animation on the screen. The distinction between these two performative operations is facilitated by a performers necessary 'wearing' of two distinct costumes – the MoCap suit (or uniform) of the physical, and the constructed, characterized and costumed avatar of the virtual of the screen. A similar exploration of the conditions of performance interrogated through costume were conducted at The Bauhaus School nearly a century ago. This costume resides in what Aronson recalls as Edward Soja's 'thirdspace… the attempt to understand

space through the body' (in Hannah and Harsløf 2008: 32) and it is here that we can locate a spatial collision of velcro, avatar and Oskar Schlemmer.

MoCap and PeCap

MoCap describes the process of digitally recording motion in a global frame. It translates that motion onto a model in projected or screen-based 3D space. While it borrows from traditional film-making, the major distinction from traditional film is that it does not record what would traditionally be referred to as the framed moving image (the translation of the 3D to the 2D). It records a more accurate impression of plotted motion in 3D space that can be transferred to a screen-based 3D impression. This discussion concentrates on a passive optical MoCap system as it is the type most often deployed in the commercial animation and film-making sector, and uses a velcro suit (or uniform) covered in a series retro reflective markers that are tracked by a camera array in 360°. Traditionally, a human figure would have between 35–50 markers attached at designated areas to create a template to drive a digital skeleton in an avatar (the second mode of costume). While MoCap is used extensively in military and biomedical applications, it is the use in creative applications that are discussed here. MoCap refers to recording actions of human actors, and using that information to animate digital character models in 3D animations to be used in computer generated imagery (CGI).

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Figure 1: Standard marker set shown from four angles of the MoCap Suit (Image S Fox 2006).

Performance Capture (PeCap) is a term often used in industry to describe aspects of performance captured using a MoCap system. The term, first employed by the director/producer Robert Zemeckis during the Warner Bros production of *The Polar Express* (2004), describes the total recording of a performance without cuts using an Optical MoCap system. PeCap allows an entire performance to be captured in one take, significantly eliminating the need for multiple takes (of a single scene) to be recorded. It allows for the exploration and capture of a whole scene to be undertaken unhindered by device limitations (like the frame and physical environments). Many animation enthusiasts tend to look with disdain at the work of Zemeckis, claiming that PeCap diminishes the role of the animator. Contemporary literature focused on MoCap and animation tends to suggest the opposite of this, where the act of performance is diminished and often looked on with disdain (see Liverman 2004; Kitagawa and Windsor 2008; Hayes and Webster 2013). The position of the costumed performer (and performance) needs to be reasserted in this mode of production. PeCap incorporates the pragmatic elements of MoCap (motion), but then demands a mode of performance that maintains a sense of theatricality (through mimetic movement) able to be naturalized in a global performative frame.

Motion, movement and Oskar Schlemmer

To anchor this practice historically I use Schlemmer's *Man and Art Figure* (Schlemmer [1925] in Gropius 1961) and Melissa Trimingham's *The Theatre of The Bauhaus* (2010) and *Oskar Schlemmer's Research Practice at the Dessau Bauhaus* (2004).

Schlemmer's interrogation of the mathematical/organic clash of the body in space is intimately linked to the actors (twice) costumed body in both the physical and virtual performative conditions of MoCap and PeCap. This view of costume in MoCap and the contribution The Bauhaus School offered as 'the workshop of the future' (2004) connects costume to the isolation and subsequent capture of movement in the present. It is my intention that the 'riddle (of Schlemmer) that continues to fascinate and intrigue' (Trimingham 2004: 28) is interrogated further through this discussion. It reinforces the place of costume as the means to 'access the actor's body on the stage' (Monks 2010: 20), not just as mimetic device but also as a pragmatic and necessary form of techne in the contemporary capture and reproduction of human movement.

It is important to delineate between the two concepts of motion and movement. Motion here is understood as that which is fundamental to the body. Rather than distilling the essential humanness of motion as a primary and aesthetic consideration only (Schlemmer), the capture of motion is a pragmatic function of the MoCap suit to enable mimetic movement to be subsequently generated and captured in the driving of an avatar in virtual space. Trimingham recalls Alwin Nikolais' assertion that 'movement is purposeful while motion is not'. Schlemmer's primary concern with motion and not the mimetic falsity of movement is problematized in MoCap when both motion *and* movement are captured and streamed onto the screen. This poses a challenge to Schlemmer's intention for costume as a distillation device to reveal essential human properties (which MoCap does), as it also enables an aestheticized body defined by a series of historical and cultural codes to be driven as well.

To explore this distinction I examine the two modes of costume central to performing within an optical MoCap system. The first mode is focused on the uniform of MoCap, the suit seen in Figure 1. I refer to this costume in the vein of Monks' 'uniform', which enables the actor's body to be 'made uniform by wearing uniform'. This mode of costume is intimately connected to the modern/futurist notion of the actor constructed of the same materiality of a 'new theatre of technology' (Monks 2010: 66, 74), which prepares the actor for the labour of acting. The MoCap uniform (and its pragmatic function as a form of techne within a MoCap system) is a contemporary evolution of devices used to distill motion in performance where 'costume is freed from its usual function of helping to delineate character and is used only for the articulation of space' (Trimingham 2004: 136). The problem here is that the suit of optical MoCap enables not just a connection between physical motion, movement and virtual space, but also binds a performer to characterized and dressed avatars on-screen.

Early MoCap

It is important to acknowledge that the MoCap suit is a small part of an ongoing technological discourse occurring within the context of capturing performance. The earliest forms of MoCap existed before the digital, and can be attributed to photographic pioneers, Edward Muybridge and Etienne-Jules Marey. Looking back to Marey's MoCap suit from the 1880s it is possible to see that basic principles of costuming for optic capture have not changed. The optical MoCap suit serves a specific purpose, a

technological purpose, enabling the performer to connect with a system that captures, virtualizes and makes motion repeatable on-screen. The Muybridge contribution, regarded as the precursor to contemporary film-making and animation (and predating Schlemmer), was achieved by a dozen cameras in an array taking sequential photos triggered by the movement of a horse's feet. The iconic image in Figure 2 was generated by a series of frames captured in sequence by an early camera array. It is the first surviving record of captured motion, or, more precisely, the capture of motion over a determined period of time. Muybridge later invented the zoopraxiscope (1879), a device designed to project a series of images with great speed. Muybridge's texts *Animals in Motion* ([1899] 1957) and *The Human Figures in Motion* ([1901] 1955) are still used by students of anatomy, animation and film-making today.

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Figure 2: Horse in motion (Image E Muybridge 1872).

In 1882 Etienne Jules Marey met Muybridge in Paris and was inspired to invent the chronophotograph. This was a fixed plate camera with a timed shutter that allowed multiple images to be exposed together onto a plate. It was similar to Muybridge's zoopraxiscope, but when Marey used his recording device in conjunction with a special suit designed to allow a plotted record of human movement to be extracted from the image sequence, he laid the foundations for contemporary optical MoCap and the modern MoCap suit.

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Figure 3: Marey's Capture suit (Image E. Marey 1884).

Performing in the duality of physical and virtual space in PeCap can only be explored through the wearing of this uniform. When underpinned with a selection of relevant history, and a revising of the language we use to discuss virtual space, this view of performance practice contributes a layer of understanding to locating costume in the development of performance (re)visualized for the screen.

Framing and virtual space and language

When performance is captured in the digital MoCap environment framing decisions can be made during and/or after the capture. This is unlike traditional film-making or the staging of performance where all of these intentions need to be confirmed by the director in the production or rehearsal stage. This presents a unique challenge for the performer as there is no specified frame apart from a direct concentration on the actual scene. The entirety of the capture is recorded as a data stream through a framing device called, The Omniscient Frame (Delbridge 2012). This revitalized notion of the frame is enabled by the capacity of a MoCap system's camera array to see within a volume and capture not just the height and width of the 2D frame, but to capture depth as well. It is a global frame, not hindered by the formally understood notion of the window typified by the cinema. The Omniscient Frame challenges our understanding of intentioned performance, and the costume of MoCap is inextricably linked to this revitalized frame.

The role of virtual space in performance remains problematized. What it is that it is composed of beyond data? How do we perceive it beyond the confines of the screen? Fundamentally, 'does our experience of space change between our three-dimensional daily immersion in it and our experience of it as an "imaginary" space?' (Trimingham 2004: 130). As Arnold Aronson rightly suggests in Hannah and Harsløf's *Performance Design* 'Whatever cyberspace is, it is not physical space (and) the whole concept of design will require a new vocabulary if it is to have meaning' (2008: 25). The introduction of terms like The Omniscient Frame, MoCap and PeCap to the lexicon of performance contribute to the 'ongoing series of actor practices' that define the place of costume in contemporary discourse.

When these terms are introduced to the technique(s) and wordstock of performance they combine to generate a form of new knowledge in the understanding of performance captured in physical and virtual space. The captured data of performance requires its own language. It is not preserved organically and chemically, like film, but stored immaterially in a language form as data. This restoration of data in the virtual contributes to a material understanding of space on the screen even though it remains immaterial. It comes from the physical and disappears as code, to reappear on the screen as captured movement, or the recreation of a representation of movement. As the re-creation of language in virtual space is represented as a form of movement, it is fitting that this discussion of space, informed by the presence of movement on the screen captured with a MoCap system is additionally framed within the broad field of costuming.

Schlemmer's cubical space and the native costume

There is a vital connection between the analysis of space undertaken by Schlemmer and the division of space facilitated by the contemporary camera array of MoCap. This understanding comes from Schlemmer's interrogation of the laws of Cubical Space (Schlemmer [1925] in Gropius 1961). In Schlemmer's laws, the dialogic between the organic of the body is set against the hard lines of cubical space. His concern with the laws of order governing cubical space and how these laws can be manipulated when compared to the organic laws of the human form illustrates the 'invisible linear network of planimetric and stereometric relationships' that govern a performance space (Schlemmer [1925] in Gropius 1961: 23). Trimingham asserts that Schlemmer's primary concern was to 'set himself seriously to the task of investigating *Bühnenprobleme* ('stage problems'), discovering literally the primary meaning of the stage' (Schlemmer in Trimingham 2004: 129). The spatial analysis of Schlemmer and the furthering of this understanding facilitated by MoCap contributes to the solution of 'primary meaning' in performance, in this instance the capture, analysis and reproducibility of motion.

In his image of cubical space in Figure 4, Schlemmer depicts the actor standing in the centre of a performance 'volume' in a neutral 'A' pose (a pose also used in the templating of a performer in MoCap). Schlemmer's volume is the performance stage, but in MoCap we use the term volume to delineate the amount of space that an optical MoCap system can see, or capture within.

This frame provides a means of identifying both the volume of a focused MoCap system and the camera array that tracks the markers of the MoCap suit in the environment.

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Figure 4: The laws of Cubical Space, Oskar Schlemmer (Image O Schlemmer 1925).

Schlemmer's laws of cubical space serve as a useful illustration to introduce the performer to the capture environment. When Schlemmer's image of the mathematical properties of a performance stage are placed alongside an image of the rays from an optical MoCap system's camera array, there is a comparable dissection of space. Schlemmer rightly asserts that 'space is an abstract concept only made visible to us through the forms that are (placed) in it' (Trimingham 2004: 131). It is the human figure at the centre of the volume that enables a revealing of the properties of space to occur. Figure 5 provides a comparison of Schlemmer's cubical space with the focused camera array of an optical MoCap system. They are startlingly similar, especially where the 'mathematic corresponds to the inherent mathematic of the human body and creates its balance by means of movements, which by their nature are determined mechanically and rationally' (Schlemmer [1925] in Gropius in 1961: 25). This reveals the 'elementary facts of its space ('das elementare des raums') or its inner laws' (Trimingham 2004: 131). The governance of movement of the organic in the cubical shifts towards a transformation of the body, emphasizes mathematical properties, and highlights the potential to measure and plot movement in performance.

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Figure 5: Cubical Space alongside image from MoCap Camera Array (Image M. Delbridge 2013).

Schlemmer's concern with the spatial clash of the organic versus the cubic in the theatre was counteracted with 'native' costuming (Schlemmer [1925] in Gropius 1961: 29). The MoCap environment approaches the problematic in a way where costume is not used as antidote. The MoCap suit captures the dimensions of the organic figure in space and this capture of movement, scale and form transforms it into a mathematical (or cubical) representation. Schlemmer's response to the laws of organic man in the inorganic environment centres around two notions: the *Kunstfigur*, the mechanical human figure; and the 'native costume' (Schlemmer [1925] in Gropius 1961). The MoCap suit is not a response that renders the body mathematic, nor does it simply mechanize the human. It enables the movement of the organic to be recorded and facilitates the transformation of this movement to data able to drive a digital version of native costume, the avatar.

Schlemmer's native costumes were used performatively as a representation of the characteristics of 'everyman' and as device for cubifying the lumpiness of the organic human form in performance. This is achieved through 'the body's free movement is restricted by the unyielding material, but the dynamic of the body's movement is revealed through the movement of that material' (Trimingham 2004: 135). These essential attributes for Schlemmer were facilitated by a performance mode known as *Tanzermensch* (man as dancer). The integration into space was achieved where the

organic is transformed into the inorganic via costume and movement. This transformation is replicated in the representation of the human figure facilitated by the costume of MoCap.

Edward Gordon Craig had an unmistakable influence on Schlemmers' *Kunstfigur* and *Tanzermensch* (1933). In his essay, 'The Actor and the Über-Marionette', Craig asserts 'the body of man is by nature utterly useless as a material for art' (Craig [1907] in Walton 1983: 84). In doing so, he implies a future form of performance that will allow the 'everyman' to populate the spaces of performance. He asserts that actors will continue to hinder the development of the theatre 'impersonating and interpreting' and tells us they 'must create for themselves a new form of acting' (Craig [1907] in Walton 1983: 84). Craig is often misread by those who suggest he would prefer all actors to be done away with and replaced with automata, but what he suggests (or predicts) is closer to the manifestation of an obedient puppet, or in MoCap terms, the avatar the actor drives in virtual space. He suggests 'there is something more than a flash of genius in the marionette, and there is something in him more than the flashiness of personality' (Craig [1907] in Walton 1983: 86). This abandonment of personality is precisely what occurs with the knowledge that as the actor's motion is captured in physical space their performance drives the marionette in screen space. The noble stone carving Craig alludes to in 'Über-Marionette', the return of the ancient all man mask, is unburdened by human emotion and idol dreams, but blank enough to receive instruction and control from a constant and present master. This driving of the ancient is facilitated by the MoCap suit and enables the capture of movement and performance through spatial integration. The

MoCap suit offers a Turner like threshold to connect Craig's notion of the marionette, Schlemmer's abstract native costume in the cubic, and the limitless roundness of The Omniscient Frame PeCap'd performance is captured within.

Schlemmer's explorations articulate to the complexities of MoCap, and their centrality to the spatial discourse that underpins the practice of performing in these environments. His vision of the dancing man as the most appropriate form to occupy cubical space connects to the primary aspect of performance captured in PeCap – movement. For Schlemmer 'we use the line and exploration of its palpable limits. With this in mind, we use the geometry of the surface of the field, from its central linear division, into a square or a rectangle, proceeding to its axes, its diagonals, curves etc' (Schlemmer in Trimingham 2004: 132). The translation in the studio from physical space to the virtual is facilitated by the costume of MoCap. This translation determines the abstract cubical representation that drives the neutral avatar in screen space. The avatar, the templated figure driven by the actor in the software environment of PeCap, occupies a similar spatial dimension (with its own set of parameters to be observed in the translation from the physical to the real), and further reinforces this connection.

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Figure 6: Templated figure in MoCap Software (Image M. Delbridge 2013).

When images of Schlemmer's native costumes, a neutral template and a characterized avatar are placed alongside each other the connection between Schlemmer's organic dilemma and the MoCap solution can be visualized. Figure 7 offers an illustration of the comparative transformative aspects of all three modes of costume that render the performer's occupation of space from organic to mathematical form. The first image represents Schlemmer's native costume; the second, the template from the capture software; and the third an avatar that the performer drives in a pre-visualized environment. When the three images are combined in this single figure we can see the link between the spatial transformations of costume and how the costume of an avatar also occupies space in the virtual.

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Figure 7: Native Costume, Template, Avatar (Image M Delbridge 2013).

Conclusion

Just as Henri Lefebvre tells us that any space may outlive its natural purpose and become re-appropriated for different use, it is true that the natural space of performance is translated in MoCap by the costume of MoCap. This is achieved through appropriation and an illusion of spatiality where the original purpose of the space captured has been outlived. This outlived and translated space is central to developing a deeper understanding and classification of the place and function of costume in the MoCap

environment. The classification of this new mode of performance and the space(s) where it takes place in the future forms part of this contribution to the continually adapting lexicon of theatre and to modes of performance that endure not in spite of, but through the movement of the human body.

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