Vactor Ontologies: Framing Acting Within a Motion Capture Context

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Author's Biography

Dr Jason Kennedy is a senior lecturer and Animation Pathway Leader in the Digital Design department at Auckland University of Technology. He is a practicing artist with work in 3D animation, 3D Fine Art, and video projection. Jason entered the fine art world circuitously through his initial ambition to become a palaeontologist. He enrolled in Albion College's geology programme (in Albion, Michigan, USA), only to discover that while he still loved dinosaurs, he liked the idea of animating them more than digging them up. Jason graduated from Albion in 2004 with a major in studio art (drawing) and minors in geology and mathematics. He completed a MFA in electronic art from the University of Cincinnati in 2007. His Masters research focused on the role of identity and immortality vis-à-vis digital representations of self. He completed his PhD through Auckland University of Technology in 2021 His PhD, entitled "Acting and Its Double: A Practice-Led Investigation on the Nature of Acting Within Performance Capture", examines how our understanding of what is acting is changed by modern animation and performance capture practices. In addition to being an animator, he is also an actor, and he draws on these two areas of experience in his research.

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Abstract—While an actor's performance in a stage play may be seen as a continuous and unmediated form of acting, an actor's performance in a film is constructed through shot framing, editing, effects work, and other cinematic apparatuses. With the advent of digital filmmaking, constructed performances have become more complex and nuanced, especially through the use of motion capture. This research explores how we frame acting within a motion capture context – and specifically, how this affects our larger understanding of what is acting and how acting can be constructed. What does acting become when the product of acting starts as data and finishes as computer-generated images that may only tangentially resemble the actor's "original" performance? Is the source actor solely responsible for the performance we see on screen, or should other people within the production pipeline receive credit for their creative contributions to the finished acting result? How do we understand the act of acting in motion capture? Through consolidating and linking theoretical and practical considerations of acting in motion capture, this paper proposes a number of ways to conceive of acting and presence within a virtual acting context.

INTRODUCTION

In 2018, the Austin Film Critics Association expanded its list of categories to include what may be the first of its kind: an award for Best Motion Capture/Special Effects Performance. Five films were nominated for this award, each of which were attributed to a single actor deemed responsible for the motion capture (MoCap) performance. Actor Josh Brolin took home the award for his portrayal of Thanos in *Avengers: Infinity War* (Anthony & Joe Russo, 2018). However, is it fair to present an award for the performance of a motion-captured character to a single person? Who is responsible for the digital character's acting we see on screen? Is it just the actor who produces the original performance while wearing the MoCap suit, or does it also include the MoCap clean-up artists and animators who interpret the performance data later in the production pipeline, and who may also have a role in subtly (or sometimes grandly) altering the acting in a given moment of the performance? This research explores how we frame acting within a motion capture context – and specifically, how this affects our larger understanding of what is acting and how acting can be constructed.

PERFORMANCE

Performance and *acting* are terms that resist fixed definitions. This paper is only concerned with securing a set of definitions for these terms that will clarify and serve its purposes. Definitions of acting vary between scholars and practitioners of acting, but acting is often described in terms of "being", "reaction", "imagination", "empathy", "pretending", "playing", and "mimesis" (Kennedy, 2019a: 299). For Kirby, "[a]cting means to feign, to simulate, to represent, to impersonate." (1972: 3). Kirby loosely defines *acting* as "something that is done by a performer rather than something that is done for or to him […]" (1972: 6). He expands on this idea:

> If the performer does something to simulate, represent, impersonate and so forth, he is acting. It does not matter what style he uses […]. No emotion needs to be involved. The definition can depend solely on the character of what is done. […] Acting can be said to exist in the smallest and simplest action that involves pretense (1972: 6).

Acting encompasses a wide range of styles that are socio-historically constructed and subject to revision. As a result, any meaningful definition of acting needs to be able to embrace diversity and mutability. Rozik provides a more theoretical understanding, defining acting as "inscribing on matter a description of an entity in a world and deflection of reference to it" (Rozik, 2002: 111). Actors attempt to convey a separate identity while hiding any sense of themselves. However, a virtual performer is never able to deflect reference to itself because it has no identity separate to its animated role: "the virtual performer never pretends to be anything other than what it is" (Kennedy, 2019a: 300).

Kirby identifies a continuum of acting, from not-acting through to complex acting (Figure 1). This continuum is not concerned with the style but rather the *amount* of acting. These dimensions of acting include any action that involves pretense, including emoting, simulating an action, or impersonating a character. For instance, non-matrixed performing takes place when the performer "is merely himself and is not imbedded […] in matrices of pretended or represented character, situation, place and time" (1972: 4). On the left end of the continuum, actors receive references of acting, as opposed to producing those references themselves. As we move toward the right end of the continuum, the actor's role in producing references and representing a character increases (1972: 6).

Of concern to this study of motion capture are simple and complex amounts of acting. Kirby identifies simple acting as "that in which only one element or dimension of acting is used. [… Emotion] may be the only area in which pretense takes place […] or only an action such as putting on a jacket may be simulated" (1972: 8). Complex acting, by contrast, is multi-dimensional and involves simultaneously engaging in more than one area of pretense. For instance, an actor experiencing/performing an emotion *and doing nothing else* would be considered a form of simple acting by Kirby's definition (1972: 8). However, Ed Hooks, a veteran actor who teaches acting to animators, believes that in terms of acting, "[e]motion by itself has no theatrical value. […] It is not even acting. Acting is *doing* something. It is doing something in pursuit of an objective while overcoming an obstacle" (2011: 20). While Kirby's theory is acting-style agnostic, Hooks' position is based on a realist style of acting.

Hosea asserts that complex acting is commonly associated with "lifelikeness and authenticity in which the actors lose their own egos and become the characters that they portray" (2012: 168). Hosea argues that acting is rarely authentic or spontaneous, and instead "draws upon a series of learned, planned and twice-behaved actions" (2012: 168). Schechner couches *restored behaviour* in personal terms as "'me behaving as if I were someone else,' or 'as I am told to do,' or 'as I have learned'" (2006: 34). Since restored behaviour is never performed for the first time, it becomes *twice-behaved behaviour* (2006: 36), and can "[refer] to actions or speech acts that are prepared or rehearsed and then re-presented" (Hosea, 2012: 25). The process of creating animation leads to twice-behaved behaviours, whereby an animated character's performance is (re)constructed through drawing from live reference, creating planning sketches, and refining drawings and poses over time. In each of these examples, the twice-behaved behaviour is never produced in real-time – a characteristic specific to animation.

Hooks defines acting as "[b]ehaving believably in pretend circumstances for a theatrical purpose" (2017: 27). For Hooks, a theatrical purpose involves an action, conflict, and objective (2017: 118-119). It can be argued that *believability* is a hallmark of the North American *realist* style of acting, which privileges mimesis above other forms of

representation. Such styles "[aim] for lifelikeness and authenticity in which the actors lose their own egos and become the character that they portray" (Hosea, 2012: 168). The perceptions of lifelikeness and authenticity specific to the realist style derive from the audience knowing that flesh and blood actors are responsible for those performances. When we speak of realism in the context of character animation, a perceptual shift is required: the characters are no longer flesh and blood. Instead, the audience must extend its suspension of disbelief in order to accept as authentic the behaviours and situations acted through animated bodies, despite those bodies having no physical connection in the real world.

Animation offers perhaps the greatest range of performance possibilities of all visual media. One could discuss performance within abstract animation, such as in Oskar Fischinger's *An Optical Poem* (1938), which features early experimental performances of geometric objects to a symphonic composition. Or, on the opposite end of the spectrum, one could focus on the performance possibilities within hyperrealism, such as the character Neytiri from *Avatar* (James Cameron, 2009) or Gollum from *The Hobbit: An Unexpected Journey* (Peter Jackson, 2012). Realism and hyperrealism are used here to describe visual styles, as opposed to styles of acting. Within the context of visual style, realism refers to characters that appear true to life, whereas hyperrealism refers to characters that are both realistic and "exaggerated in comparison to reality" (Oxford Living Dictionary, 2017).

VACTORS, SYNTHESPIANS, AND DIGITAL DOUBLES

Rozik's description of acting in terms of "deflection of reference" invokes an actor's attempt to remove any sense of him/herself while conveying a separate identity. According to Kennedy:

> While flesh and blood actors participate in a deflection of reference to themselves, a virtual performer never does so. The virtual performer never exists outside of the digital medium nor assumes a personality other than what is ascribed to it through its performance. As a result, the virtual performer never pretends to be anything other than what it is (2019a: 300).

He continues that not all virtual characters produce screen performances that

> involve facets of acting such as empathy, simulation, impersonation, pretence, or even pseudo-deflection of reference. However, all virtual performances in feature films are a type of constructed performance, whereby more than one (living) person is responsible for the final product of the performance on screen (2019a: 300).

Such performances are often constructed via motion capture, which can result in complex and nuanced virtual performances, but which also sometimes lack the full depth of the source-actor's performance.

There are several categories of virtual performers, the most well-known of which are *synthespians*. The term *synthespian* is a portmanteau of "synthetic" and "thespian", coined by Jeff Kleiser and Diana Walczak in 1987 to describe a digital actor (Synthespian Studios, 2015). Since then, the definition of synthespians and other digital performance categories have often been used interchangeably. Kennedy assigns specific meanings to categories and argues that the term *virtual actor* (vactor) "is an overarching category that contains both synthespian, digital doubles, and other categories of virtual performance" (2019a: 300). He defines a vactor as "a CG or digitally-augmented character capable of producing a screen-based performance" (2019a: 300). Vactors only need to produce a performance, but the nature of that performance doesn't have to be of a specific type or quality. Kennedy differentiates synthespians on the basis on the type of performances they produce: "[a synthespian is] a CG or digitally-augmented character that advances a screen-based story while producing acting that engages in at least one area of pretence" (2019a: 300). This is in contrast to a digital

double, which is "a CG character whose participation in a screen-based story is implied more by its physiology, costume, and surroundings than by its actions" (2019a: 300).

Synthespians and digital doubles are primarily distinguished by their capacity to produce acting. Synthespian performance is akin to film acting and synthespians are akin to actors. By contrast, digital doubles produce performances more akin to *received acting* than acting with pretence, such as virtual stunt doubles, performance "extras" in dense crowd scenes, or moments when a character must embody "some property or ability that the actor it replaces does not have" (Wolf, 2003: 49). Camera distance plays a major role in whether a character can visibly engage in pretence (Kennedy, 2019a: 300) – for example, examples of digital doubles include crowds of orcs, goblins, dwarves, and elves in *The Hobbit: Battle of the Five Armies* (Peter Jackson, 2014), and thousands of spectators in *Moneyball's* Oakland Coliseum (Bennett Miller, 2011).

Kennedy creates subclassifications of digital doubles in order to articulate a wider range of roles particular to this term: digital doppelgängers, protean doubles, and digital fantoccini. *Digital doppelgängers* are digital doubles that are "exact recreations of the actors on which they are based", whereas *protean doubles* are "digital doubles that do not resemble the actors on which they are based (Kennedy, 2019a: 301). Regardless of whether the digital resembles the source-actor, Kennedy distinguishes between digital doubles whose performances are derived from MoCap versus those which are solely keyframe animated, the latter which he describes as *digital fantoccini*. Fantoccini are Italian puppet shows featuring jointed puppets manipulated by rods, strings, and mechanical devices (World Encyclopedia of Puppetry Arts, 2018), which serves as a metaphor for how a digital character's geometry is controlled by a series of joints that articulate its movement. Because these terms are subclassifications of digital doubles, they are all subject to the constraints of received acting (Kennedy, 2019a: 301).

MOTION CAPTURE

The paratextual content on Blu-rays and DVDs have increased a common awareness of what MoCap is, if not all that it involves. Viewers may recall performers wearing form-fitting Lycra body suits with tracking markers Velcroed to them. The terms motion capture and performance capture are often used together to describe this process, although the terms are not interchangeable. In his PhD thesis, Delbridge defines motion capture as "the process of digitally recording movement in 360 degrees and translating that movement onto a model in projected or screen-based 3D space" (Delbridge, 2014: 70). Performance capture exists as a subset of MoCap that describes "the total recording of a performance without cuts using a motion capture system" (2014: 11). In MoCap, what the actor does functions as an input into a vast performance mechanism. Allison describes MoCap as a form of translation, "stemming from the Latin *translatus*, to carry over", meaning both moving an object between points in space, as well as converting one substance into another (Allison, 2011: 329). For King, this process of translation provides a means for the deflection of reference between actors and their synthespian counterparts:

> the deflection of reference in digital photorealism is not accomplished by a direct transfer of the actor's indexical or bodily qualities but by a process of translation. Such a process is an abstraction of what we otherwise know to be the 'substance' [of a flesh and blood actor in real life]. In a way that is not true of cinematic images, the digital image establishes its own terms of reference within a parallel but self-sufficient world (King, 2011: 256).

However, these definitions lack some of the nuance necessary to encapsulate all of the available methods for producing MoCap. For instance, Faceware is a PeCap system that interprets a video of a performer's face without any tracking markers. The 2D video is imported into a software called Faceware Analyzer, which "[identifies] key features of the face and [samples] every pixel of it on every frame of video [… to] build a statistical model of [the performer]" (Faceware Technologies, 2017). Another software called Faceware Retargeter retargets (translates) this statistical model onto the face of a 3D character in order to drive its performance through a library of preconstructed facial shapes. Instead of recording 360-degree movement, the Faceware system solely interprets 2D data and reconstructs 3D movement from it. Considering this type of solution, and building on Delbridge's definition, this author proposes that a more apt definition of MoCap could be: *the process of digitally recording movement in either 2D or 3D physical space and translating that movement onto a model/object in screen-based or physical 3D space.*

Bode discusses MoCap in terms of a hybridity between performance and animation, and indicates a discursive shift from PeCap being understood as "actor-assisted animation" to "technologically-assisted performance" (Bode, 2008: 7). In this context, it is important to clarify what is meant by *animation*, especially animation within a *realistic* context. Hosea defines animation as "mediated, moving images of a manipulated, artificial construct that could not have been photographically captured by a camera in real-time" (2012: 22). She differentiates between *cartoonal* and realistic approaches to character-based animation. Cartoonal character animation involves a "heightened and exaggerated type of animated performance […] in which animated characters squash, stretch, exaggerate and otherwise defy the conventional laws of physics and human biology" (2012: 54). Animators frequently refer to the cartoonal style of movement as *believable* animation. A believable character is "one that provides the illusion of life, and thus permits the audience's suspension of disbelief (Bates, 1994: 122). Any mention of the "illusion of life" within an animation context likely refers to the principles of animation developed at the Walt Disney Animation Studio during the 1930s. These so-called "12 Principles of Animation" are considered the axioms of believable cartoon character movement. Such movement is derived from the observation of real-life movement, but it is caricatured or exaggerated. The greater the degree of this caricature, the more cartoony the style of animation (Thomas & Johnston, 1981). By contrast, realistic character animation adheres to the laws of physics and biology, whereby every motion is distinguished by subtle, unrepeatable nuances based on a performer's "behavioural pattern" (Joon, 2008: 2). Realistic character animation results when an animated character's performance is indistinguishable from that of a profilmic actor, animal, or creature. Hosea cautions that the ubiquitous use of Disney's 12 Principles of Animation means that animators often apply the principles to their work when a closer observation of the natural world would have been more appropriate. This is especially true when working with realistic character animation, as a reliance on principles alone becomes a "mechanistic technique that is learnt by rote rather than grounded in a critical analysis of nature" (2012: 55-56).

Within MoCap, animators edit an actor's myriad takes into a single hybrid performance, hand-selecting moments of acting, and fine-tuning expressions and body movements to construct the actor's double through the performance of the vactor. Wolf identifies a series of functions that screen doubles can perform, and in each case the double "possesses some property or ability that the actor it replaces does not have" (2003: 49). Shacklock indicates that

> [a] double can provide additional physical skills, a particular bodily feature, or simply a degree of patience for standing still while the crew goes about its preparatory work. […] The necessity of the double for the work of screen acting

suggests that the performance is always an ensemble form of labor, exceeding the ability of a single individual (2016: 70).

Antonin Artaud, one of the major figures of the 20th Century avant-garde theatre in Europe, describes the double as a "spectral effigy" (1958: 134), a reflection that is sublime in contrast to its progenitor. Baudrillard conceived of the double as "an imaginary figure, […] which makes it so that the subject is simultaneously itself and never resembles itself again, which haunts the subject like a subtle and always averted death" (1983: 95). The double has no mass, no substance, and no name. It can be understood in relation to the Body without Organs (BwO), a concept that Deleuze adopted from Artaud in "The Logic of Sense" (1969) and developed further in later works. Deleuze and Guattari describe the BwO as:

> […] opposed less to organs as such than to the organization of the organs insofar as it composes an organism. The body without organs is not a dead body but a living body all the more alive and teeming once it has blown apart the organism and its organization. […] The full body without organs is a body populated by multiplicities (1987: 30).

Bouldin compares the animated body to the BwO, and describes the animated body as a "complex and constantly shifting assemblage" 2001: 49). Deleuze and Guattari describe this lack of a consistent body in terms of *deterritorialization* (1987: 56) – a metaphor that I extend to the actor's double as vactor. Historically, character performances on stage and in film are portrayed through the actor's body. In motion capture, the BwO challenges the idea of the actor as the sole author of a character's performance; the character we see - the actor's double - is a simulacrum of something that, in many cases, does not exist.

SCREEN PRESENCE

While the notion of presence is a common subject in discussion about acting, it is more often tacitly understood than well-defined. "Presence" is laden with several connotations, including the fact or condition of "being, existing, or occurring at this time or now" (Collins English Dictionary, 2019). Kennedy explains that "[while] on stage or in front of the camera, any actor can be considered *present* – that is, the actor exists for an audience at a specific location and time. However, regardless of whether an actor is in the right place at the right time, not all actors emanate a profound charisma that captivates the audience" (2019b: 191-192). Chaikin views presence as a feeling of standing next to the actor on stage, regardless of whether such a connection with the actor is maintained off stage (1991: 20). "Screen presence" refers to this quality of connection with an actor specifically within the context of film, which is usually related to a combination of charisma, chemistry, appeal, and audience investment in a character (Kennedy, 2019b: 192). Playwright and theatre critic Bert O. States recognises good screen presence as the moment when "artistry becomes the object of our attention" – the recognition of a specific actor's artistry, which is activated when we are affected by "the actor's particular way of *doing* his role" (1985: 165). An actor must be able to embody or perform features specific to a given character. Kennedy explains that

> a character in a stage performance who is a gifted whistler must be played by someone who is adept at whistling. The more adept the whistler, the more the stage presence is amplified. Presence is the viewer's ability to fully believe and accept that the actor is the character at a given moment. An actor's presence is increased the more often this happens throughout a performance (2019b: 192).

Strictly speaking, the actor is not the object of our attention in PeCap roles. Even when the actor and the vactor share the same physiology, they are not the same object. Therefore, screen presence within a vactor context is not engendered by the same means as it is in live-action

filmmaking. In so far as a vactor may achieve screen presence, its divisibility of performance means that there is no single unified consciousness and body responsible for that presence (Hosea, 2012: 68). Therefore, a vactor's presence is less a unique artistic contribution and more of a *gestalt* screen presence where, generally, the source-actor provides the single greatest contribution to the gestalt. Kennedy points out that even though actor Andy Serkis does not physically resemble the PeCap roles that have made him famous, such as Gollum in *The Hobbit: An Unexpected Journey* and Caesar in the recent *Rise of the Planet of the Apes* (Rupert Wyatt, 2011), there is still something recognisably "Serkis" in each of these roles. States refers to this phenomenon of recognising an actor in a character as "actor-presence", especially when disguise is involved (1985: 165). When we are aware of a specific actor's contribution to the performance of a digital character, it is gestalt screen presence at play.

Kennedy identifies two more aspects of screen presence specific to MoCap performances: how well a vactor integrates into a profilmic mise-en-scène, and how we understand the presence of an actor performing through the body of another actor, especially if the body is of a deceased actor (2019b). In the first instance, vactors are not recorded by the same profilmic means as flesh-and-blood actors, but vactors and actors share the same screen space in a finished film. Vactors

> are composited as one element within the profilmic screen space, and it is the quality of this visual integration that determines how much the audience believes the synthespian is actually present in that space. The quality of visual integration is determined by how well the synthespian is rendered to match the profilmic elements of the scene (including the lighting, materials, and level of detail), as well as how the synthespian is seen to perform alongside its profilmic co-stars (including matching eye-lines, timing, and screen chemistry). When any one of these technical or performance elements is compromised, it impoverishes the audience's ability to accept the synthespian as present within the same screen space as its human co-stars (2019b: 193).

In the second instance, the audience is faced with an ontological uncertainty: whose presence is detected through the vactor? Is it the presence of the original actor whose body is simulated on screen, or is it the presence of the performance-captured actor who is playing through the simulated body? Or is it a combination of both? These questions are especially relevant in the context of characters such as Brian O'Connor in *Furious 7* and Tarkin in *Rogue One: A Star Wars Story*. O'Connor, played by Paul Walker, is a central character to the *Fast and Furious* film franchise. However, when Walker died midway through the production of *Furious 7*, the film's producers opted to create a vactor version of Walker designed to seamlessly perform and integrate into the actor's remaining scenes. *Rogue One* revisits the character Tarkin from the first Star Wars movie in 1977. Originally played by Peter Cushing, the producers of *Rogue One* wanted to ensure that nearly 40 years later, Tarkin still retained the same age and appearance as in *Star Wars: Episode IV – A New Hope*. However, Cushing died in 1994, which required another actor, Guy Henry, to be cast into the role and perform not only as Tarkin, but as if he were Cushing revisiting the role (Kennedy, 2019b).

Tied to screen presence is the notion of the authenticity of the flesh, which is challenged by trying to locate the corporeality of the vactor's virtual flesh. Dixon cautions that among cybertheory and digital performance studies, there is a pervasive belief in the disembodiment of the source-actor, which suggests that audiences retain an empathetic distance to virtual characters. He disagrees with this view and believes that when done well, audiences perceive virtual flesh as embodied material flesh. The virtual body retains an indexical relationship to the source-actor, which preserves its sense of embodiment (2007: 215). Through a spectral and kinetic transfer, the actor's performance aura is transferred from flesh-and-blood to the onscreen simulacrum (Balcerzak, 2013). However, actors may be concerned whether their star power is also present in this transfer. Afterall, marketing, publicity, and compensation are all

directly tied to the recognition of a star within a role (King, 2011), and in the case of posthumous acting, whether an actor is able to maintain a similar stardom when animators and other actors perform through virtual doubles of their bodies.

Traditionally in stage and film, the character and the actor are one in the same body. However, a vactor is a virtual body onto which one or more actors' performances are translated. The nature of authorship within a PeCap environment is convoluted not just by multiple actors, but also by multiple animators who contribute to the final performance product. Wolf describes this as the "divisibility of performance" and indicates that performance "needs to be rethought due to the large number of people who may be involved in the creation of a single example" (Wolf, 2003: 48). Hosea indicates that despite there not being "one unifying consciousness and embodied presence creating the performance, a coherent character can still be read from a unified creative intention" (2012: 68). Such a creative intention is mapped onto the vactor's body in order to produce a performance by proxy – a substitution for the actors and animators alike (2012: 68). Conscious of the constructed nature of doubled performances, Shacklock critiques the tendency in the Stanislavski school of acting to:

> reiterate notions of a coherent and autonomous self [… whereby] acting emerges from the actor's sense of self […]. Here, acting is the project of the single actor: the expression of a coherent, authentic, interior self and the work of the creative, autonomous agent (2016: 71).

Such a dominant understanding of acting as the product of the contributions of an individual rather than a collective (Dyer, 1986) is at odds with how acting is produced using motion capture, and foregrounds the need to frame acting differently within this context.

While motion capture is recorded in real-time, the recording of the performance is just one stage in a larger process of arriving at the virtual acting result. Once the source-actor's performance is digitized as data, it is then worked upon by MoCap artists and animators in a frame-by-frame process. Each frame is analysed to ensure each recorded part of the body retains accuracy to the source-actor's performance. The performance can then be adjusted on a frame-by-frame basis to either "honour" the original performance or to adjust the performance based on the director's wishes. MoCap's ability to allow a director to micromanage an acting performance at the individual frame level provides a level of control far greater than in standard live-action (Wolf, 2003). A MoCap actor's performance can be divided into separate components, each of which can be individually manipulated and recombined in postproduction. Wolf identifies nine such components:

- **the body** (capable of being swapped with a performance double);
- **the voice** (capable of being dubbed);
- **the face** (capable of being replaced with another face);
- **movement** (editable via motion capture, including combining movement from one or more performers);
- **facial expression** (editable via performance capture to adjust an expression, alter a performance, or create a mapping between different physiologies);
- **timing** (retiming movement);
- **image** (texture detail, such as skin and animated blood flow);
- **shape** (3D-scanning an actor's physiology); and
- **behaviour** (algorithmic simulation, such as crowd simulation) (2003: 55).

A single actor does not necessarily need to provide all of these components for the final production – a variety of actors who specialise in each of these areas can be combined and reconfigured into the vactor's performance (Wolf, 2003). For instance, the character of Colossus in *Deadpool* (Tim Miller, 2016) is constructed from five separate performers: a motion capture recording of a performer enacting Colossus' physical movements (**movement**); a performer in a tracking suit and platform shoes filmed onset interacting with other actors (**body**); a performer whose face was used as the basis for Colossus' facial features (**shape**); a performer who produced all of the dialogue (**voice**); and a performer responsible for producing the facial performance of the character (**facial expression**) (Chitwood, 2016). As opposed to acting in live theatre or even in live-action films that don't rely on visual effects, MoCap actors have little or no control over the final versions of their performances, and instead function more as suppliers of raw data that can later be combined and shaped by others (Wolf, 2003). Balcerzak describes this process as the actor being stripped of a physical body "to exist as pure kinesis" (2013: 198). The piecemeal nature of this example runs counter to Serkis' often-cited assertion that his virtual doubles fully honour his individual performances (Allison, 2015). This paper doesn't aim to dispute this claim but rather to illustrate that within MoCap/PeCap, there are a variety of methods for producing a finished vactor result. Some of these methods are more likely to retain most, if not all, of the actor's original performance, while others heavily fragment and recombine performance components from multiple authors.

ACTING IN MOTION CAPTURE

While discussions about the production of motion-captured roles are relatively common within visual effects literature, the actual experiences of actors engaging with MoCap technologies are less explored. Just as the shift from stage acting to screen acting required actors to develop different performance practices (such as modulating expressivity based on proximity to the camera), so too does motion capture require modifications to the screen actor's repertoire. At moments where new technologies challenge our concepts of screen performance, there is a need to reconsider how acting is produced and constructed by way of those technologies (Bode, 2010). Bode writes that there are historical precedents for this renegotiation, such as the introduction of sound into film, "which during the recording process 'severed' the voice from the body, but reintegrated the two during the editing and mixing process" (2010: 64).

Kade, Özcan, and Lindell argue that a motion capture studio does not provide a "natural acting environment" when compared to a stage or film acting environment. The virtual nature of the MoCap environment often means that props, obstacles, and other actors (living or virtual) are not visually present, and instead must be imagined or memorised (2013: 68). As a result, a key element for a MoCap actor is both a strong and flexible imagination to overcome the limited immersion within a MoCap environment. Actors may struggle to achieve the same degree of emotional authenticity and truthfulness when confronted with the barrenness of the MoCap stage (2013), but actors who have trained to perform in black box or minimalist theatre productions are perhaps the best prepared for such an environment.

Actors new to motion capture are unfamiliar with the vestments required by the technology. The most common form of motion capture is optical tracking (Pizzo, 2016), which requires that performers wear from-fitting Lycra bodysuits with Velcro-attached tracking markers. With passive optical tracking, the markers stick out about 10mm from the suits and are used to reflect near-infrared light in order for the MoCap system to track the 3D positions of each marker (Delbridge, 2014: 71). Active optical tracking uses markers more closely embedded within the suits and produce their own infrared signals without the need for reflection (Pizzo, 2016). Kennedy performed a study with experienced actors engaging with a MoCap environment for

the first time. He notes that the actors became quite aware of the MoCap suits and the tendency for the Velcroed markers to become stuck to another actor's suit during physical interactions. Compassionate actions, such as embraces and hugs, were compromised and the actors instead "resorted to artificial pats, which possessed no real sense of intimacy and ultimately were neither emotionally-connected nor emotionally-authentic." (Kennedy, 2015: 945). The actors were also intimidated by the complexity and expense of the equipment, which led to a fear of damaging it. The fact that the actors were hyperaware of the technology prevented them from being present in their acting. Additionally, the actors were aware of the limited dimensions of the capture volume (the space in which the MoCap cameras are able to "see" and record the positions of the tracking markers). These limits are identified by strips of tape on the stage floor, but the absence of physical boundaries required that the actors maintain an awareness of the imagined barriers. Again, the actors were initially concerned about transgressing the capture volume and disrupting the data. However, many of these concerns are similar to workflows actors frequently engage with for screen acting, such as moving to and stopping on a given "mark" on the set floor in order to stay in focus for the camera, or ensuring that your head or body doesn't move outside of the composition of a shot. Once the actors became aware of these analogies to screen acting, as well as being reassured about the durability of the equipment and receiving encouragement to continue acting even if they lost a tracking marker, the actors were able to reengage with their craft as if in a more familiar environment. Within an hour, the actors reported that they had adapted to their suits and had mentally mapped the capture volume, which led them to produce more emotionally-connected and authentic performances (2015).

Another adaptation for actors unfamiliar with performing through MoCap is how to understand their performances in a 360-degree recording environment. Performance capture allows a filmmaker to record the entirety of a performance without a fixed camera composition, which allows decisions about framing to be determined in postproduction instead. However, the lack of set framing can be confusing for screen actors who are used to scaling their performances based on camera proximity. The most meaningful motion capture performances in Kennedy's study occurred when the actors treated their emotional work as if they were being shot in closeup, and their physicality as it they were composed in a long shot (Kennedy, 2015).

For *Avengers: Age of Ultron* (Joss Whedon, 2015), Andy Serkis was a performance capture consultant to Mark Ruffalo, who plays Hulk using PeCap. Ruffalo was filmed on set wearing the motion capture suit while engaging with the other actors in full costume. Serkis advised director Joss Whedon to aim for capturing onset the performance he intends for the final cut of the film, rather than expecting to alter it in postproduction. To assist with this, Ruffalo was allowed to interact with a digital avatar of the Hulk character to understand how his movements translated onto the vactor result. In order to get a more meaningful sense of mass, Ruffalo was affixed with weights, as well as inhibitors that prevented his biceps from intersecting his body. Ruffalo's voice was also pitch-modulated on set to provide a more meaningful sense of the character to all of the actors (Stern, 2019). Some of these techniques are used to assist the imaginations of the other performers on-set to perceive Ruffalo not as a man but as the towering, muscle-bound Hulk their characters are meant to witness. Additionally, Ruffalo is assisted by added weight and physical limitations to perceive his own body in a way that is more akin to Hulk's actual physiology – something that may be difficult and inconsistent to perform when relying on imagination alone. The technological mediation of Hulk's voice provides Ruffalo with an added layer of performance depth, which also affects the way the other actors perceive and respond to his character. All of these steps helped to better ground Ruffalo's presence as Hulk between the on-set acting and the desired final performance result.

CONCLUSION

This paper is an attempt to consolidate and link together a number of considerations about how we understand the nature of acting within motion capture. The constructed nature of performance within MoCap runs counter to the common perception of acting as the sole product of an individual[1]. Within screen acting, the director's ability to edit performances in postproduction means that the actor never has full control over the acting that appears on screen – that all screen-based performances are constructed to at least some degree. Motion capture pushes the constructed nature of acting much further and permits all components of an actor's performance to be digitised, adjusted, combined, and reconstructed. Unlike our standard understanding of acting as a type of artistry performed live (either on stage or before a camera), acting in motion capture functions as merely one mode of input into a larger performance mechanism that is produced through the labour of multiple artists over long spans of time. Based on the current state of the technology, the following is an attempt at framing acting in motion capture.

Within the context of acting, motion capture is:

- A method of capturing, translating, and augmenting a source-actor's performance into the screen performance of a virtual double;
- An acting performance produced by a collective of artists, with the source-actor generally providing the single greatest contribution to the ensemble;
- A hybridity between performance and animation, especially within a realistic context;
- A series of physical and technological mediations between the source-actor and the finished vactor result;
- A cross-over between acting as a form of animation and animation as a form of acting.

We can understand the screen presence of a motion-captured performance based on the following:

- The sense of being present in a scene and a deflection of reference to the source-actor;
- The ability to convey qualities such as charisma, chemistry, appeal, and audience investment;
- A recognition of the act of acting through the virtual double (as it is constructed by the contributions of many artists to form a gestalt presence without a single unified consciousness and body);
- How well the character integrates into a profilmic mise-en-scène;
- How well the original presence of the now-deceased actor is preserved and conveyed through his or her virtual double (in the case of posthumous performances).

Tensions arise from an actor playing through a body different from his or her own. In this case, the authenticity of the actor's body is sacrificed in order to achieve a spectacular body. What is less clear is whether an actor playing through a different physiology results in a loss of a sense of embodied star quality (in the case of a famous actor playing through a newly designed physiology) or a boost in star presence (in the case of a less prominent actor playing through the physiology of a famous actor). In each instance, the resulting virtual actor is a body without organs – a simulacrum that the audience must extend its suspension of disbelief in order to accept it as authentically flesh and blood.

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[1] The film actor's performance is never fully the product of an individual, who depends on the contributions of directors, wardrobe, hair/makeup, lighting, cinematographers, set designers, visual effects artists, musicians, and a host of other creative/technical staff to produce an appealing illusion. A passive or uncritical audience may not consciously recognise the roles of these contributions in enhancing an actor's performance, and instead regard the actor as the single provenance of the screen performance.

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FIGURES

NOT-ACTING   ACTING

Non-matrixed Performing	Non-matrixed Representation	"Received" Acting	Simple Acting	Complex Acting

Figure 1. Kirby's continuum of acting.

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