Antonio Pizzo
Actors and Acting in Motion Capture

What is motion capture
Motion capture is a rapidly growing and relatively recent technology, increasingly pervasive in the contemporary entertainment industry. It can be summarized as a method of recording the movements of a real body in 3D space as data which is then mapped onto a computer-generated body. The mapping between the real body of the performer and the digital body is made possible thanks to a set of specifications that enables the transference of data from human figures onto computer-generated 3D characters. At the time of writing, the specification generally used for humanoid modelling and animation is the H-Anim standard, provided by Humanoid Animation.[1]

In actual fact, this very same concept for recording movement dates back to the early pioneering photographic work of the late nineteenth century, such as Eadweard Muybridge's motion studies, Étienne-Jules Marey's chronophotographic, and Harold Edgerton's stroboscope. However, it is generally considered that the modern notion of capturing the movements of an actor, for the purpose of giving lifelike qualities to an animated character, was born with Max Fleischer' rotoscope in 1915.[2] This was the first device whereby «real participants provide a template of human movement and translate that movement into another medium».[3] Although most widely known for its use in Disney's *Snow White* (Appendix 1), rotoscoping was first utilised in the *Out of the Inkwell* series (Appendix 2), where the protagonist was a clown named Koko.[4] «The process of tracing off, by hand, individual frames of previously filmed footage of a live subject gave the animation a completely naturalistic action. Using rotoscoping, and others techniques and methods of referencing live motion, quickly became standard practice in feature film animation where a higher standard of animation with more naturalistic action were sought».[5]

These previous techniques (i.e. chronophotography, stroboscope, rotoscope) were basically systems of rendering the movement of a body in space (3D) in a sequence of bi-dimensional silhouettes onto a film or a drawing (2D). Modern motion capture not only records the x, y and z coordinates of a number of points at each moment along precise time intervals but, thanks to the H-Anim standard, defines the formal mapping from the recorded body onto the final digital character.

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[1] Humanoid Animation (H-Anim)'s standard is used to model and to animate humanoids, cf. < http://h-anim.org>. For a brief discussion of the methodology for motion capture see the *Overview of Motion Capture Systems* at the end of this paper.

[2] Cf. Midori Kitagawa and Brian Windsor, *MoCap for Artists: Workflow and Techniques for Motion Capture*, New York, Focal Press, 2012.

[3] Ali Grey, *A Brief History of Motion-Capture in the Movies*, «uk.ign.com», 11 July 2014, <http://uk.ign.com/articles/2014/07/11/a-brief-history-of-motion-capture-in-the-movies> (last accessed 25 August 2015>.

[4] Cf. Richard Fleischer, *Out of the Inkwell: Max Fleischer and the Animation Revolution.* Lexington, The University Press of Kentucky, 2005.

[5] Derek Hayes and Chris Webster, *Acting and Performance for Animation*, New York and London, Focal Press, 2013, p. 185

Digital motion capture was first used in medical and military research in the late 1970s and entered the entertainment industry in the mid 1980s in the form of a commercial called *Brilliance* (1985) (Appendix 3), in which a sort of purpose-built capturing system recorded the movements of an actress, giving more lifelike qualities to a sensual robot.[6]

Over the three decades since, the technology has spread, and more and more actors have experienced the process. In brief, the motion capture process usually involves: a performer that enacts a particular body movement; a series of markers (usually infrared reflective dots) located on specific points of the performer's body; a studio fitted with devices able to record the markers within the space (usually infrared lights and cameras); a computer and software to gather the data of the movements and transfer them onto a generic digital skeleton, and a digital character that will be animated using the movements so recorded.

The aim of this paper is to investigate whether (or not) and how this technology has influenced and changed the work of performers. In the movie and game industries its methodology has been improved and is now employed on a massive scale to capture actors' performances for the purpose of animating 3D computer-generated characters.[7] This is why another term has come into use: performance capture. The new term indicates a practise that aims not only at capturing the movement (walking, jumping, crawling, etc.) but also at recording the actor's entire performance, the latter being regarded as a richer and more complex activity than the mere physical motion. In this context, the term "performance" clearly echoes "acting", and implies a deliberative behaviour, an emotion that motivates it, and some kind of interaction with other agents. Thus, the term "performance capture" tends to refer to situations where the most accurate available system is used, aiming to capture all the nuances of human actions to record not only the movement but also, if we may say so, the motivations and meanings behind it. However, the technological differences between "motion capture" and "performance capture" are not substantial; the processes of performance capture fall within the motion capture field, and may also be referred to by this term.

Acting and digital technologies

When approaching the subject of how actors' work is influenced by a new media or digital technology, we must bear in mind that this is just the latest part of a long history of technological impacts on the art of acting. [8] As Barbara Flueckiger notes, «the filmic apparatus has always fragmented, transformed, and enhanced the human body – in front of, in, or after the camera».[9] Therefore, when discussing motion capture acting in a digitally enhanced film production,

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[6] Cf. Midori Kitagawa and Brian Windsor, *op. cit.*, p. 7; cf. also Matt Delbridge, *Motion Capture in Performance. An Introduction*, New York, Palmgrave Macmillan, 2015, p. 15.

[7] Matt Delbridge, *op. cit.*, p. 26.

[8] For a brief introduction to the topic cf. Antonio Pizzo, *Attori e personaggi virtuali*, «Acting Archives Review», vol.1, n. 1, 2013, pp. 83-118.

[9] Barbara Flueckiger, *Digital Bodies*, a chapter from Barbara Flueckiger, *Visual Effects. Filmbilder aus dem Computer*, Marburg, Schueren, 2008, translated from German by Mark Kyburz and revised by Barbara Flueckiger, 2010, p. 1, available at <http://www.zauberklang.ch/BodiesFlueckiger.pdf>.

we must also be aware that any recording apparatus will influence the performance and that any type of display devices (video, audio) will add their own contributions to the audience experience.[10]

Some authors, such as Sharon Marie Carnicke, feel that these influences are operating over certain «basic processes» of acting that remain relatively stable over time:

> My experience as actor and director and my scholarship on the history of acting informs my conviction that acting is – at base – a discrete art form, which has – over the centuries – variously adapted to the changing technologies that have framed and presented actors' work to audience, whether those frames be the proscenium arches, camera lenses, or computer screens. Put another way, the history of acting shows that the basic processes of acting – grounded as they are in the actor's body and voice – remain relatively stable, while the changing technologies of stage and screen continually prompt actors to rethink how they use their body and voices in the service of their art.[11]

This distinction does not seem particularly helpful to studying the phenomenon of acting in a historical perspective until the latest developments of motion capture. The notions of «body» and «voice» appear, in fact, pointless (or at least too generic) if considered in isolation from the modality and the medium. Instead, it is important to consider, as Carnicke says, that if the performances on screen «are always a hybrid between human activities and technological interventions», the acting remains «the actor's domain».[12]

The specific modalities and media will induce varying degrees of an actor's authorship over the final appearance of the performance.[13] We may quote Mark Wolf:

> Live theatre has a long tradition of performance enhancement, wherein the use of makeup, lighting, costume, and so forth served to emphasise certain aspects of an actor's live performance onstage. But since the actor's physical presence was required, the power to control and shape a performance lay mainly with the actor.[14]

The movie set has now become the most technologically complex environment in which an actor will have to deliver a performance. Beyond the editing, postproduction effects have become more and more pivotal and influential.

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[10] As Mark J. P. Wolf emphasises, it is widely acknowledged that «performance in film has almost always been more than the straightforward recording of actors; film performances are typically, to some degree, constructed in postproduction through technological means», *The Technological Construction of Performance*, «Convergence: The International Journal of Research into New Media Technologies», vol. 9, fasc. 4, 2003, pp. 48–59:48. For the aesthetics of transformation implicit within the transmutation of the physical body into an image on a screen cf. Margaret Morse, *Body and Screen*, «Wide Angle», vol. 21, fasc. 1, 1999, pp. 63–75.

[11] Sharon Marie Carnicke, Emotional Expressivity in Motion Picture Capture Technology, in Jörg Sternagel, Deborah Levitt, Dieter Mersch (eds.), Acting and Performance in Moving Image Culture. Bodies, Screens, Renderings, Bielefeld, transcript Verlag, 2014, p. 322.

[12] *Ivi*, p. 331.

[13] For the theory of acting cf. Claudio Vicentini, *Theory of Acting. From Antiquity to the Eighteenth Century*, Marsilio & Acting Archives, Napoli, 2012. (www.actingarchives.it). Cf. also the important work of James Naremore, *Acting in the cinema*, Berkeley, University of California Press, 1988; a more recent survey is Jörg Sternagel, Deborah Levitt, Dieter Mersch (eds.), *Acting and Performance in Moving Image Culture. Bodies, Screens, Renderings*, cit.

[14] Mark J. P. Wolf, *op.cit.*, p. 48.

Given that the shoot itself is only one step of many in making a contemporary live action movie, we can also say that the recording of the actor's performance is but one small step in the creation of a character on screen.

Digital cinema has increased the way in which the actor's work is blended into production and postproduction. Peter Kiwitt, describing digital cinema, is quite outspoken about it:

> Yes, in some cases a live-action shot is just one small piece of the final image. But even before the advent of visual effects, each live-action shot was always just one potential piece of the postproduction puzzle. It is the nature of cinema that the crucible of production is ultimately only an intermediary step in the storytelling process.[15]

> Green-screen environments, motion/performance-capture elements, and other visual effects now mean the palette of cinema production can fall anywhere along a physical/digital continuum.[16]

This is an ongoing development, and although there are still – and likely always will be – film and video productions that depend less on digital effects and more on the camera and editing, it is indisputable that the mass consumer markets (particularly the USA, but also the new industry in the Middle and Far East) are now demanding more and more special effects (FX) and computer-generated imagery (CGI) in live action movies. In what could be defined «the cinema of attractions reloaded», the very role of the actor has been reassessed.[17]

> In a digital age – says Peter Kiwitt – animation has expanded. Through visual effects it can join seamlessly with live-action, and increasingly, live-action is incomplete without it. It is also now equally a part of the realm of new media, particularly interactive gaming.[18]

In this framework, «actors – Mark Wolf has noted – become just another element to be thrown into the mix, and through keying processes, their bodies are separated from the environments and backgrounds in which they supposedly appear».[19]

In recent decades the digital technologies of FX and CGI (both in pre- and postproduction) have blurred the boundaries between live action and animation within cinematic products.

In digital cinema, as matter of fact, the audience has become accustomed to emotionally bonding with what is the outcome of a well-worked mixture of traditionally filmed "carbon-based" actors and pure CGI animated synthespian.[20] Carnicke believes that this makes no difference to the work of

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[15] Peter Kiwitt, What Is Cinema in a Digital Age? Divergent Definitions from a Production Perspective, «Journal of Film and Video», vol. 64, fasc. 4, 2012, pp. 3–22: 6.

[16] Ivi, p. 18.

[17] Tom Gunning's famous definition from The Cinema of Attractions: Early Film, Its Spectator and the Avant-Garde, «Wide Angle», Vol. 8, nn. 3 and 4, Fall 1986, rephrased in a discussion of contemporary high spectacle film production in Wanda Strauven (ed.), The Cinema of Attractions Reloaded. Film culture in transition, Amsterdam, Amsterdam University Press, 2006. Clearly I take the definition from the latter.

[18] Peter Kiwitt, op. cit., p. 6.

[19] Mark J. P. Wolf, op. cit., p. 51.

[20] I take the sardonic definition of the "carbon-based" actor from Barbara Flueckiger, op. cit., p. 14, who quotes Scott Billups in an interview for Paula Parisi, The New Hollywood, «Wired», Issue 3.12, Dec. 1995

critics and scholars who wish to analyse and evaluate the acting performance of an agent on screen, and considers that «performances created through motion capture photography, like that of Gollum, can be subjected to the same kind of analysis and assessment as any other screen performance».[21]

But in this way, focussing on the finished product – the performance of an «agent» in front of the audience – we evade the problem of authorship: i.e. the actor's contribution to the production of the «agent».

Acting and/or animation?

The notion of capturing human movement is historically rooted in analyses of the physical behaviour of living beings, and has focused on the detailed rendering of movement as a sequence of changing states over time. Its original aim was to gain a better understanding of human and animal motion and soon became a method of rendering that movement with lifelike qualities. This is why motion capture, from its very beginnings, has been linked with the animation of human figures, either drawn, synthetic or artificial. As noted by Barbara Flueckiger:

> Since the beginning of computer-based character animation, motion capture has been considered the ideal technique for endowing animation with personality, as highly work-intensive keyframe animation also entails extensive division of labour.[22]

Now, whereas live action directors and editors have never asked to be directly credited as creators of the acting component of a live action movie, despite the impact they may have had on the final rendering of the actor's work, animators have always claimed to be the authors of their characters' acting. Since the art of animation began, the animator's work has comprised the ability to give life to an illustration, thanks to a well-structured technique, mainly developed at Disney and known as "the illusion of life".[23] As animation techniques developed further and lifelike CGI characters became more widely used, animators had to learn to deliver more sophisticated and subtle performances from their 'characters'. In recent years, the refinement and expansion of action and expression in CGI animated characters has led to increasingly compelling performances. In just under a decade, from John Lasseter's *Toy Story* (1995) to Osborne and Stevenson's *Kung Fu Panda* (2008), the complexity of CGI characters' actions has evolved; for example: they frequently tend to manipulate objects whilst delivering lines, in a naturalistic way, and have an increased mobility of facial animation as well as a wider range of expressions.[24] This may explain why it is now quite common for animators to receive at least some 'acting training' in order to better understand how to create a believable character on screen.[25]

(<http://www.wired.com/wired/archive/3.12/new.hollywood_pr.html>).

[21] Sharon Marie Carnicke, *op. cit.*, p. 332.

[22] Barbara Flueckiger, *op. cit.*, p. 30.

[23] Thomas, Frank, Ollie Johnston, *Disney animation: the illusion of life*, New York, Abbeville Press, 1981.

[24] Cf. Antonio Pizzo, *Attori e personaggi virtuali*, cit., p. 14.

[25] In more recent years, Ed Hooks, a former actor and acting coach, has switched the focus of his teaching towards animators. Cf. Ed Hooks, *Acting for Animators*, New York and London,

Although in film and, to an extent, video games, the animation of a character makes extensive use of motion capture, the movement data must always be supervised and refined by an animator to correct a myriad of imperfections or improve the correspondence between the captured subject and the animated character. [26] The production of a figure animated purely through CGI takes place essentially in three phases: modelling (the creation of a 3D static figure), rigging (the creation of the control points – i.e. a kind of skeleton – of the 3D model that an animator can bend and deform to create the animations) and animation (the addition, frame by frame, of movements that match the given shot). Needless to say, the latter plays a pivotal role in the rendering of a lifelike character on screen: movement is generally held as a key factor in bringing a computer-generated image to life (as John Lasseter has demonstrated with *Luxo Jr.*, the 1986 computer-animated two-minute film produced by Pixar, Appendix 4).[27]

Starting from this process, technological developments started to raise the importance of the actor's work. Once a rigged 3D model of the character had been constructed, the animation could be created from the actor's movements as recorded in a motion capture session. Various directors have envisioned the possibility of merging the real performance of an actor with the playful world of animation movies. The first successful example of this trend was *The Polar Express* (Appendix 5), the 2004 fantasy film written, produced, and directed by Robert Zemeckis.[28] The movie's animated sequences were created entirely using performance capture techniques (Passive Marker Motion Capture). In this case, the Motion Picture Academy's animation branch entertained «doubt about whether such extensive use of motion capture should constitute animation […] Ultimately, the deciding factor was whether the film required frame-by-frame manipulation (in other words, animation) on top of the motion-capture imagery.

Routledge, 2011 (third edition). Another relevant book on the subject, containing a more detailed description of the production process, is Derek Hayes, Chris Webster, *op. cit.*

[26] The relation between animation and motion capture has been long debated and is well summarised by Yacov Freedman who also notes that «an image is being recorded, to be sure, but in practical terms, the data are impossible to view— let alone exhibit—until they have gone through multiple layers of digital modifications. Motion capture, almost by definition, requires additional animation to succeed as a work of recorded cinema». Jacov Freedman, *It is Real … Or it is Motion Capture. The Battle to Redefine Animation in the Age of Digital Performance*, «The Velvet Light Trap», n. 69, Spring 2012, pp. 38-49:39.

[27] Yet, motion capture is not always the best tool for crafting animated characters. There are situations where traditional CGI animation better serves the task. As Scott Richmond notes: «The very human impossibility of Spider-Man's athletic feats determined the visual effects techniques, not the other way around: because such acrobatics really would require superhuman strength, the film employs key frame animation, as motion capture could not give the proper effect of Peter's superhuman athletic effort». In such cases, motion capture's role in film animation would be primarily to provide a cost-effective method of creating lifelike natural behaviours for human or animal figures. Scott C Richmond, *The Exorbitant Lightness of Bodies, or How to Look at Superheroes: Ilinx, Identification, and Spider-Man*, «Discourse», vol. 34, fasc. 1, 2015, pp. 113–144.

[28] Yacov Freedman, *op. cit.*, p. 40.

The *Polar Express* did involve such additional work, so it was deemed acceptable for the Best Animated Feature category».[29]

The Academy's focus on frame-by-frame manipulation led animators to emphasize the pre-eminence of their own authorship. Indeed, they have often seen motion capture as a kind of cheating, as was made clear by Pixar's famous disclaimer at the end of Brad Bird's *Ratatouille* (2007) that reads «Our Quality Assurance Guarantee: 100% Genuine Animation! No motion capture or any other performance shortcuts were used in the production of this film».

Actors' contribution to motion capture, then, has been "diminished" by animators' claims that deem motion capture merely an accessory or ancillary to the genre of animation film as defined by the Academy. Conversely, while motion capture struggles to find a place in the animation Oscars, at the same time it is rejected as performance: real actors captured with this technology are prevented from seeing their work recognized alongside those in live action. New Line Productions have long promoted Andy Serkis as candidate for best supporting actor for his performance as Gollum in Peter Jackson 's 2002 *The Lord of the Rings: The Two Towers* (Appendix 6), and although he won the 2003 MTV Movie Award for "Best Virtual Performance", Serkis was never nominated for the Oscar.[30] Since then, there has been a quarrel over whether the Academy should or should not award actors whose performance was given via motion capture.[31]

Over the years, as Serkis became famous for other, even more striking performance capture roles (with a special affection for apes, such as King Kong in the eponymous movie, or Cesar in the two movies based on *The Planet of the Apes*), the question started to involve other actors (such as Zoe Saldana in James Cameron's *Avatar*). As Pamela Robertson Wojcik says, the issue stretches beyond award categories:

> The Serkis case, along with questions about the nature of acting in *The Hulk* (2003) and the recent *Star Wars* trilogy (1999, 2002, 2005), points to a crisis in the conception of acting, a crisis that is seemingly historically and technologically determined: the issue of acting in the digital age.[32]

The reluctance of the Academy to accept the actors' motion captured performances – according to Wojcik – reveals a privileging of the actor's body as key evidence of their presence.[33] Indeed, some purists may be sceptical about the idea that someone who provided the movements for a synthetic character

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[29] *Ibid.* Freedman stresses that on 8th of July 2010 the Academy issued a new rule for the 83rd Academy Award for the animation category. The rule has remained in place in the 88th edition and reads as follows: « An animated feature film is defined as a motion picture with a running time of more than 40 minutes, in which movement and characters' performances are created using a frame-by-frame technique. Motion capture by itself is not an animation technique. In addition, a significant number of the major characters must be animated, and animation must figure in no less than 75 percent of the picture's running time», <http://www.oscars.org/sites/default/files/88aa_rules.pdf>.

[30] <http://www.mtv.com/ontv/movieawards/2003/>.

[31] Hugh Hart, *When Will a Motion-Capture Actor Win an Oscar?*, «Wired», Jenuary 24, 2012, <http://www.wired.com/2012/01/andy-serkis-oscars/>.

[32] Pamela Robertson Wojcik, *The sound of film acting*, «Journal of Film and Video», vol. 58, fasc. 1–2, 2006, pp. 71–83: 71.

[33] Ibid.

could be awarded in the same category as a traditional live action actor. Nevertheless, Wojcik challenges this scepticism, and notes that if the same Academy has awarded John Hurt for the role of John Merrick in David Lynch's *The Elephant Man*, it means that:

> whereas theatrical effects, such as make-up and prosthetics, are seen as supplements to good acting, cinematic effects, such as special effects and digital technology are seen as hindrances.[34]

In other words, it is just a matter of differing perceptions of a supplement (the integration of the prosthesis and the hindrance of the special effects) to the same kind of job; thus, the unrecognizable performer behind heavy makeup may not be so far from the hidden performer behind the digital marionette. But in my opinion, the parallel between the mask and the digital character is misleading. The former concerns a performance occurring in the "here and now" of the acting (in either a movie set, TV studio or live theatre); the latter must take into account the sequence of manipulations of previously recorded data (the movements). John Hurt's performance constitutes the creation of a character during film production, while the creation of a digital marionette, even using motion capture data, is a process that takes place mainly in post-production. The logic followed by the Academy recognizes as acting everything that happens mainly within production and rejects what is primarily the result of further processing.

Yet, following Wojcik's hint, I would suggest that most of the audience – regardless of the debate over acting awards – is at ease with synthetic characters, albeit aware that these have been artificially created by digital means. Essentially, the audience seems to not care much about the authorship problem. The match between what has been shot in real life and what appears on screen is less relevant that it may seem. Even if the Academy refuses to nominate an actor or actress «if all the dialogue has been dubbed by another actor», from the point of view of the audience, the body (and the illusion of physicality) of the performance is altogether so relevant in movies that the dubbing into another language is no longer perceived as a displacement of the voice.[35] At least in a country like Italy, where dubbed movies are mainstream, the spectators' suspension of disbelief would not be remotely affected by the fact that the foreign actors and actresses speak perfect Italian.

Finally, Wojcik also notes that in *The Lord of the Rings* saga, it is not only Gollum's performance that depends heavily on digital effects.[36] The same could be said for his counterpart Frodo, as well as for hundreds of other characters, in what we nevertheless consider live action.

Andy Serkis is actively engaged in promoting the concept of motion capture actorial authorship in the eyes of the audience, and has also taken the role of motion capture ambassador in the industry. The character of Gollum started a new trend in motion capture acting, although his – or its - genesis was not purely

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[34] Ibid.

[35] Cf. rule 6 at <https://www.oscars.org/sites/default/files/88aa_rules.pdf>.

[36] Pamela Robertson Wojcik, *op. cit.*, p. 80.

a product of motion capture per se.[37] In 2002, Gollum was created through a combination of motion capture and frame by frame references. Serkis worked on set with the actors, dressed in an all-white jumpsuit that produced sufficient contrast to the set environment for animators to use as reference for the CGI character. He also repeated the same actions in a motion capture studio to provide the movements for transposition to the character. And, notably, he produced the voice that made Gollum so famous.[38]

In summary, Gollum is the composite result of Serkis' work and the intervention of animators, even if the character is perceived as a whole by the audience (and promoted as such by the actor). We have to imagine the work of Serkis and the animators as the work of artists who, layer upon layer, build up and elaborate the various elements forming a figure in a painting. Better yet, as the creation of a picture using different layers in digital image processing software. To avoid the character appearing as a kind of Frankenstein, the actor must be able to handle his individual contributions given at different times to the composition without losing the sense of the final figure's organic unity.[39]

Over the years, technology has changed, allowing data to be captured in an open environment. In 2014, Weta Digital, the company in charge of special effects for *The Dawn of the Planets of the Apes*, took motion capture to the next level. As visual effects supervisor Dan Lemmon says:

> [the advances] allow characters and actors playing characters to connect with the audience at a level we've never been able to achieve before. What makes these films unique and special is how much acting our digital characters do and how well they integrate into the rest of the movie […] We did a lot of things to take the performance-capture tools out of the dedicated capture stage and on location. We made them more portable […] We did a lot of capture in the rainforests […] Having the whole system put together in a way that was relatively unobtrusive and quick to set up meant we could allow the actors playing the apes to be in the set working with the other actors playing the humans. They were in the immediacy of the scene.[40]

One of the key elements of this advance was to switch from using markers that only reflect infrared light to ones that emit their own signal; i.e. a change from passive to active technology (Active Marker Motion Capture).[41] The team had already trialled active technology during *Rise of the Planet of the Apes* (2011)

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[37] Barbara Flueckiger says that «professionals and audiences alike hailed Gollum, the goblin-like character in *The Lord of the Rings* who memorably accompanies the protagonists on their journey, as a successful example of a digital character», *Digital Bodies*, cit., p. 17.

[38] Nick Broughall, *How Weta changed motion capture tech for Dawn of the Planet of the Apes*, «Techradar», November 21, 2014, p.1, <http://www.techradar.com/news/world-of-tech/how-weta-changed-motion-capture-tech-for-dawn-of-the-planet-of-the-apes-1273893>.

[39] The metaphor of Frankenstein was suggested by John Dower in the interview published as John Dower, *Working with Motion Capture. The Director and the Actor. Interview by Antonio Pizzo*, «Acting Archives Review», n. 11, maggio 2016, p. 72.

[40] Barbara Robertson, *Weta Digital VFX Supe Dan Lemmon on Dawn of the Planet of the Apes*, «http://www.studiodaily.com», Feb 9, 2015, http://www.studiodaily.com/2015/02/weta-digital-vfx-supe-dan-lemmon-dawn-planet-apes/ (last accessed 28 August 2015). Cf. also Nick Broughall, *How Weta changed motion capture tech for Dawn of the Planet of the Apes*, «Techradar», November 21, 2014, p.1, <http://www.techradar.com/news/world-of-tech/how-weta-changed-motion-capture-tech-for-dawn-of-the-planet-of-the-apes-1273893>

[41] Nick Broughall, *op. cit.*, p.1. For the difference among passive and active markers see the *Overview of motion capture systems* at the end of this paper.

but the early suits were quite fragile, with cords and cables easily broken. So, for the second film, Weta developed a system which used active IR LED lights within the suit itself, and was more appropriate for use in a forest, where most of the film was shot. The director Matt Reeves recalls how all the scenes were shot with actors wearing head mounted cameras and suits with LED markers, and most interestingly he says:

> We only added the visual effects after, so there's a version of this movie that we've been watching for a long time that has no apes in it […] It just has all the actors in their performance suits and the crazy thing is that it is still an incredibly emotional experience.[42]

His intention, or at least implication, with this statement is to shift the focus from post-production effects to events that took place during filming. Thus, as with Gollum in *The Lord of the Rings* saga, or as with *Avatar*'s blue giants, the immediacy of the acting is emphasised over the work of the animators, thus elevating the prominence of the actors' authorship in the process of character creation.

Serkis has always been very upfront in equating his motion capture acting to his live action work.

> There is no difference. Acting is acting. Performance capture is a technology, not a genre; it's just another way of recording an actor's performance.[43]

In his experience, playing roles in motion capture was near-identical to playing live action roles and very different to character production in animation movies.

> You're living and breathing and making decisions for that character from page 1 to page 120, the whole emotional arc. In an animated movie, it's a committee decision. There are 50 people creating that character.[44]

He describes the work as exactly like any other form of acting, yet for a different kind of camera.

> Performance capture is just a technology that picks up everything you're doing, but in terms of embodying the role physically, mentally, and doing all the research, you do that with any character you play as an actor. We are creatures of imagination and trick ourselves into believing we're murderers, lovers, etc., so what you wear is just a superficial coating. I've never drawn a distinction between doing a motion-capture performance and one without motion-capture technology, because it's just a different set of cameras.[45]

Serkis constantly emphasises the primacy of his performance, not only when applied to a realistic, life-like character (a goblin or an ape) but even when it is utilised to render a cartoonish image in animation movies, such as when he

[42] Joao Medeiros, *Andy Serkis is changing the face of film-making*, «wired.co.uk», 6 July 2014, <http://www.wired.co.uk/magazine/archive/2014/08/features/planet-of-the-apes-andy-serkis> (last accessed 10 February 2016).

[43] Tim Appelo, Andy Serkis on Who Sends Him Hate Mail; Why Oscar Should Rethink Animated Category (Q&A), «The Hollywood Reporter», December 1, 2011.

[44] Ibid.

[45] Marlow Stern, *Motion Capture Maestro Andy Serkis on 'Dawn of the Planet of the Apes' and Revolutionizing Cinema*, «The Daily Beast», 8 July 2014, <http://www.thedailybeast.com/articles/2014/07/08/motion-capture-maestro-andy-serkis-on-dawn-of-the-planet-of-the-apes-and-revolutionizing-cinema.html> (last accessed 10 March 2016).

played Capitan Haddock in Spielberg's *Tintin* (Appendix 8).[46] Although this movie was made entirely using CG, whereas *Planet of Apes* included live action, both movies were filmed largely via motion capture.

> It's very interesting being in two movies this year that are manifested completely differently but use the same process. The same visual effects company, Weta Digital, produced apes that look entirely real and a palette and a style that honours the source material of *Tintin*. What Steven was trying to do was to have the best of both worlds, where you can create the look and the feel and the sensibility of Hergé [*Tintin*'s cartoonist creator] but have emotionally truthful performances. The technology allows the actors to enter into those worlds.[47]

Serkis says that by watching Captain Haddock onscreen he was able to recognise his acting choices.[48] Thus, because the acting part of the process is entirely the same, he believes that motion capture acting should be included within the regular acting category of the Oscars.[49]

Despite Serkis' efforts, the quarrel between animators and actors within the industry is a difficult business to account for. Even the choices made by the Academy look somehow contradictory, as stressed by Freedman in relation to *The Curious Case of Benjamin Button* (David Fincher, 2008) (Appendix 9).

> Brad Pitt became the first actor to receive an Academy Award nomination for a largely synthetic performance. (Even after the film's first hour, during which Pitt is onscreen only via motion capture, his subsequent image was often digitally de-aged.) Benjamin Button existed only as a complex hybrid of computer imagery, detailed makeup, and several physical bodies, but the performance was credited to one actor.[50]

It must be said that this long debate can be seen as part of a wider discourse on the Hollywood star system, and the increasing focus given to the actor's performance in motion capture may also be the result of a specific marketing strategy. As suggested by Barbara Flueckiger, the role of a proxy actor in digital production may secure the link between the fictional character and the actor's real life persona; bringing with him or her the features of stardom, the actor consolidates a well-known strategy that the industry uses to market its products.

> Alongside narrative construction, the proxy model is a reliable technique for establishing a solid foundation for character consistency. Moreover, a proxy adds another aspect to character representation: his existence in real life. […] such existence and its related associations import extended meaning into character construction, namely, the very history that digital characters often lack. The studio and Peter Jackson were variously and justifiably criticized […] for placing too much emphasis on acting performance, while the tremendous achievement of

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[46] It is worth noting that *Tintin* was not nominated for the Animation category of the Academy Awards. We know that, even though Serkis was not nominated for best actor, the first chapter of *The Planet of the Apes* was nominated as Best Achievement in Visual Effects in the feature films category. Steven James Snyder, *The Oscars vs. Motion Capture: Tintin and Apes Snubs Raise Big Questions About the Academy*, «Time», Feb. 08, 2012, <http://entertainment.time.com/2012/02/08/the-oscars-vs-motion-capture-tintin-and-apes-snubs-raise-big-questions-about-the-academy/> , (last accessed 28 august 2015).

[47] Tim Appelo, *op. cit.*

[48] Ibid.

[49] Ibid.

[50] Yacov Freedman, *op. cit.*, p. 46.

the CG team, especially Raitt's team of animators, was downplayed. From the perspective of reception psychology, however, such foregrounding was a clever move, because in attributing this achievement to one person, the digital character attains something akin to a physical presence, which is far more concrete than the abstract and incomprehensible operations of a host of animators.[51]

Serkis' campaign has undoubtedly made its point, given the ubiquity of interviews and comment over his work as motion capture actor. But even the proxy model, as Judith Roof seems to suggest, seems challenged by more general type of misunderstanding about acting in film.

> Serkis exemplifies an aesthetic of absence as a series of marked deferrals. His literally absent body plays out the hoaxic economy of virtual lures offered by layered sound and imaging apparatuses.

> Serkis's present absence or absent presence are one result of a series of attempts to produce cinematically the illusion of spatiotemporal presence when, by definition, nothing in the cinema is actually "there" except resurrected light and sound wave patterns.[52]

The advancements in CGI and motion capture challenge the notion of the actor as an indispensable proxy for the character. Moreover it marks a shift in the historical tie between the constructed image of the actor and the fictional image of the character. From Bogart's Rick, to Connery's James Bond, to Cruise's Ethan Hunt, to Schwarzenegger's Terminator, to Chris Evans's Captain America, these are all powerful fictional characters deeply related to their interpreters. Yet, in more recent filmic representations, the link between these two constituent elements (actor and character) is stretched, or weakened, by means of digital effects. Clearly, Serkis' goal is for his performance to be linked directly to him as actor (with all the stardom included) even if the actual character on the screen doesn't resemble him at all, and may be some strange gigantic monster. However I agree with Wojcick when she says:

> Discussions of film acting must find a way to account for the role of technology in performance. Rather than assert an identity between voice and body or a non identity between acting and technology, we must describe film performance as nonauratic and always already mediated.[53]

Nevertheless, the problem of where, between actors and animators, to attribute authorship of the final rendering of character cannot have a theoretical solution. My suggestion is that as long as technology continues to develop, the link between actor and character may be stretched to a point where the exterior similarities of the two vanish completely. We are now in a situation where the job of the actor is best represented as existing on a spectrum ranging from real acting to digital acting. And the actor's location on this spectrum defines the extent of his/her authorship of the final rendering of their performance. This final rendering can be the outcome of one single individual who can claim the whole and organic responsibility for what the audience sees, it can be a collaboration between different individuals (for example, actors and stunt

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[51] Barbara Flueckiger, *op. cit.*, p. 45.
[52] Judith Roof, *The Actor Who Wasn' t There: Economies of Absence in Virtual Ecologies*, «University of Toronto Quarterly», vol. 83, fasc. 3, 2014, pp. 625–644: 626.
[53] Pamela Robertson Wojcik, *op. cit.*, 80.

performers), or can be the complex layered result of different artists (for example, the actor, the FX director and the animators). The fictional character has increasingly become a text with many authors, whose jobs may be interdependent. The question therefore is one of determining the extent of an actor's authorship in any given situation, and not at all a matter of defining which points on this spectrum denote "true" acting and which do not; it is a matter of lifelikeness and believability, or consistency to the aesthetic goal of the work.

Nevertheless, it seems quite clear that the media are testing the limits of audience acceptance. Rather than worrying about fitting into a specific category (animation or live action), the industry is challenging the boundaries of the traditional genres and production types. This is possible because digital cinema is now overcoming the problem of "nearly but not quite enough" realism in the image. Thus the question arises of what the consequences of crossing the "uncanny valley"[54] will be. What has already been anticipated in the video game world may now occur in film and television. Once technology is able to render completely lifelike synthetic characters, it will be probably the case that acting becomes not only the territory of the actor's body and voice but also a ground for digital artists to create engaging characters. Freedman foresees the increased blurring of these boundaries in film production.

> If identical technology can be used to create both live action and animation, the latter may now be defined as an aesthetic choice rather than a production technique.[55]

In other words, the distinction between animation and live action movies, once based on two completely different production practices, is now meaningless because the production systems have changed. Thus, whether the movie it is made using animation or live action becomes relevant only as a stylistic option of the author. It is irrelevant whether or not Serkis wins his battle over the Academy, as long as the audience is able to make an emotional bond with the characters on screen (in whatever way they were created). Each member of the audience, once seated in front of the screen, rather that conjecturing whether what he or she is watching is animation or live action, will question only the believability of the character. Characters have always been constructed in some respect; they are cultural and technical constructs, invented by an author, rendered by the well-crafted dialogue of a dramatist, and delivered by a skilled

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[54] «This blurring of the real and the digital became possible in movies recently when moviemakers reached a long-anticipated milestone: they crossed the "uncanny valley." The term has been used for years to describe a problem faced by those using computer graphics to depict realistic human characters. When these creations stopped looking cartoonish and started approaching photo-realism, the characters somehow began to seem creepy rather than endearing. Some people speculated that the problem could never be solved; now it has proved to be just a matter of research and computing power», Tekla S. Perry, *Digital Actors Go Beyond the Uncanny Valley*, «spectrum.ieee.org/», 27 May 2014, http://spectrum.ieee.org/computing/software/digital-actors-go-beyond-the-uncanny-valley (last accessed 10 March 2016). The term was coined by Masahiro Mori in an Japanese paper in 1970; an English translation is available at <http://spectrum.ieee.org/automaton/robotics/humanoids/the-uncanny-valley> (last accessed 10 March 2016).

[55] Yacov Freedman, *op. cit.*, p. 47.

actor on stage or by the astonishing possibilities of CGI on screen: they are all artificial.

A new territory for actors and directors
Obviously, the environment in which the actor performs is of great importance. However, motion capture usually takes place in a studio fitted with special cameras and lighting, forcing the actor to work in a kind of aseptic environment. On the other hand we know that for a large number of film productions the set (or part of the scenery) consists of real objects in front of a blue screen. Often, even on the theatre stage, actors build their own imaginative environment out of a space decorated only with minimal elements. Despite their sparsity, the physical objects within the film set or on the theatrical stage set provide a context not only for the actors but also for the camera or audience. In the motion capture studio, the cameras do not even see these elements because they are purely recording data generated by the actors' movements. As an apparent result, the shooting floor should need no props or scenography whatsoever, because the movement will be applied to a virtual character and inserted into scenes which are created digitally or filmed elsewhere.

Therefore, at least in the case of passive marker technology, the motion capture production environment is a very strange one (compared for example with a live action feature film shoot): an enclosed space with no physical references to the fictional location, washed out by white lights.[56] This condition may be wholly unfamiliar for the actors and, indeed, it has become standard to provide them with see-through set design elements (usually made of metal grids) that simulate walls or doors, and a few props (chairs, table, platforms) to create a sense of the space where the action takes place. In some cases the actors handle objects (where applicable) to improve the realism of their movements. Usually, these objects are marked as well, so as to be tracked and used in animation, whereas the set elements are there only for the purpose of helping the actor to have some physical reference, an orientation, and will not appear as recorded data (Appendix 10).

We have seen that advancements in technology have allowed the motion capture shoots to take place directly on site (as with the active marker technology used in *The Dawn of the Planets of Apes*). In this situation the environment is no longer the void of the studio but may be any kind of real location (a forest, a street…), with the actors performing under more normal conditions. We also know that on-site motion capture does not exclude the use of the studio to shoot the same action again – in fact this is done more often than not, as it gives the animator a greater amount of data and references to work from.

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[56] As recalled by Serkis: «Sometimes when you're in motion capture and you're doing a film like Tintin for example, it's a very clinical, very dry environment. It's more like the equivalent of working on a stage rehearsal space so you have to do a lot of work internally and using your imagination», in Christa Ktorides, *Dawn of the Planet of the Apes' Andy Serkis: "It's so Much Easier Working on Primates"*, DIY, 17th July 2014, <http://diymag.com/2014/07/17/dawn-of-the-planet-of-the-apes-andy-serkis-interview> (last accessed 10 March 2016).

Before the actual shooting can start, there is a routine to be followed: donning the special suit; putting the markers in place; maybe also fixing the head-mounted camera and, finally, going through the so-called T-pose, with your feet parallel, legs slightly apart, back straight, and arms extended outward. Delbridge explains that «this pose (currently adopted as the general standard) keeps all markers at a relative distance from each other to prevent marker swap in the construction of the template».[57]

As well as the other movements the actor performs, there is a series of movements called Range of Motion, needed to calibrate a virtual character skeleton (usually involving the rotations of the limbs and of the torso) (Appendix 11).

Once this routine is complete, the actor is linked to a digital skeleton, and this may even be used to animate, in real time, a virtual figure that resembles the character to be rendered in postproduction. Serkis explains:

> When you calibrate your avatar, you are a kind of both marionette and puppeteer at the same time [...] You're controlling it in that way. And you're responsible for the relationship you have with your avatar, if you're given that opportunity.[58]

Once in the studio or at the film location, and having calibrated the avatar, the kinds of task that the actor has to undertake may vary considerably, depending on the type of production. For a feature film, he or she may be asked to act in a scene with fellow actors and deliver his/her lines; in a video game he/she might perform numerous variations of the same action.

Although there is not yet a great deal of literature on motion capture acting methodology, some contributors have tried to identify its key features. Daniel Kade, who has written a thesis on the topic, underlines four basic requirements for the motion capture actor. The first is quite generic, namely «good acting skills»; the others (imagination, body language, athleticism, know-how), although quite generic too, are more specifically relevant to motion capture.[59]

Imagination is a quality routinely associated with the work of actors, but it takes on an additional significance in the peculiar conditions of the motion capture production environment. Kade states that «the current acting environment in a motion capture studio does not provide a natural acting environment for an actor, especially when we compare it to stage or film acting», because of the absence of real and physical references (such as the set, the objects, the obstacles).[60] This, he suggests, increases the challenge facing actors

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[57] Matt Delbridge, *op. cit.*, p. 27.

[58] Joao Medeiros, *Andy Serkis is changing the face of film-making*, «wired.co.uk», 6 July 2014, <http://www.wired.co.uk/magazine/archive/2014/08/features/planet-of-the-apes-andy-serkis> (last accessed 10 March 2016).

[59] Cf. Kade, Daniel, Rikard Lindell, Oguzhan Özcan, Rikard Lindell, *Towards Stanislavski-based Principles for Motion Capture Acting in Animation and Computer Games*, in Paula Tavares, Pedro Mota Teixeira, Alan Male, Marta Madureira, Jorge Marques, Manuel Gaspar Albino (eds), *2nd International Conference in Illustration and Animation*, 277–293, Porto, IPCA, 2013. http://www.confia.ipca.pt/files/confia_2013_proceedings.pdf, p. 289. I will discuss these "qualities" in the following pages.

[60] Kade, Daniel, Towards Immersive Motion Capture Acting Design, Exploration and Development of an Augmented System Solution, Licientiate Thesis, Malardalen University, 2014, p. 4.

because of the privation of any real (or realistic) scenery.[61] Approaching the problem from a technological point of view, he considers that a key development towards a better motion capture system would be the design of an immersive environment. Thus he concludes that the creation of some visible virtual content yields the greatest positive result in helping an actor to perform.[62]

Another example, also centred on the experience of the actor, is a series of empirical experiments conducted by Delbridge in a number of motion capture sessions with actors from different training backgrounds. Here he tested a variety of acting tasks to investigate how the actors responded to the new environment and adapted to the technology. Yet even in this case the methodology involved some kind of visual aid; in particular, a large screen in front of the actors on which they were able to see, in real time, their avatar within a virtual reconstruction of the typical Elizabethan stage. The experiment aimed to test how the actors were able to merge the experience of the real (yet aseptic) space in which they moved, with the 3D virtual stage in which their avatars were living.[63]

Albeit from different perspectives, Kade and Delbridge both devote considerable effort to solving the problem of the overly aseptic environment in which motion capture takes place. They stress the lack of physicality in the space as the major flaw in the motion capture system. Both focus on how to provide environmental feedback to the actor. Kade's solution winks to the possible use of motion capture as a user interface for new, immersive 3D forms of video game. Dulbridge seems to foresee the possibility of real time presentation of virtual characters in a live performance.

The need for a visual reference has not generally been addressed in the movie and game industries. For instance, the director John Dower consciously discourages his actors from staring at screens or monitors while performing for capture as he finds that it misdirects their focus.[64] Furthermore, although it is important to provide actors with the optimal conditions for using their imagination, this should not necessarily be in the form of simulated environments, because this would underestimate the actors' ability to imagine and create their own worlds in which to act. As Dower points out, the actor needs to focus on his or her presence rather than be distracted by a reference on a screen or a monitor. Almost all actors' descriptions of their experience of motion capture have stressed the powerful sensation of being free to imagine the world rather than the difficulty of acting in an empty space. In any case, the advancements in technology have made it possible to capture movement in real, open sets, rendering the whole issue of the lack of an environmental context almost obsolete, or at least not greatly different from that faced in traditional film shoots. What is far more relevant is the attention actors need to pay to their own presence in terms of concentration and the selection of tasks to be rendered. Rather than visualizing the details of the virtual environment where the character will appear, the actors have to be aware that their movements are only one part of a larger composition of character, and calibrate them accordingly.

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[61] *Ivi*, p. 14.
[62] *Ivi*, p. 9.
[63] Cf. Matt Delbridge, *op. cit.*
[64] Cf. the interview with John Dower that follows this paper.

This brings in the essential issue of body language, a skill more pertinent to motion capture than to any other acting environment, given that the overall goal of the shoot is to record the expressiveness of body movement. Typically, facial expressions are provided through the work of animators or by other actors, whereas body movements are more directly recorded through the actor's motion capture. For example, in *The Curious Case of Benjamin Button*, Brad Pitt's CGI character's aged face was superimposed onto the body of a child actor. In the *007 Legend* video game, as recalled by the director John Dower, the motion capture actor provided the body movement but not the face or the voice.[65] Even in the most recent and advanced applications of performance capture (from the *Planet of the Apes* saga to the *Tintin* animated 3D version) the actors' main task was to provide emotionally engaging actions and behaviours for their characters, while the animators would use the face markers to render an effective range of facial expressions.

Body language is also crucial in terms of athleticism, which is essential in video game, where the actors need to deliver complicated physical performances alongside emotional rendering of the movement. Thus, as Kade points out, «the actor should be physically fit. Being an athlete, stunt performer, dancer or similar might help in many cases».[66]

Finally, being a motion capture actor requires sufficient know-how of the technology involved. For example, an actor that knows the T-pose and the Range of Motion will save time for the settings operator. Besides that, knowing the importance of the markers will ensure that the actor immediately calls for a replacement should a marker get lost. The know-how also includes a general understanding of the norms to be followed on the floor of a motion capture studio. (Although in some case these norms are the same as those for any other film or TV production with a tight schedule, such as the necessity to learn the script or the action on the very day of the shoot.)

We can see, then, that many requirements for acting in motion capture are still quite generic, and there is not yet therefore a specific actors' training. Nevertheless, courses and seminars are becoming far more common. The UK-based Mocap Vaults are one of the forerunners in providing training (offering both a generous archive of educational video and a series of workshops held in Europe and the US). Although not yet mainstream in traditional film schools, motion capture is starting to gain a foothold in universities and private companies, where acting classes dedicated to motion capture are beginning to appear.[67] A glance over the content of these courses suggests that the main concern is to allow the student to gain direct experience of the new technique, but not much it is said about the specific acting method. It goes without saying that the emergence of courses is due to the enormous growth of the motion

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[65] Cf. Ibid.

[66] Kade, Daniel, Rikard Lindell, Oguzhan Özcan, Rikard Lindell, *op. cit.*, p. 289.

[67] A simple internet search shows how pervasive motion capture has become in education. For example: Vicon collaborated with Bradford University (UK) in providing motion capture courses; Mount St. Mary's University (Maryland, USA) held a course in Acting for Motion Capture; Organic Motion provided the technology for a Masters at the New York University Tisch School of the Arts Asia (Singapore).

capture market both in film and video game. Undoubtedly, among the various opportunities becoming available to an actor wishing to advance his or her career in the last decade, motion capture training is the new baby in the family. Woody Schultz, chairman of the Screen Actors Guild's performance capture committee, who has considerable experience in the field, points out how motion capture is changing the nature of actors' work - thanks especially to high-end video game.

> *L.A. Noire* cast more than 200 actors. That's a lot of actors who'd never been exposed to performance capture and now have that experience. Compared to 10 years ago, many more actors now understand firsthand that the approach to performance capture is no different than any other acting job.[68]

Video games represent a stronghold in the motion capture industry and are the field where most actors find new jobs, and where a new profession is emerging: something that has yet to be fully understood. As reported by David Cage of Quantic Dreams, there is something special about the experience of motion capture acting.

> Directing actors in performance capture is a very special job […] It's not like being director on a set. It's probably more challenging even than dealing with green screens. You rarely shoot an entire film in green screen; here you shoot the entire game. So the role of the director all the time is to explain what's going on, and try to recreate reality on set so the actor knows what to do. It's a very different experience for actors.

> On the first day you can read in their eyes 'what am I doing here? These people are crazy!' […]. On the second day they seem to realize: wait a minute, I'm free. I don't know what these guys are doing but actually they don't give me any constraints. There is no camera, no lights, no marks on the floor, no wire of any kind. We don't need to take care of sound or anything, so I'm free to act. [69]

Final considerations

Although the subject is still too young for a retrospective analysis of historical trends and acting techniques to be possible, certain theoretical considerations are beginning to emerge around potential future shifts that motion capture might induce in the field of acting.

Given motion capture's close links with the gaming industry, one of these considerations is the notion of interactive story and its implication for actors and acting. David Cage, in a tentative definition of acting characteristics in a motion capture environment, draws comparisons with the sense of freedom that the actor must attain in what he calls "minimalist theatre", where the stage is an almost empty space which must be filled with the work of imagination.[70] In this new territory, he suggests, the most striking difference is made by the notion of interactivity:

> There are key differences, though, most notably the interactive element of things – this necessitates not only the recording of different lines and scenes according to

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[68] Hugh Hart, *op. cit.*

[69] Pete Davison, *David Cage: "We Can Use Technology to Say Something"*, «USGamer», September 4, 2013, <http://www.usgamer.net/articles/david-cage-we-can-use-technology-to-say-something> (last accessed 10 March 2016)..

[70] Ibid.

the choices the player makes, but also considering how the finished product will be "filmed". [71]

In game production, an actor may be asked to play different actions, to embody whichever choice the player may make. Similarly, he/she may be asked to perform the same action (such as being hit by a gunshot) again and again, in numerous variations. In short, the actors must perform their character to follow a multitude of possible plot trajectories. Rather than being bound by a single chain of cause and effect, the actor must create a whole host of possibilities in the elaboration of his or her character. These may be built on a few key character features (personality, physicality, motivations, etc.) and must be consistent with the overall plot. The situation is comparable to what happens in theatre rehearsals, where actors try out different solutions for a single action and, with the ultimate help of the director, chose only one. In the case of the motion capture studio, however, although the actors must have a similarly rich imagination in order to provide multiple solutions for an action, the difference is that the entire spectrum of these actions may be used in the video game release.

As with virtual storytelling, where we may refer to a 'database narrative', the notion of interactivity in video game production may induce us to consider the actor's performance as a database of behaviours.[72] Mark Wolf says:

> After slightly more than a century of cinematic technology, actors have today become databases of performance components separable into a series of individual elements each of which can be manipulated and recombined in postproduction. [...].[73]

Thus, in video games, the notion of actor as database calls into play the cinematography itself - not only in the cutscenes but also in the gameplay. As Dower stresses, a large amount of agency in video games is left to the player, who is free to direct the character, which frequently also means selecting the viewpoint and frame through which the action will be seen. As Dulbridge says, «these decisions can be made after the shoot, in several different permutations or, indeed, by the end user, depending on the user interface».[74]

In contemporary video games, the player experiences the narrative through a screen; therefore, even if the motion capture does not require framing (the event recorded does not need to be enclosed in a specific camera frame), the final rendering of the action captured must still take camerawork into account. Of course the camerawork in video games it is often handled by an algorithm, yet it still represents an important asset for the success of the work. Indeed, to avoid the traditional and most widely used over the shoulder viewpoint, Cage and Quantic Dream have developed a tool (used in *Heavy Rain* and *The Sorcerer*) to provide more cinematographically engaging frames and virtual lenses.[75]

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[71] Ibid.

[72] For the notion of database narrative cf. Lev Manovich, *Database as a genre of new media*, «AI & Society», v. 14, n. 2, 2000, pp. 176-183; Lev Manovich, *Database as Symbolic Form*, «Convergence: The International Journal of Research into New Media Technologies», June 1999, vol. 5 no. 2, pp. 80-99.

[73] Mark J. P. Wolf, *op. cit.*, p. 55.

[74] Matt Delbridge, *op. cit.*, p. 30. Cf. also Pete Davison, *op. cit.*

[75] Ibid.

This leads us to the other main consideration that has been highlighted by many people involved in motion capture: the fact that the actor loses both the notion of camera framing and/or the audience's point of view. In a motion capture environment, regardless of the technology used (optical marker, inertial, etc.) a key consideration is the Volume where the actor is recorded, i.e. the size of the space where the data is collected. Delbridge says:

> Depending on the capture that is being undertaken, the volume will be adjusted. These variables include: the number of objects to be captured, the type of performance to be captured, and the physical properties required in the space for performers to interact with. [76]

From his perspective, motion capture induces a «theatrical approach to performance» precisely because it records the entire event «in real time unhindered by device limitations (like the frame)». In his words, the freedom experienced in motion capture

> is clear of the traditional hurdles encountered in the profilmic set up and continuity of film production. It abandons the onerous repetitions required for the ongoing reset and reframing of physical environments, enabling performance to occur and its inherent theatricality to re-emerge.[77]

I would dispute the affirmation that the theatricality of a performance relies on the absence of certain technical elements of film production: the theatre stage can also be a highly technical environment in which to perform. Thus, rather than claiming a theatrical ascendancy for motion capture acting, I would prefer to view it as belonging to the general category of acting for a particular shooting technology.

There is no doubt, as we have noted before, that the production procedures for motion capture are different from those for traditional live action film. At least hypothetically, the recording does not have to take framing decisions into account. Ants Farrel, a performance capture technician who worked at Weta Digital, says:

> Traditionally, if you want to capture a scene – say two actors at a table – you would have to cover all angles and that would be a day's work […] With performance capture, actors can just play out the scene as they would in theatre. The cameras around the Volume capture everything. Then the director can just come into the Volume with his virtual camera and play it back over and over and cut it as he pleases.[78]

Therefore, if the actor in motion capture, like the actor in live action filming, is acting for a technological device (and not for a live audience), the difference is that in live action the actors act for the camera, whereas in motion capture they act for the Volume. Yacov Freedman says:

> As Robert Zemeckis contends, the function of motion capture is to retain a performance, but the goal of motion capture is to effectively eliminate the camera. By transporting actors onto a fully digital stage, motion capture allows filmmakers

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[76] Matt Delbridge, *op. cit.*, p. 30.

[77] *Ivi*, p. 4.

[78] Joao Medeiros, *Andy Serkis is changing the face of film-making*, «wired.co.uk», 6 July 2014, <http://www.wired.co.uk/magazine/archive/2014/08/features/planet-of-the-apes-andy-serkis>.

to create shots without ever looking into a lens, move the image in ways that defy physics, and experience an infinite amount of angles during editing, all the while maintaining the indexical weight and "truth" of recorded cinema.[79]

Within the field of this new cinematography, a further consideration that may challenge the traditional work of actors is that of editing within the shots. Digital cinemas have vastly increased the possibility of composing scenes through different layers of images, far beyond the simple blue screen effect. Nowadays, the director has the ability to add a number of layers, virtually as many as he or she wishes, to a single scene, and can therefore edit the actual shots. Mark Wolf suggests:

Just as film broke up theatrical performances into series of shots, special effects breaks up shots and the performances themselves into elements.[80]

Yacov Freedman writes:

Steve Starkey, the producer of both *The Polar Express* and *Beowulf*, explained that by capturing an actor's performance in 360 degrees of data, Zemeckis can determine many crucial elements – such as camera placement, lighting, and set decoration – at any point during the production with an ease and flexibility that had been previously unthinkable. Motion capture, it seems, even blurs the traditional markers of preproduction, production, and postproduction. Furthermore, it gives the filmmaker greater control of the performance without sacrificing the original performer, allowing for a clearer, more direct artistic vision from both actor and director.[81]

For the editing within the shots, the actors must bear in mind that the different actions performed in a scene may not only be temporally connected with others (as happens in live action post-production editing), but must also be aware that their performance may be part of a complex composition where, for example, the actions of other people on set may be inserted or removed. Thus it is fairly normal that a motion capture actor may be asked to produce a certain set of data (the actions) in a situation where other people (fellow actors, stage crew…) who are in direct physical contact with him or her, perhaps helping him or her to carry out the action, will disappear in the final composition, while other characters will be inserted in.

Finally, there is a more ontological shift in the actor's work, which lies in the awareness that his or her performance may be stripped of all remaining connections, mediated or not, with the physical reality of his or her body, leaving it as pure digital data.

As Delbridge describes it:

The captured data of performance contributes to a language that isn't fleeting, like a live performance, nor preserved organically and chemically, like film, but is stored immaterially in a language form known as data. [82]

[79] Yacov Freedman, Is It Real . . . or Is It Motion Capture?: The Battle to Redefine Animation in the Age of Digital Performance, «The Velvet Light Trap», vol. 69, fasc. 69, 2012, pp. 38–49:47-48.
[80] Mark J. P. Wolf, *op. cit.*, p. 57.
[81] Yacov Freedman, *p. cit.*, p. 42.
[82] Matt Delbridge, *op. cit.*, p. 30.

In the case of actors in a live theatrical performance, we see their physical bodies on stage. TV or movie actors are at least aware that a beam of light will offer the illusion of their body for the enjoyment of the spectators. Even voice actors who provide dialogues for an animation movie would be aware that the final render would retain some sense of physicality in the form of the sounds waves they have produced. The motion capture actor, by contrast, is providing nothing more than a set of digital data, a kind of instruction or score to be played by someone else (usually the animator). Of course, any kind of digitally recorded data can now be digitally manipulated (whether image or sound), but with motion capture the nature, purpose and goal of the activity itself is to provide a very specific set of digital data. The performance given by the actor is abstracted into a list of information, becoming a text in much the same way as a musical score or the symbols of dance notations. But this score can be re-played (and even manipulated) to run a different event to the original one that produced the data. Although cinema and TV have already pushed the live performance of the actors toward the realm of texts, they still maintain a simulacrum of the original event. Motion capture seems to have the potential to remove all reference to the live event whilst still being able to maintain the realism of the action and retain emotional information which the audience is later able to infer.

This leads to our final consideration. We have seen that, in motion capture, movements can be abstracted into a list of data; the live action of the performer is encoded into a text for future use, just as much as software is able to automatically translate sounds played on a keyboard in a musical score. Needless to say, any enactment of a score into a live event involves translation or interpretation. We may similarly suggest that the motion capture actor does not provide a performance per se, but a text to be played and interpreted by the animators. The data the actors provide can be used in a different setting from the one imagined at the moment of shooting, the pace of the movement can be changed, the length can be increased. But there is one thing that will be retained: the emotional mood of the action. Just as, although a score or a script may be read or performed in different way, unless the data is radically changed, it will hold its original sense.

Motion capture plays with our innate capacity to perceive human action as significant and to make sense out of it. Now that we have become accustomed to the evocative power of the shadow on the screen, we can start to elaborate upon the potential of a set of dots distributed in space and time.

Overview of motion capture systems

In the last three decades the technology for capturing and tracking spatial and temporal information relating to a movement across 360 degrees has developed and changed in terms of both application and scope. Here we provide an overview of the systems, marking only the primary differences between the various technologies available.[83]

1. **Optical systems**

   To date, the most widespread and widely used motion capture systems are optical. All these obtain tracking data through optical recordings: an array of video cameras record the action within a given space. The term 'optical system' is a broad definition under which we include different technologies. Foremost there are marker systems, i.e. systems that record movement by positioning a number of markers onto the performer's body. Basically, the cameras do not record the body itself, but only the position of the markers within the space.

   a. **Passive Marker Motion Capture**

      The best known systems are based on Passive Markers. These usually take the form of a tiny white sphere covered with retro-reflective fabric that allows them to be tacked by infrared cameras, a given number which are all pointed towards a given space, usually called "the floor". The larger the space to be tracked, the more cameras are required. The performer wears a tight spandex/lycra bodysuit onto which there are velcroed, at given points, a number of markers (traditionally between 35 and 50) that reflect the infrared light. Each camera is equipped with an infrared lamp so as to light the entire space. The camera's threshold is adjusted in order to record only the bright reflective markers, and nothing else in the space. All the cameras are connected to software that processes the recorded data, and stores it on a drive. One of the most important steps in this process is the calibration of the cameras, i.e. correlating the cameras with the actual environment, in order to provide the software with the location of each one in relation to the others. This usually takes place using the same software. An operator, in the centre of the floor, moves a "T-shaped wand" onto which are fixed some markers at specific points; the data recorded by the cameras allows the software to calculate the relative positions of each camera, and creates a 3D reference for each of them. After this step, the system is able to record the x, y, z data of each point in the space. Thus, if at least two calibrated cameras can record a

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[83] A detailed description of the systems used it beyond the scope this paper, but a reasonable amount of information available online. I suggest starting with the dedicated Wikipedia page: Wikipedia contributors, *Motion capture*, <https://en.wikipedia.org/w/index.php?title=Motion_capture&oldid=676025973> (accessed August 25, 2015). The book still providing the main reference for the topic is Midori Kitagawa and Brian Windsor, *MoCap for Artists: Workflow and Techniques for Motion Capture*, New York, Focal Press, 2012.

marker, the system obtains a three-dimensional fix of it. To complete the capture, the software not only locates the markers on the performer's body but also couples them with the points of a virtual skeleton according to the H-Anim standard. This means that the points in space on the body of the performer are uniquely mapped on a humanoid skeleton; for example, the standard requires that the marker on the performer's head must be mapped to the extreme point of the skeleton's skull.

The data is fed to another piece of software that will create a screen-based 3D impression. The data can be recorded and then applied and played onto any synthetic agent to be animated, provided that the original markers correspond to the rigging on the agent.

b. **Active Marker Motion Capture**

Although it is based a similar principle, Active Marker Motion Capture represents an improvement on the passive technique because it uses LED markers connected by wires to the motion capture suit. Instead of using specific infrared lighting for the environment, this system relies on the light emitted by the markers. In fact, in this case, the marker provides its own signal; therefore, it can also convey its own ID (for example by strobing one marker at a time). This reduces the need for complex algorithms to eliminate overlapping and confusion between the different markers. A further benefit of this technique is that, since it does not require a studio with specific infrared lighting, it allows movement to be captured in an open environment. Its shortcoming is that the performer must also wear a battery or charger pack. The Active Marker technique is the one usually employed when motion capture is required alongside live action filming, and when the shoot needs to take place on open air sets, real locations, where it would be impossible to strictly control the light conditions (as, for example, in the case of *The Dawn of The Planets of Apes*).

c. **Video / Markerless**

Despite the now iconic image of the motion capture performer wearing a bodysuit with markers, there are other systems that still rely on cameras, but do not require markers because they use algorithms capable of recognizing, within a normal video shoot, the contours and the position of a given subject so as to track its movements. The results depend on both the number of cameras in use and on the algorithm that processes the information. The equipment can be very basic, such as three cameras tracking the position of a body in a three dimensional space, or it can be scaled up to incorporate a higher number of cameras able to track more than one agent and provide more detailed resolution of the movement (i.e. the moving part of the agent's body). Typically, this type of technique requires the performer to be positioned against either a neutral background or one appropriately marked

with lines or other specific signs, so that it is easier to recognise the contours of the figure and to track its movements in the three-dimensional space. Usually the accuracy of this systems depends on the quality of the data processing and therefore on the specific algorithm used; however, the level of error in the captured data tends to be wider than with marker-based solutions. Recently, these systems have undergone further developments by improving the data recording device. The most famous example is the Kinect that (thanks to its camera, a depth sensor and multi-array microphone) is able to provide a reasonable capture of the body movement in space even if taken from a single viewpoint.[84] Among the other integrated systems for optical markerless motion capture, OpenStage 2 is, according to its producer, Organic Motion, the only professional system on the market to deliver accurate tracking with no markers.[85]

2. **Mechanical Motion Capture**

If we leave aside the whole range of optical systems, i.e. that uses video, then we enter a field where the choice of solutions is wider and, even if these solutions are less well known, their relevance in the industry is growing. For example, Mechanical Motion Capture has been used for scientific measurement and also in experimental theatre and dance performance. It can be carried out in different ways.

a. **Electromechanical**

The key feature of this is that the capture is achieved using electromechanical devices attached at the joints and pivotal points of the body. Typically, a mechanical motion system consists of electrogoniometers - a sensor system consisting of potentiometers or transducer technology designed to estimate joint angles. These devices can be individually attached to the body of the performer or can be incorporated into outfits. When such an outfit is composed of a set of rigid elements and articulated joints, it is usually called 'exo-skeleton'. The purpose of these devices is not usually to track the subject's position in a tri-dimensional space, but to record the angles of the actor's joints. This kind of technology is often preferred for live performances because it is fairly inexpensive, can be used in any environment and does not require a special lighting set. For example, the exoskeleton has been applied by Marcel·lì Antúnez Roca in *Afasia* (1998) and, with minor developments, in many of his subsequent productions.[86]

b. **Electromagnetic**

A less frequently used system is Electromagnetic Motion Capture, which utilizes sensors placed on the body to measure the low-

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[84] Cf. J. Han, L. Shao, D. Xu, and J. Shotton, *Enhanced Computer Vision with Microsoft Kinect Sensor: A Review*, «IEEE Trans. Cybernetics», vol. 43, n. 5, 2013.,

[85] Cf. <www.organicmotion.com> (last accessed 10 March 2016).

[86] Cf. Antonio Pizzo, The Kaleidoscopic Career of Marcel·lì Antúnez Roca, «The Scenographer», 2015.

frequency magnetic field generated by a transmitter source. Both sensors and source are connected to an electronic control unit that links their locations within the area. This unit is networked with a computer that runs software which is able to represent these positions in a 3D space. With this technology it is possible to track the movement without the need for specific background lighting. It must be said that these systems can be highly influenced by magnetic and electrical interference (e.g. metal objects, any kind of wiring, electrical sources). For this reason, they have generated less interest in theatre and movie sets where avoiding these kind of interferences is almost impossible.

3. **Inertial Motion Capture**

   Recently, the miniaturization of technology has introduced in the market the Inertial Motion Capture. This solution is in some ways similar to optical systems using active markers but with the difference that, instead of markers, it uses special sensors (usually wireless) located on the body or subject whose movements are to be captured, which then transmit position data to the software. Although there are several types of inertial sensors, most use gyroscopes. As with optical systems, the position data is mapped onto a skeleton, so the higher the number of sensors, the more accurate the registration of movement will be. We will probably see an increasing dissemination of this technology, perhaps in the consumer market (as we have seen with Kinect), mainly because it is low cost, but also because it does not require a specially equipped studio, is very portable, and is able to capture large articulate areas. One inertial system receiving much attention is Perception Neuron.[87]

4. **Facial Motion Capture**

   In movies, and occasionally in videogames, body motion capture is often paired with facial motion capture. Under this definition we group a number of recording methodologies capable of digitally capturing detailed data about the facial expressions of the actor to be rendered on the synthetic agent. Clearly, capturing facial muscle movements requires a system which can record at a higher granularity and level of detail compared with tracking a body. Facial capture systems include marker based and markerless technologies, however the latter are considered less cumbersome for the actor. The capture is usually done with a high-resolution camera that records the actor's face from a fixed viewpoint, requiring the actor has to stay in one place in order to keep their head in the given frame. When the production requires the body and face to be recorded simultaneously, a camera is mounted on the actor's head, pointing towards his or her, so as to allow free movement around the set.

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[87] Cf. <https://neuronmocap.com/> (last accessed 10 March 2016).