# The Impact and growth of Motion Capture in Computer generated Films

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## Abstract

This study has been conducted to find out how motion capture has transformed and developed for use within computer generated films, what it is being used for and whether it will continue to have a future within animation. Andy Serkis a performance capture actor has repeatedly said that the animators of his films are generally just digital makeup artists, as he does all the performance work and they just make him look like the character. Large films such as Beowulf, The adventures of TinTin and The Polar Express have been in the limelight for their extreme use of motion capture technology, as there are mixed feelings towards the use of this animation method. By pitting the arguments of many animators together a conclusion as to whether motion capture will continue to have a big role within the production of computer generated films will be made.

# Contents

# Introduction

Motion capture has been an ever growing part of the production of Computer generated animated films; it has thrived and is being widely recognised by producers and companies everywhere. This paper will be looking into the development of motion capture and how it has been used over the years in various computer generated films and why it is being used more frequently. It will also be looking at how motion capture has affected the animation industry whether this is good or bad as well as the views of the audiences of these films. The use of motion capture has caused allot of controversy causing a divide of beliefs between animators and this paper aims to seek out why. It will then be looking into the future of motion capture and whether it will continue to thrive and end up being a leading part in the production of films and animations everywhere or whether it will eventually come to a standstill and eventually forgotten by animators.

# The development of motion capture

Motion capture is the process of recording the live motions of people or objects; this footage is then transferred over onto a computer and then used to animate a character in a three dimensional (3D) space. This is used to give the character realistic movement and appearance, whether the character looks like the actor or not. Motion capture systems that use tracking cameras whether this is with or without markers can be referred to as optical motion capture. Whereas systems that use mechanical motion are non-optical motion capture (Dent, 2014).

Before motion capture was created the original method of creating animations using the movement of actors was rotoscoping which was first invented in 1914 by Max Fleischer (Dent, 2014). Rotoscoping is the process of tracing over the actors of a live action film on each frame which would be used in the animated film. When rotoscoping was first used the images of the live action film would be projected on a glass panel and the animator would then draw over them. This medium was used in the creation of the Walt Disney animated film *Snow White and the Seven Dwarfs* which was the first use of rotoscoping within a feature film in 1937 (Dent, 2014). The use of rotoscoping allowed the animators to come to grips with the challenges of animating the movements of realistic human characters.

However Disney quickly realised that staying too close to literal realism produced disappointing consequences, which resulted in the animation looking stiff and inexpressive. When animating a performance through movement a degree of exaggeration and expressiveness is needed and this is hindered by sticking too close to rotoscoping. In *Snow White* the best animated scenes turned out to be those in which the performances of the actors were exaggerated the most. (Rowley, 2007)

Motion capture first started to appear in the late 1970s and early 1980's. The first motion capture animation was produced for the purpose of advertisement in 1984 (Gomide, 2012). Then another animation was produced using this technology the year thereafter for the advertisement of canned food in America.  Motion capture was first used as a technique in animated films in 1991, which was then used to reproduce a live performance into a digital performance.

There are different forms of motion capture, some of these are:

**Mechanical** – The actor would wear a metal suit which takes the form of a basic human skeleton that is attached to the actors back. When the actor then moves the suit then moves as well. The suit has sensors which can feel the rotational movement of the actor. The advantage of using a mechanical suit is that there is no interference from light or magnetic fields. The disadvantages are that using this technology provides no awareness of the ground, so there would be no jumping (Furniss, 2015).

**Optical** – The actor would wear reflective dots which are tracked by cameras set around the stage. These dots can be tracked by reflection or by infra-red emitions. The advantage of optical motion capture is that the actor would be free to move as there are no cable attachments to the body from the equipment. The disadvantage is that the suit is vulnerable to light interference (Menache, 2011).

In 1999 the question was asked as to whether motion capture was really animation when the animated TV show "Donkey Kong Country", which used allot of motion capture and keyframe animation was denied the right to be nominated for the "Emmy" Awards, when claims were brought up that the use of motion capture was not really animation (Gomide, 2012). However in the year 2002 motion capture was used to animate a character from T*he Lord of the Rings Them Two Towers* called Gollum which then brought about new discussions as to whether a new nomination in the Oscars should be created which would award actors who brought animated characters to life through the use of motion capture.

The debate of whether motion capture is animation still exists. Supporting the side of motion capture is animation Phil Cooper stated that for an image to be animated is for it to be endowed with the qualities of life (Jackson, 1999). Some people are unsure as to whether it is animation or not, Diana Walczak says the it is hard to say whether motion capture is animation or not, motion capture itself applied to a character is not animation, it is a performance and it is not animation unless an animator edits it (Jackson, 1999). For others the debate has become personal the animation artist Mark Kausler says "If you've done this a long time and you really love the look of drawing that comes to life, it really hurts when people call mo-cap animation" (Mallory, 2007). He suggests that the term digital puppeteering be used instead (Mallory, 2007). At the end of Pixar's "Ratatouille" they had a logo in the end credits boasting that their movie consisted of "100 Per Cent Pure Animation – No Motion Capture!" (The Economist, 2011).

In 2001 the first photo-realistic movie character was created using performance capture in the movie *The Lord of the Rings*. This character Gollum was played by an actor called Andy Serkis. At this time motion capture was just purely used to record the motions of an actor and not the emotion or performance (McCarthy 2011).

Through the early 2000s, Serkis became the public face of performance capture, showing that performance capture is a viable technique to novel realism and a legitimate form of performance in the digital era (Allison, 2011). When creating this movie the director Peter Jackson's original idea was to make Gollum an animated character, but the more he saw the power of Serkis's performance the more he started to reconsider. Later on Jackson told the 3D modellers to redesign Gollum's facial structure to resemble Andy's. "The final version of Gollum ended up being fully inspired by Andy's

performance" (Medeiros, 2014). The technique of using motion capture received allot of attention due to Andy Serkis's performance as Gollum in *the Lord of the Rings: The Two Tower (*Lozzio*, 2014).*

In 2004 the animated movie *The Polar Express* was released. *The Polar Express* was the first feature film to be shot entirely in performance capture. The use of motion capture in the shooting of *The Polar Express* proved to be allot faster than shooting a traditional live action film. As a live action version with all the locations could have taken up to eight months to shoot, but with Imageworks motion capture setup, they were able to shoot it on forty four days. Motion capture also allowed the actors to play more than one role in the film as the actor Tom Hanks played no less than 5 roles including: The dad, the conductor, the hobo, jolly old St. Nick, and a young boy (Otto, 2004).

In 2011 Rise of the Planet of the Apes was created where Andy Serkis wore a suit developed by Weta a New Zealand digital effects house that used active IR LED lights to create the performance of the ape Caesar. The *active system* was developed so that actors would be able to create strong performances between the ape actors and the human actors on in outdoor locations. The ability to be outdoors in full sunlight and capture motion was a huge advantage for them (Broughall, 2015).

## The Impact of motion capture

*Beowulf* created by Robert Zemeckis is a performance captured film that was created in 2007. *Beowulf* has advanced on the techniques that were used in Zemeckis' previous film *The Polar Ex*press, in which the movemnts of the performance actors were then mapped directly onto digital characters. This is the same technique that was used on Peter Jacksons' Gollum, however Jackson was working with characters that could not be achieved by traditional means, and the motion captured performance was sizeably reworked by their team of animators. Most of the characters within *Beowulf*, only had a small amount of involvement by animators as all that was really required of them was a few technical touch ups and no more, the main bulk was done by the performance actors (Rowley, 2007).

Film such as *King Kong* which used performance capture to assist in the animating of the movie stayed away from sticking too closely to the actors performance learning this lesson from the rotoscoping in *Snow White*, and it ended up being remarkably effective as they only used Serkis's performance as a starting point as the animated pieces were collaborations between the actor and the animators (Rowley, 2007).

In Zemeckis' film *Beowulf* most of the characters are just a mirror image of the performance that the actors gave and are not exaggerated at all. This caused the human characters in the film to often look lifeless and distasteful, compared to less realistic animated films where the characters are fully animated without the use of any motion capture technology such as *The Incredibles* or *Ratatouille* (Rowley, 2007).

A debate started after the release of *Beowulf* asking the question: what artistic purpose does the hyper-realist look of *Beowulf* serve, exactly? Zemeckis then acknowledged the debate by telling the International Broadcasting Convention in 2007 "that to call the process used for *Beowulf* animation

was a disservice to the great animators of the past" (Rowley, 2007). However then saying that calling performance capture something other than animation doesn't answer the question either.

The animated film *Monster House* created in 2006 by Sony Pictures Imageworks which used the same technology as *The Polar Express* used both motion capture and keyframe methods throughout. However they were not suing this technology to replicate reality, they took on the animation process of the characters as if they were puppets and not realistic human characters. They used motion capture actors' facial data as a foundation for the animation, and then added selective exaggerations with keyframing while maintaining the integrity of the actors' original performance. Sometimes the motion capture was only changed faintly, but a majority of the scenes were a combination of both methods. The eyes and fingers of the characters were always key-framed and a majority of the human characters body movements were done by motion capture (Bielik, 2006). There were times in the animating of the film where they felt as they needed to add something else into the scene. The animators would then be called upon to animate the whole character using keyframe animation to fill in the missing part of that scene without the assistance of motion capture. The House in the film was done completely using keyframe animation as well as the dog. "The motion capture process has a certain texture to the movement that is slightly different than most keyframed animation" (Bielik, 2006).

With the production of *Monster House* Sony Pictures Imageworks has shown how adaptable its ImageMotion system is. "We combined performance capture and keyframe animation throughout the film to create a unique hybrid style" (Bielik, 2006). They believe that the overall use of motion capture will continue to grow and expand and that motion captured does not have to be restricted to emulating photorealistic reality. It has the potential to be used in different and innovative ways.

Motion capture sessions are less demanding than traditional 3D key-frame animations. This is due to actors being able to quickly produce motion tests by carrying out various revised actions while being recorded whereas traditional animation would take time to carry out blocking passes and other tests (Steve's Digicams. 2015). Motion capture animation will give immediate and real time results (Smith, 2014). This allows animators to see what works with the character and what doesn't and make changes to an action in an instant. This also makes it allot easier to create improvised movements into a scene where the actor feels they could add more weight into the current situation, whereas it could be a huge risk in time to try and improvise a movement into a traditional animation and risk the chance of finding that it does not work too well in that scene. Motion captures allows for the shooting of infinite-angles in one take. This allows the ability to defer some of the decision making process until later on in the production pipeline which creates more flexibility (Creative Bloq, 2015).

Motion capture allows the animator to easily see secondary movements in a character such as, the amount of force that is used and the weight of a movement of impact and other physical interactions. It can be difficult for animators working from a storyboard to portray these kinds of secondary movements, however with the use of motion capture; the animator will have real movements to work from and will be able to represent these movements more realistically (Steve's Digicams, 2015).

Some motion capture animations have caused a divide between the viewers of the films created with these methods. As some people believe too much motion capture is being used in films such as

*The Polar Express* and some people believe motion captured should not be used at all and the use of motion capture is purely cheating (The Economist, 2011).

Some viewers were disappointed at the way motion captured has been used in films such as *The adventures of Tintin* where they say that motion capture makes the character step beyond the realms traditional animation, but far enough from simulating real people that it is a turn-off (Siebert, 2011). He then goes on to say that *The adventures of Tintin* may likely be the last motion capture film to be created by Hollywood for a while, or the last one to ever be created due to the soulless look of the characters.

Others say that motion capture has its uses; however they do not believe that fully motion-captured feature films should be one of them (Hickman, 2011).The use of motion capture should solely be to improve upon the performance of a film but it should not be used throughout the entire production, and some films that have taking up this trend has paid the price for it financially these films include: *Beowulf*, *A Christmas Carol* and *Mars Needs Moms* which are all fully performance captured films (Siebert, 2011).

For viewers of a performance captured film it can sometimes leave an unsatisfied taste in their mouths as the viewer will not fully be able to appreciate the thrill of amazing acting or brilliant animation as they can never be quite sure how much of either they are watching. It can leave them wondering if some actions have really been done by the actor or if they were done completely by the animators or vice versa (The Economist, 2011).

Performance captured films such as; *The Polar Express*, *The adventures of Tintin* and *Beowulf* all have something in common, which is the uncanny valley. “One of the paradoxes of animation says that if you make a character too lifelike, it crosses the line from cute to creepy” (Rose, 2007). The uncanny valley is a term which first appeared in psychiatry which states that as a character starts to get too close to looking like a human, it then begins to unnerve the viewer and can even scare them (Seyama and Nagayama 2007). A study was performed by roboticists to discover where the uncanny valley would be present to the observer of facial images whose degree of realism was manipulated by altering between artificial and real human faces. These tests showed that the uncanny valet was only present to the observer when there is an abnormal feature on the morphed faces of humans, where they had features such as unusual looking eyes (Seyama, J.I. and Nagayama, 2007).

“Performance capture tends to have a weird betwixt-and-between quality” (The Economist, 2011). The characters will look life like but something about them makes them look dead and not quite right. When computer generated character are made to look life like one small deformity can be disastrous for the film, as the viewers will be more prone to finding deformities in a character that is meant to resemble a human. In the film *The Polar Express* critics shuddered at the sight of what seemed to be dead eyed, walking mannequins (The Economist, 2011). Some believe that the performance capture within *The adventures of Tintin* is sufficiently off putting for the viewer to wish that the film was either created in live action or for it to be straight two dimensional (2D) animation. However some viewers have already been tricked by the effects of performance capture in film as Jeff Bridges plays a younger computer generated version of himself in the movie “Tron Legacy” which some viewers thought was the actual live actor playing that role (Rose, 2011).

## The Future of motion capture

Motion capture looks as though it will have a very bright future as more and more animation and film companies are looking into the possibilities of using motion capture software and hardware.

One of the advancements in motion capture is the *Captury Studio* created by The Captury, a motion capture company created by a group of researchers from the Max Planck Institue for Informatics (Falconer, 2013). The *Captury Studio* is a markerless performance capture software that captures the movements of actors and animals without the use of markers, suits or special hardware (Inition, 2015). Captury Studio works in real-time and can be used by every day cameras which makes it allot more accessible to regular animators and for outdoor performance capture. They are also in production of motion capture software called the *Captury Live* which aims to be an improvement on the current version (Inition, 2015).

This software may have the power make the use of suits obsolete as it requires less to operate than a classic Hollywood motion capture studio wood need which makes it allot cheaper and more accessible. The system only needs between five and twelve ordinary cameras around the target actor(s) and it can then detect the actor(s) movements even when they are covered up by another object or if there are interferences in the background (Falconer, 2013).

Andy Serkis is a pioneer of performance capture, even co-founding the Imaginarium studios in 2011 (Dyer, 2015). The Imaginarium has cutting edge performance and motion capture facilities, which are committed to creating emotional and amazing performances for use within, movies, TV shows and in games (Singleton, 2014). This shows that there is still great interest in motion capture technology and this interest will continue to grow. Andy Serkis's Imaginarium has now become the go-to place for motion and performance capture expertise. The Imaginarium has attracted allot of attention, as special effects companies are interested in their projects for *Animal Farm* and the *Jungle Book* film projects. They have also been enlisted in the creation for the *Star Wars* and *The Avengers* sequels. Serkis is now an essential part of many franchises such as the *Lord of the Rings*, *Star Wars* and the *Marvel Universe* (Labrecque, 2014).

The global interest in performance capture is always rising. Serkis' Imaginarium is also a centre for teaching actors the skills of motion capture performances, familiarizing them with the process of the technology. He sees performance capture as the future of cinema and training these actors is an investment into this future (Klabin, 2013). Although motion capture has had its ups and downs, it does show that it has the ability to create amazing films and the capacity to portray emotion through powerful performances as if it was actually shot in live action.

In relation to 3D keyframe animation motion capture has and will continue to have a big role in the creation of many animated films, as it will be used as a way of planning and executing the actions of a character. Companies will always be looking for faster and cheaper ways to create their visions, which may end up in the removal of drawn storyboards for visual performance capture storyboards, which would allow a much easier and faster way of showcasing scenes of a film in production. However there will still be those who believe that performance capture animation takes away the magic of bringing a character to life with your own hands and without the aid of performance capture actors as shown by the bold end credits of Pixar's Ratatouille. Motion capture may continue

to develop to the point where the use of motion capture becomes a standard in the production pipeline of any film production. Creative Bloq believes that while we still have a long time to go, it seems that the end conclusion will be that tradition 2D cinematography will be completely replaced with 3D capture for every kind of production (Creative Bloq, 2015). Motion capture combined with keyframe animation will always have a stronger visual effect than films that only use motion captured animations. This is because exaggeration gives more life to a character and makes the traits of that character stand out more whether that certain character is brave or cowardly etc. This can only be exaggerated to a certain point by normal human movement however traditional animation is not restricted by the boundaries of human movement and expression. Motion capture alone will not always give off the best visual effect and this is why sometimes viewers feel that characters seem lifeless like zombies. Even though some believe that motion capture should just be abandoned in the future it may prove to be a useful asset for all animators in the studies of realistic human motion within a 3D space. The author would like to get into motion capture animation as it is an ever growing part of the industry. Having skill with motion capture is a huge asset and the skills gained from learning this would be invaluable. With even more accessible software being produced anyone will be able to create motion captured animation where ever they are. He will be looking into the possible use of motion capture within his film. Scenes where the character interacts with objects would benefit greatly from the use of motion capture for a more realistic look. Another scene which would benefit from motion capture is one where the character attempts to climb over a wall and ends up falling off of the wall onto the other side. Motion capture would allow the author to create a more believable climbing animation as well as falling over with a clearer view of the distribution of weight within the character.

## Conclusion

Throughout this paper the development, applications and types have been discussed along with the controversies, the impact and future of motion capture to get a clear depiction of what motion capture is and where it is heading in terms of computer generated and animated films. The end conclusion is that motion capture even though it has had its ups and downs and is still going through a cycle where it is hated by some but loved by others however it is not going to be leaving the cinematography industry anytime soon. Companies are still trying to better their hardware and software to create better motion captured animations and producers will be watching and waiting for the right time to use this software. With people like Andy Serkis pushing the use of performance capture technology forward and companies like Captury continuing to build upon the technology that is already there and making it better, performance capture will be a strong part of the production pipeline of films and animations. The debate of whether performance capture animation is really animation or not will also exist for quite a while, however there may come a time when performance capture is fully accepted by everyone and will just be another method of producing film. As time passes on technology will continue to improve and innovate and with this motion capture will follow suit, motion capture has come a long way since its birth and it will continue to amaze as time moves on. As Creative Bloq said the end conclusion will eventually be that motion capture will be the go to method for cinematography for every kind of production.

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