

## The Protean Camera

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### Abstract

*This article argues that the camera is a protean, mutable figure, and investigates the power of moving image sequences to perform aspects of this multifaceted apparatus. By comparing the technical characteristics of the hand-held camera, the Steadicam, and the virtual camera to their aesthetic performance on screen, this paper offers an interpretation that underlines the influence of filmmakers and technicians in producing particular camera movement effects. Analyses of virtuosic camera movements in *The Last Laugh* (F.W. Murnau, 1924), *Atonement* (Joe Wright, 2007), and *Avatar* (James Cameron, 2009) serve to illustrate the protean nature of the camera by highlighting how films can put on display different facets of these camera movement technologies. Finally, this paper gestures towards the importance of engaging with the work performed by camera operators and technicians behind these machines, which plays a key role in producing these effects on screen.*

**Keywords:** Aesthetics, camera movements; hand-held camera; technology; Steadicam; virtual camera.

Throughout its first decades, cinema was the site of many technological innovations in ways of moving the camera, as evidenced in such films as *Panorama du Grand Canal vu d'un Bateau* (Alexandre Promio, 1896), *Kri Kri e il Tango* (anonymous, 1913), *Cabiria* (Giovanni Pastrone, 1914) and *Intolerance* (D.W. Griffith, 1916). In a video essay on camera movements and their analogies in the early decades of the medium, Patrick Keating argues that this climate of innovation grew more important in the 1920s and 1930s, becoming a battleground for two fundamentally different ways of moving the camera and, more importantly, of discussing the nature and attributes of camera movements in narrative cinema.<sup>1</sup> In particular, Keating identifies a key opposition in the practical and theoretical discourses that surround technologies of movement in this period: “the contradiction between anthropomorphism and omnipresence.”<sup>2</sup> While the former casts the camera as an embodied entity within diegetic space, the latter refers to techniques that allow the camera to become a narrator in the story by making it possible to move seemingly beyond physical and diegetic

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<sup>1</sup> Patrick Keating, “A Homeless Ghost: The Moving Camera and Its Analogies,” *[In]Transitions*, (December 29, 2015), <http://mediacommons.futureofthebook.org/intransition/2015/12/29/homeless-ghost-moving-camera-and-its-analogies>. Accessed December 3, 2016.

<sup>2</sup> Ibid.

bonds.<sup>3</sup> Underlying this dichotomy, however, is the notion that camera movements can reveal a great many things about cameras and their protean nature.

In this article, I propose to take up Keating’s premise and pursue this analysis of camera movements and the discourses that surround them. Rather than juxtaposing the discourses and practices of film technicians, the purpose of this essay is to question how films use camera movements and what those movements tell us about the machines and technicians behind the image. In short, what do camera movements tell us about the devices—and operators—that created them? What aspects of the protean and multifaceted device we call “camera” are depicted through the performance of camera movement? In the interest of cohesion and clarity, this project focuses on analyses of three key technologies that revolve around the union of body and machine, namely hand-held cameras, the Steadicam, and the virtual camera. By limiting the study to devices that share ties to the human body, this article highlights how camera movements can *perform* different aspects of the same fundamental machine: the camera. On the one hand, each of these machines possesses technical attributes that affect the types of movements they can produce. On the other hand, these machines are also operated in a certain way by technicians; taking into consideration the influence of technicians opens a path towards more nuanced interpretations of camera movement technologies. Finally, it is essential that we consider how these technologies are *deployed* in films and which qualities are displayed in the onscreen *performance* of camera movement. Analyzing the aesthetic *application* of these techniques enables us to study camera movement technologies for what they *actually do*, not simply for what they *could do*.

### The Body Behind the Image

In *The Virtual Window*, Anne Friedberg frames the photographic experiments of Étienne-Jules Marey and Eadweard Muybridge as “two separate models for how the photographic camera was deployed to record movement.”<sup>4</sup> In this passage, Friedberg’s interest in this divide lies in the decision to represent movement either within a single “spatially contained” image or in a series of “adjacent frames.”<sup>5</sup> However, by looking behind the production of such images and towards the work undertaken by Marey and Muybridge and the technical solution they developed, a similar opposition appears both in the nature of the apparatus used and in the role of the body using it.<sup>6</sup>

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<sup>3</sup> Mike Jones proposes that the notion of diegesis could be used in discussions of camera movement, particularly in the context of digital technologies and the movements of virtual cameras. Jones suggests that just as sounds and music in films can exist within or outside the space delimited by a given narrative, a camera’s movements can be constrained by the film universe or transcend these rules, to move unfettered by the limits of space and time. In this context, anthropomorphic movements follow the same physical laws that govern the other entities within the narrative, while Keating’s omnipresent camera is one that traverses space and time on its own terms. Mike Jones, “Vanishing Point: Spatial Composition and the Virtual Camera,” *Animation* 2.3 (2007).

<sup>4</sup> Anne Friedberg, *The Virtual Window: From Alberti to Microsoft* (Cambridge and London: MIT Press, 2009), 89.

<sup>5</sup> *Ibid.*, 90, 92

<sup>6</sup> It should be noted that while Friedberg does spend considerable time describing Marey’s invention of the *fusil photographique* (circa 1882), the enthusiasm displayed in the above-quoted passage is directed



**Fig. 1** Handling of Marey’s *fusil photographique*.

Source: Étienne-Jules Marey, “Le Fusil Photographique” (1882): 328.

In 1882, Marey describes in the scientific journal *La Nature* his attempts at recording the movements of a flying bird for the purposes of reproducing it using an optical toy, such as a zoetrope or a phenakistiscope.<sup>7</sup> Marey goes on to explain the technical solution he developed to achieve this goal, namely the eponymous *fusil photographique*. In a chapter dedicated to the device, Pasi Väliäho describes the composition of the apparatus: “The photographic lens was located in the barrel, while the bottom end of the barrel housed a magazine containing a cylindrical glass plate alongside two disks with shutters.”<sup>8</sup> Borrowing the shape of a hunting rifle, the camera was likewise meant to be nestled in one’s shoulder and wielded with two hands (see Fig. 1). With an eye on the viewfinder and a finger on the trigger, the operator keeps the prey in sight by moving the rifle to the best of his or her physical abilities. When the trigger is

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more precisely at his later experiments in single-plate chronophotography (circa 1894). This article focuses on the former as a pioneer in using the human body as a method of moving a camera. Furthermore, the *fusil photographique* constitutes an important example of the way in which motion pictures are the product of their means of creation (i.e. how a given camera was operated in a certain way by a particular person).

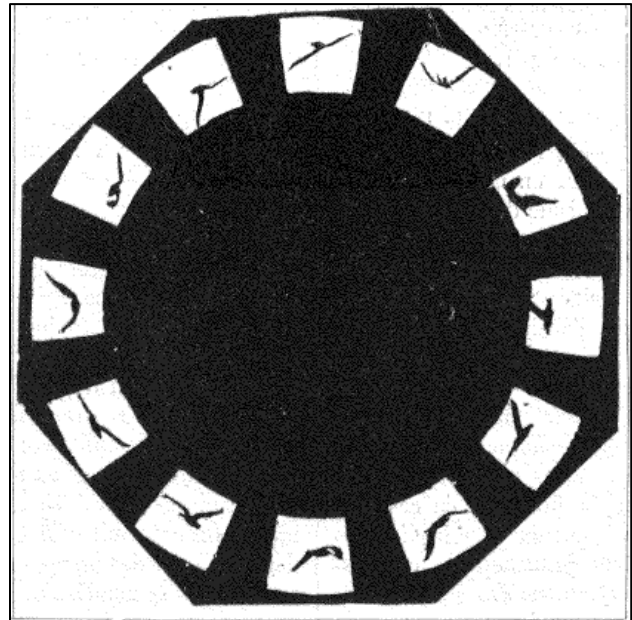
<sup>7</sup> “Ce fusil donnerait une série d’images successives prises à différents instants de la révolution de l’aile. Enfin, ces images, disposées sur un phénakistiscope de Plateau, devraient reproduire l’apparence du mouvement des animaux ainsi représentés.” *Ibid.*, 327.

<sup>8</sup> Pasi Väliäho, “Marey’s Gun: Apparatuses of Capture and the Operational Image,” in *Technē/Technology: Researching Cinema and Media Technologies – Their Development, Use, and Impact*, ed. Annie van den Oever (Amsterdam: Amsterdam University Press, 2014), 171.

pulled, the *fusil* records the movements of the flying bird in a series of twelve images spanning one second (see Fig. 2). By proxy, the images produced also act as a record of the movements of the body that were necessary to create the image. The product of this capture is therefore a series of images that, when viewed as intended in rapid succession, reproduce the movements of the bird as they were seen from the perspective of the person wielding the *fusil*.

**Fig. 2** Photographic plate of Marey's *fusil photographique*.

Source: Étienne-Jules Marey, "Le Fusil Photographique" (1882): 329.

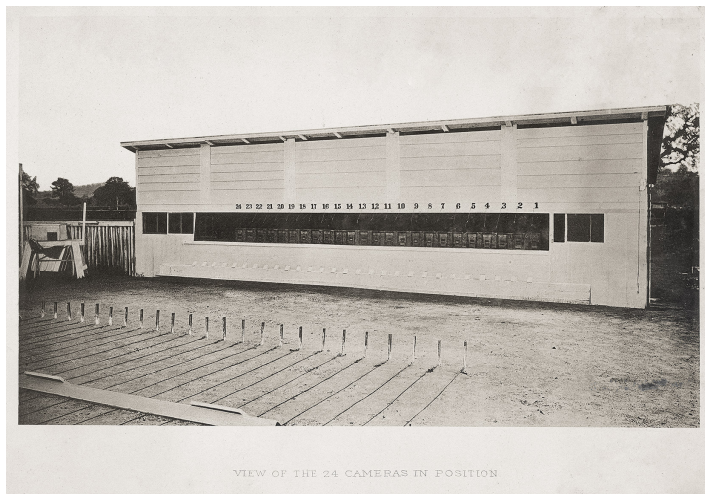


Opposite Marey's hand-held rifle camera, we can look to Muybridge's camera to weigh the importance of a device's technical attributes and of the body operating it, if any. Assembled from twenty-four photographic cameras (see Fig. 3), this machine could capture the successive positions of a galloping horse, specifically in a scientific attempt to dissect its movements into their "component parts."<sup>9</sup> The device was unmoving and passive, activated instead by the movements of the horse who, by setting off a series of tripwires, activated a sequence of instantaneous exposures. In this context, the camera was a fixed structure whose (passive) recording of movement was dictated by the equidistant space between each individual lens and, more importantly, by the movements of its subject. Similarly, the images created by this mechanism attest to the static nature of the device and to the scientific goals behind the endeavour. The twenty-four independent snapshots (see Fig. 4) reflect the abstract, non-anthropomorphic gaze of the apparatus, marked by its ability to deconstruct movement and indefinitely suspend the galloping subject in the twenty-four successive phases of its displacement through the space of the machine.

<sup>9</sup> Hugo Münsterberg, *The Photoplay - a Psychological Study* (New York and London: D. Appleton and Company, 1916), 5.



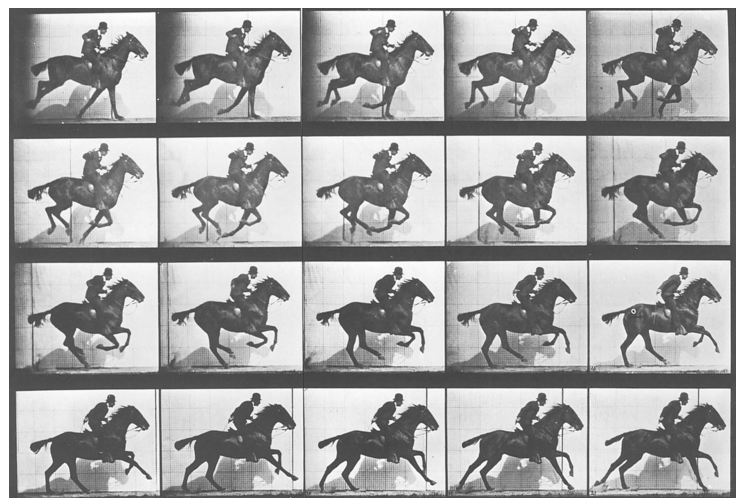
In comparison to this monolithic and inert mechanical contraption, the *fusil photographique* stands out for its technical achievements in creating a self-contained camera—a key feature in the development of motion picture cameras as we know them today—but also for its reliance on the human body. More importantly, the body emerges as an integral actor in the process of handling the camera and producing the moving image sequence, rather than as a simple operator. This collaboration between machine and body transpires in the creation of a unique and ambiguous image at once mechanically produced and anchored in the eye of an embodied observer.



**Fig. 3** Muybridge's twenty-four-camera array.

**Fig. 4** Muybridge photo, originally entitled "11. 'Daisy' galloping."

Source: Eadweard Muybridge, *Horses and Other Animals in Motion* (1985).



## Liberating the Camera

The German movement of the “unchained camera” (*die entfesselte kamera*) appears in the mid-1920s when filmmakers and technicians develop ways of liberating the camera and moving it in innovative ways. A 1927 article from *Ufa-Magazin* titled “Die Entfesselte Kamera,” identifies Friedrich Wilhelm Murnau’s 1924 film *The Last Laugh* as the first to “break through the limitations that the cinema had hitherto placed upon the gaze of the spectator.”<sup>10</sup> In *The Last Laugh*, the camera follows Emil Jannings as the porter of a posh hotel who falls from grace when he gets demoted to lavatory attendant due to *Altersschwäche* (weakness due to old age).<sup>11</sup> Throughout the narrative, the moving camera is as much of a player in the action as is Jannings. It moves through glass to witness the protagonist receiving his letter of demotion, it follows the sounds of a trumpet as they make their way to his ear, it precedes the porter who is stealing back his coat to assure us the road is clear, and it jumps closer to witness the shock in the “aunt’s” face as she learns of his shameful new position. To create these images, Murnau along with cinematographer Karl Freund and their crew developed a number of technical innovations, the most unassuming of which was the decision to attach the camera to the operator’s body to liberate it from the bonds of the tripod (see Fig. 5).



**Fig. 5** Karl Freund’s chest mounted Stachow camera on the set of *The Last Laugh* (1924).

Courtesy of Deutsche Kinemathek.

Simple as this body-mounted camera may be in comparison to other technical achievements, it is responsible for many of the camera movements that cemented the film’s place in history, including the opening shot down the elevator and through the lobby and, most

<sup>10</sup> Quoted in David Bordwell, *On the History of Film Style* (Cambridge and London: Harvard University Press, 1997), 22.

<sup>11</sup> This term is introduced in the scene where the porter receives his notice of demotion. The term and its translation are explained in James N. Bade, “Murnau’s the Last Laugh and Hitchcock’s Subjective Camera,” *Quarterly Review of Film and Video* 23.3 (2006): 259.

notably, the dream sequence. Included with the 2008 DVD release of the film, a making-of documentary produced by Pesadillas Digitales for the F. W. Murnau Foundation explains, “the truly revolutionary novelty of this film was precisely the camera movements. For these, Freund used his Stachow camera [...] tied it to his body with straps and followed right behind the actor.”<sup>12</sup> This is perfectly exemplified in the dream sequence that occurs halfway through the film, wherein the porter starts to fantasize about performing feats of strength and impressing the hotel guests. More importantly, as the scene tells the story of the porter’s dreams, it also tells us about the camera’s ability to move in ambiguous ways.

The sequence in question begins when the porter enters the crooked revolving doors with a heavy trunk held triumphantly above his head.<sup>13</sup> Through its heavily distorted image, the camera follows in the character’s footsteps for a moment before going off on its own around the room, looking at the faces of guests amazed at his feats of strength (see Fig. 6). Despite having left the porter behind, the camera’s now-omniscient gaze is nevertheless marked by the lumbering movements of a conspicuously embodied point of view (as if it were afflicted by the same ailments that caused the porter’s demotion). As the scene advances, the camera continues to move through the dream space, at times moving back to take in the protagonist’s performance, while at others it walks around observing the reactions of the hotel guests.



**Fig. 6** Screen capture from *The Last Laugh*.

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<sup>12</sup> “Making of *The Last Laugh*.” *The Last Laugh*, 1924. DVD. Kino International, 2008

<sup>13</sup> These descriptions are based on the restored German version of the film. When comparing the differences in three distinct versions of the film, “Making of *The Last Laugh*” explains: “For the dream sequence, a lens placed in front of the camera was manipulated, moving it to the rhythm of Freund’s steps who held the camera in his hand. For the German version, on the right, the version with the most marked effect was used, and for the American, below, the most weak.” *Ibid.*

Through the deployment of the camera, this scene articulates in visual terms elements of Murnau's writings from preceding years. In a letter from 1922-1923 related by Lotte Eisner, the director dreams of "a camera that can move freely in space":

What I mean is one that at any moment can go anywhere, at any speed. A camera that outstrips present film technique and fulfils the cinema's ultimate artistic goal. Only with this essential instrument shall we be able to realize new possibilities, including one of the most promising, the 'architectural' film. [...] What I refer to is the fluid architecture of bodies with blood in their veins moving through mobile space [...] all this adds up to a symphony made up of the harmony of bodies and the rhythm of space; the *play of pure movement*, vigorous and abundant. All this we shall be able to create when the camera has at last been de-materialized.<sup>14</sup>

In the dream sequence from *The Last Laugh*, the body-mounted camera plays a leading role in this "play of pure movement." The simplicity of the device—a camera roughly strapped to Karl Freund's chest—also lends itself to this goal, for which Murnau suggested the solution did not lie in "some complicated new technical apparatus [...] just the opposite."<sup>15</sup> The hand-held camera also answers the director's call—in 1928—for a device "as mobile as possible to catch every passing mood."<sup>16</sup> That being said, *The Last Laugh*'s dream scene also exposes the limitations of the union of camera and body that created it. In the abrupt way in which the image judders unrepentantly throughout the scene, this sequence reveals the presence of a human agent at work behind the image. In so doing, *The Last Laugh* tells us that the hand-held camera is perhaps not the best suited for responding to Murnau's wishes, since it fails to heed the director's warning: "it is important that the mechanics of the cinema should not be interposed between the spectator and the picture."<sup>17</sup> While *The Last Laugh* features what Arthur Knight dubbed "the first appearance of the camera as actor,"<sup>18</sup> this scene shows that perhaps the hand-held camera was not the most skilled actor, walking clumsily and stiffly towards its goal of going anywhere, at any speed.

### The Augmented Body

For all the freedom and flexibility the hand-held camera has given to New Wave cinemas and documentary genres, one of the device's most notable qualities—its ability to move just as well as the human operator behind it—is also the source of its biggest flaw: the hand-held camera is afflicted by all the knocks and bumps that characterize human movement. While the imperfections in our habitual movements are essentially eliminated by the brain—such that under normal conditions we should only see the most fluid vision possible—the hand-held camera did

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<sup>14</sup> Eisner suggests that these notes were most likely written for a special Christmas issue of a German film journal from the period. Having found these notes on Decla Bioskop stationery, Eisner estimates that Murnau must have written this between 1922-1923, during his time at this studio. Quoted in Lotte Eisner, *F. W. Murnau* (Berkeley and Los Angeles: University of California Press, 1973), 84; original emphasis.

<sup>15</sup> *Ibid.*

<sup>16</sup> *Ibid.*

<sup>17</sup> *Ibid.*

<sup>18</sup> Arthur Knight, *The Liveliest Art: A Panoramic History of the Movies* (New York: New American Library, 1959), 63.

not benefit from such skills until very recently, with developments in optical and electronic stabilization systems. New techniques emerged in the late twentieth century that aimed to remedy the problems faced when trying to move the camera with the flexibility of the human body but without any of its inherent flaws. One such solution is the Steadicam, a technology developed out of necessity, in response to the challenges of using the hand-held, body-mounted camera.

The Steadicam evolves from the hand-held camera in the sense that it is also carried by a human body who moves the camera and operates it. From there, however, this new device adds a number of mechanical components that serve to eliminate traces of the body within the image. These components include an isoelastic arm articulated at a makeshift elbow, a gyroscopic gimbal, as well as an inertia-enhancing “expanded camera” setup (see Fig. 7).<sup>19</sup> Through a combination of these different elements, the Steadicam’s technical achievement lies in its ability to counteract the body’s natural imperfections: the arm dampens vertical movements (such as those caused by footsteps), the gimbal counteracts rotations in all direction, and the expanded camera distributes the weight which produces “a greatly increased angular inertia.”<sup>20</sup> When correctly used, the Steadicam can produce camera movements that seemingly eliminate the body of the operator and liberate the camera from its physical limits.

Coincidentally, the full collaboration of the Steadicam operator is necessary for this apparent erasure to succeed. In her short history of the device, Priska Morrissey points out that “[the Steadicam] evolves precisely into a reunion of body and machine (the machine constituting an extension of the human body) and *an erasure of the operator’s body*, the founding principle being the disappearance of clashes produced by the cameraman’s body.”<sup>21</sup> Similarly, Vivian Sobchack comments on the invisible fluidity of the



**Fig. 7** The Steadicam.

Courtesy of John E. Fry (Copyright John E. Fry 2015, [www.fryfilm.com](http://www.fryfilm.com)).

<sup>19</sup> For more precise descriptions of the Steadicam’s different components and the way they function, see Serena Ferrara’s *Steadicam: Techniques and Aesthetics* (2001), as well as Jerry Holway and Laurie Hayball’s *The Steadicam Operator’s Handbook* (2009).

<sup>20</sup> Holway and Hayball *The Steadicam Operator’s Handbook*, 10.

<sup>21</sup> “Le Steadicam a été conçu pour pallier les ‘défauts’ de chaque système (secousses des images enregistrées par les caméras à l’épaule ; limites pratiques, géographiques et coût des grues et dollies) et pour ouvrir une troisième voie : il évolue justement entre une réunion corps-machine (la machine constituant une extension du corps humain) et un effacement du corps de l’opérateur, le principe fondateur étant la disparition des heurts provoqués par le corps du cameraman.” Priska Morrissey, “Histoire d’une Machine,” *Vertigo* 1.24 (2003): 47. Author’s translation; emphasis added.



device, while Steadicam operator Ted Churchill suggests: “Ironically, the greatest aspiration and reward for a serious operator becomes, by default, the undetectability [sic] of one’s work.”<sup>22</sup> More generally, literature on the Steadicam consistently insists on the transcendental quality the device produces.<sup>23</sup> This insistence underlines the irony Churchill evokes, given that we look beyond discourses surrounding the Steadicam and towards the work necessary to produce this impression of transcendence.

This irony is no more apparent than in the fact that Steadicam operators are often called upon to perform elaborate camera movements in what have become extremely long takes, the culminating example of which being the ninety-minute continuous Steadicam movement that constitutes Alexander Sokurov’s *Russian Ark* (2002). While the technical apparatus and its operator work in tandem to create fluid and undetectable movements, the virtuosic nature of these Steadicam set-pieces risks undermining the work of the operator—the process of erasure Churchill and Morrissey describe—by showcasing the purely mechanical prowess of the device. One such example is the work of Steadicam inventor Garrett Brown, who worked as the cinematographer for most of the production of Stanley Kubrick’s *The Shinning* (1980). Scenes like those that follow Danny on his trike throughout the hotel ask of the Steadicam that it float mere inches off the ground for takes lasting over three minutes.<sup>24</sup> Other scenes feature more restrained movements that strive towards the invisibility of their means of production—a quality stressed by Steadicam operators<sup>25</sup>—such as when the chef of the Overlook hotel, Dick Hallorann (Scatman Crothers), shows Wendy (Shelley Duvall) and Danny (Danny Lloyd) around the kitchen. Describing his experience of shooting this scene, Brown expresses the flexibility afforded by the device in the path it can follow, which is more circuitous than it might have been had the scenes been created through other means of supporting or transporting the camera: “I took the least disturbing ‘line’, like a race driver going through turns, and so the result has an unearthly tranquility about it which seems to best fit the requirements of that particular scene.”<sup>26</sup>

As Brown suggests, there is a certain ethereal quality films can achieve when the Steadicam and its operator work in unison. When the technician learns to facilitate the contraption’s propensity for eliminating traces of the body, films can produce what appears “an autonomous gaze, freed from a body, without incarnation, susceptible of moving at any time as if propelled by some strange force.”<sup>27</sup> As Jean-Pierre Geuens concludes in his article on the “visual

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<sup>22</sup> Vivian Sobchack, “Toward Inhabited Space: The Semiotic Structure of Camera Movement in the Cinema,” *Semiotica* 41.1-4 (1982): 333; Ted Churchill, “Steadicam: An Operator’s Perspective Part 2,” *American Cinematographer* 64.5 (1983): 35.

<sup>23</sup> Descriptions of the Steadicam that underline the device’s propensity for producing transcendental or fluid images can be found in Jean-Pierre Geuens, “Visuality and Power: The Work of the Steadicam,” *Film Quarterly* 47.2 (1993-1994); Ferrara, *Steadicam*; Holway and Hayball, *Steadicam Operator’s Handbook*; Sean Cubitt, *The Cinema Effect* (Cambridge and London: MIT Press, 2004).

<sup>24</sup> Garrett Brown describes his experience in: Garrett Brown, “The Steadicam and *The Shinning*,” *American Cinematographer* 61.8 (1980): 827.

<sup>25</sup> Cf. Churchill, *Steadicam*, 35.

<sup>26</sup> Brown, “Steadicam,” 827.

<sup>27</sup> “Un regard autonome, libéré d’un corps, sans incarnation, susceptible de se déplacer à chaque instant comme mu par une force étrange pour aller voir ‘ailleurs’.” Christophe Cognet, “Visages Du Hors-Champ,” *Vertigo* 1.24 (2003): 65. Author’s translation.

power” of the Steadicam: “Leaving behind its empirical grounding, the perceptual field now generates what appears as *pure, omnipresent, and objective visuality*. In other words, vision seems to emanate from a notional point hypothetically constructed outside of space and time [...] Consequently, the Gaze becomes *all-transcendental*.”<sup>28</sup> Despite its necessary ties to the body of an operator, operators can use the device in ways to bring out the apparatus’ otherworldly potential. Linked as it is to the human body, the Steadicam is manipulated to produce unnaturally fluid images, a feature that is often underlined in technical and theoretical discourses about the device. In turn, films can use this unique quality to transcend both physical and diegetic bonds, such as in *The Shining* where the Steadicam both “a neutral narrative voice” for the story and “an object that is ‘alive’ in its own right, a separate entity that moves in a quasi-mental space.”<sup>29</sup>

One notable example of using the Steadicam to play with the diegetic positioning of the camera can be found in *Atonement* (Joe Wright, 2007). During a five-and-a-half-minute Steadicam sequence that occurs halfway through the film, the camera follows Robbie Turner (James McAvoy) and two fellow WWII soldiers wandering through the chaos on the beaches of Dunkirk. As the scene progresses, the virtuosic camera movement reveals different aspects of the Steadicam’s abilities. When the three protagonists separate to explore the scene on their own, the camera begins by following Robbie but quickly breaks away to look at a different tableau (see Fig. 8). This tableau resembles what Steadicam operator Peter Robertson describes as “a hallucination from a Bosch painting or, in the case of the dying horses, like the contorted images from Picasso’s *Guernica*.”<sup>30</sup>



**Fig. 8** Screen capture from *Atonement* (2007).

<sup>28</sup> Geuens, “Visuality and Power,” 16; emphasis in original.

<sup>29</sup> Serena Ferrara, *Steadicam: Techniques Aesthetics* (Oxford: Focal Press, 2001), 77.

<sup>30</sup> Peter Robertson, “Beach at Dunkirk” *SteadyShots.org*. [http://www.steadishots.org/shots\\_detail.cfm?shotID=298](http://www.steadishots.org/shots_detail.cfm?shotID=298). Accessed December 14, 2016.

The Steadicam begins its independent stroll through diegetic space by following the movement of papers drifting up from a fire, which brings into view a soldier yelling “I’m coming home” from high on the mast of a beached ship. Throughout the remainder of the sequence, *Atonement* uses the Steadicam to expose the absurdity of diegetic happenings by weaving together snapshots of an improvised gymnast, a sunbathing soldier, a group naked men running, and a makeshift choir. As diegetic sounds of the massive crowd start to dissipate in favour of the non-diegetic score, the impression that the camera is moving of its own accord—independently of any prescribed narrative event—becomes more convincing. This feeling culminates for a moment when the Steadicam circles the group of soldiers under the gazebo whose hymn has gradually and seamlessly integrated itself with the non-diegetic theme. Without breaking stride, the camera continues its sinuous journey until it ultimately concludes its trip by offering one last look at the living painting of Dunkirk. Indeed, the camera follows Robbie in looking out at the scene, but indulges in one final lateral movement over the shoulders of soldiers to take in the immense complexity and absurdity of the scene. The transcendental quality of this final movement is underlined once again in the soundtrack, by the resurgence of non-diegetic music and of the same screaming soldier whose earlier “I’m coming home” had cued the liberation of the camera from its physical and diegetic ties.

In this sequence, *Atonement* showcases the ambiguous power of the Steadicam. While the camera depends on the body of its operator—allowing it to move up stairs and avoid obstacles as they occur—the Steadicam also produces an image that transcends the diegetic shackles of any one character within the narrative, allowing it to generate a point of view that is greater than the sum of the subjective participants whose movements it follows. To borrow from the title of Patrick Keating’s video essay, the camera appears to act like a “ghost”; a liminal figure that exists in both physical and ethereal realms.

Of course, this transcendental quality of the Steadicam, which so much writing on the device has argued, is an effect *produced* in films. While films adopting this device can emphasize this aspect of the camera, it is not an inherent and necessary feature of the machine. This otherworldly aspect depends on the way in which the operator manipulates the camera and how this process is deployed within the confines of the narrative. A camera is a protean machine, and it will appear to move beyond the rigid confines of the diegesis only if it is made to do so by the films that utilize it. Moreover, the Steadicam is also less physically transcendental than descriptions of the device would have us believe. Even as its images are captured by a physical apparatus, the Steadicam remains stubbornly tied to the physical space it inhabits: the space of the studio, of the pro-filmic bodies, of the beaches at Dunkirk. Every mechanical device, whether it is as simple as the hand-held camera or as complex as the Steadicam, is ultimately betrayed on screen by what Vivian Sobchack describes as “the finite and perspectival focus of the camera, its situatedness in the world.”<sup>31</sup> While a range of effects can be produced by using the Steadicam in different ways, it is still tied to the space around it.

### **The Body Behind the Disembodied Camera**

By virtue of its monocular construction, the mechanical camera is anchored in the physical context of the images it produces; the lens focuses light from the scene on one very specific point in space, thereby inscribing on the recording surface information about its position in physical

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<sup>31</sup> Sobchack, “Toward Inhabited Space,” 321.



space.<sup>32</sup> Even a technical apparatus as advanced as the Steadicam cannot mask the fact that it was used to carry a camera *there* and *then*, at the same time as actors, props, and physical environments in which they all coexisted. Therefore, despite any attempts by virtuosic camera movements to describe the Steadicam as this machine for creating transcendental, unearthly or omnipresent images, the fact of the matter remains that it is a mechanical entity, embodied as any other in this physical world. To continue liberating the camera following the hand-held camera, and the erasure of the human body behind it enacted by the Steadicam, the camera must therefore shed its ties to the physical world once and for all, just as Murnau had dreamt long ago.

The dematerialization of the camera suggested by Murnau came to fruition with the creation of virtual cameras in computer-generated spaces. Mike Jones introduces the virtual camera as part of a broader history of camera-less cinema, which includes “the Zoetrope, flip-book, shadow puppet and cartoon animation,”<sup>33</sup> to which we could add the camera-less films of Norman McLaren, Stan Brakhage and Len Lye. The virtual camera serves as a point of departure from the traditional film camera, which is typically, Jones notes, “rooted to a physical and tangible exploration and depiction of space that obeys rules of physics.”<sup>34</sup> In contrast, the defining feature of the virtual camera is its “incorporeal, non-physical nature.”<sup>35</sup>

A virtual camera is a software function, a viewpoint that can be inserted into a computer-generated 3D space to mimic traditional filmmaking practices and capture a single perspective on the action. As a simulation of its mechanical namesake, the virtual camera also exists in a single position at any time, but the relation it maintains with the virtual environment around it changes radically from that of previous photographic technologies.<sup>36</sup> As Jones argues: “The lack of physicality and subsequently the ability to depict, engage and navigate cinematic space in a new and omnipotent manner, forces us to reconsider our perceptions of both what the camera is and what it does.”<sup>37</sup>

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<sup>32</sup> Note that even stereoscopic cameras or spherical devices which produce “360°” images follow this rule. In all these optical arrangements, light is focused on a recording surface which records its spatial relation to the objects photographed. Only non-traditional optical devices like plenoptic cameras would fall outside this general rule.

<sup>33</sup> Jones, “Vanishing Point,” 226.

<sup>34</sup> *Ibid.*, 228

<sup>35</sup> *Ibid.*

<sup>36</sup> It is common in discourses on the virtual camera to find descriptions extolling its freedom from such limitations as shutter speed, focal length or any other remnants of mechanical photography (for examples see: Dave Kehr, “A Face That Launched a Thousand Chips,” *The New York Times*, October 24, 2004; and Jones, “Vanishing point”). However, such accounts usually do not mention that although these limitations are not *inherent* to the virtual camera—as a mere function of 3D software—it is necessary to select characteristics like focal length and frame rate when “capturing” the virtual space. To simulate a camera movement through something resembling space, the virtual camera must first be limited to a particular viewpoint, even if the camera will fly through keyholes and other objects. Failing to select a position for the camera and a perspective through which space will be seen would likely result in either representations of space that are unintelligible. Furthermore, even the software used to create the 3D spaces that virtual cameras explore are created with an interface which is typically beholden to traditional codes of perspective (i.e. seen from the single perspective of the observer sitting on the other side of a two-dimensional screen). See Anne Friedberg, *The Virtual Window: From Alberti to Microsoft*.

<sup>37</sup> Jones, “Vanishing Point,” 228.

With its newfound relation to space, the incorporeal virtual camera can be programmed to move along any imaginable path across any distance within the confines of the simulated 3D environments, from the subatomic to the galactic and beyond. To capitalize on this technical feature, 3D animated features such as *Monsters, Inc.* (Pete Docter, David Silverman and Lee Unkrich, 2001), *The Polar Express* (Robert Zemeckis, 2004), and *A Christmas Carol* (Robert Zemeckis, 2009) feature what Tobey Crockett calls “rollercoaster sequences,” which showcase the virtual camera’s capabilities.<sup>38</sup> These are elaborate set-pieces that revolve around the camera traversing incredible distances and taking the viewer on an unbelievable and visually stunning journey. Rollercoaster sequences are created by visual effects technicians who carefully define the range and nature of the displacements by programming the necessary features of the virtual camera (e.g. origin, destination, path, velocity, etc.). Such elaborate camera movement sequences allow filmmakers and technicians to showcase their technical mastery and their ability to navigate space and time with little to no physical or diegetic restrictions. However, not everyone delights in these complex rollercoaster rides, which often run the risk of seeming too facile:

Film and video-makers can now digitally stitch together shots that give the illusion of continuity across any imaginable barrier, but when the lens just zips down from the stratosphere through a keyhole and onto an eyelash, it suggests that the camera has no more substance than a neutron or a quark, and the result is correspondingly trivial.<sup>39</sup>

As Brown suggests here, the sheer length and range of movements displayed in these virtuosic virtual camera sequences can give the impression of shallow technophilic indulgence: all show and no substance. While this could be chalked up to a simple infatuation with new technical tools or as an exploration of the limits of this technique, the question remains as to whether films can find the adequate balance between the technology of virtual cameras, the work of technicians behind the “camera,” and the narrative use of their product.

In recent years, *Avatar* (James Cameron, 2009) has made its mark in the field of digital filmmaking, both for its extensive use of motion capture and digital stereoscopic cinematography, but also for the way the cinematographers handled the virtual camera. Jenna Ng analyzes *Avatar*’s use of motion capture cinematography by comparing the notion of *being* as opposed to *seeing*, a distinction she relates to the film’s narrative as well.<sup>40</sup> In the context of the virtual camera, I identify a similarly strong parallel between certain plot elements in *Avatar* and the production practices behind it. Whether it concerns the protagonist Jake Sully (Sam Worthington) and the other avatar pilots, their military counterparts, or the native of Pandora—the ten-foot-tall Na’vi—*Avatar* deals on multiple occasions with the relations between body and “machine.” Military mechs, Pandorian wildlife and the avatars Jake and his team pilot all require that the person in control become one with the entity they wish to manipulate (see Fig. 9). Throughout the story, characters are asked to step inside new bodies and learn to move anew,

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<sup>38</sup> Crockett, “The ‘Camera as Camera’: How CGI Changes the World as We Know It,” in *Cinephilia in the Age of Digital Reproduction*, ed. Scott Balcerzak and Jason Sperb (London: Wallflower Press, 2009), 130.

<sup>39</sup> Garrett Brown, “The Moving Camera Part I,” *Zerb: Journal of the Guild of Television Cameramen* 58 (2003).

<sup>40</sup> Jenna Ng, “Seeing Movement: On Motion Capture Animation and James Cameron’s *Avatar*,” *Animation* 7.3 (2012).



**Fig. 9** Screen capture from *Avatar* (2009).

they pilot mechanized battle armour that mimic their movements, and, most notably, they perform *tsaheylu* (the bond) with the other organisms that populate Pandora. On several occasions, narrative progress relies on these bonding processes, most notably when Jake regains the use of his legs when becoming his avatar, or when he succeeds in taming the legendary *toruk*, which ultimately leads him to victory.

More importantly, I identify a similar bond in James Cameron's approach to handling both the physical and virtual cameras in a heavily involved corporeal manner. In a 2010 interview for *Attack of the Show*, Cameron mentions he acted as cameraman for all hand-held movements in the film. Here, the director was talking about handling the stereoscopic camera rig (which he invented along with Vincent Pace) that was used for the live-action sequences of the film, but the same could be said for all virtual camera movements of the film as well. Indeed, for filming the motion capture sequences of *Avatar*, Cameron had a device constructed that could allow him to have direct physical control over the virtual camera.<sup>41</sup> Typically called the swingcam, this physical counterpart to the virtual camera consists of a small monitor, joysticks and markers (see Fig. 10) used to track the device's position while moving within the motion capture "volume."<sup>42</sup>

<sup>41</sup> According to Anne Thompson, the swingcam is "so called because its screen could swing to any angle to give Cameron greater freedom of movement." Anne Thompson, "How James Cameron's Innovative New 3D Tech Created Avatar." *Popular Mechanics*, January 1, 2010. <http://www.popularmechanics.com/culture/movies/a5067/4339455/>. Accessed October 1, 2016.

<sup>42</sup> In motion capture filmmaking, a volume is an array of several dozen infrared cameras arranged in a volumetric grid around an empty stage where actors play the scene. Actors wear specially marked reflective suits that allow the volume to track their movements. For Tobey Crockett, this means the volume replaces the traditional camera. Effectively, the entire space—and every point within it—gains

Anne Thompson explains:

The swing camera has no lens at all, only an LCD screen and markers that record its position and orientation within the volume relative to the actors. That position information is then run through an effects switcher, which feeds back low-resolution CG versions of both the actors and the environment of Pandora to the swing cam's screen in real time.<sup>43</sup>

When “shooting” motion capture scenes, Cameron could use his hand-held virtual camera to move around the scene as it unfolded, which he says created, “an edgy, subjective quality.”<sup>44</sup> Instead of algorithmic camera movements derived from the keyframes programmed by visual effects technicians, the hand-held virtual camera affords the filmmaker a way to physically interact with the camera and move in it ways that comply with the action.<sup>45</sup> For one, the camera could be moved around the actors as they play out their scenes for the motion capture system,



**Fig. 10** James Cameron using the swingcam.

Screen capture from “The making of *Avatar*.”

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the potential to *become* a camera in motion capture and computer generated films. It is within this “space-as-camera” that the virtual camera is activated. Crockett, “*Camera as Camera*.”

<sup>43</sup> Thompson, “How James Cameron’s Innovative New 3-D Tech Created *Avatar*”.

<sup>44</sup> Quoted in Dana Goodyear, “Man of Extremes: The Return of James Cameron,” *The New Yorker* (2009).

<sup>45</sup> While *Polar Express* did implement physical controls in the form of handwheels for controlling movement of the virtual camera along each axis of Cartesian space (similar to what one might find on a professional tripod) the swingcam brings a new level of granularity to the physical manipulation of the virtual camera. The camera operator can react naturally and follow the action of the scene as it unfolds.



allowing the camera to react to their physical performance in real time. This feature was not limited to the initial performance of the actors, however. According to Thompson, Cameron “could reshoot any scene by walking through the empty soundstage with the device after the actors were gone, capturing different camera angles as the scene replayed.”<sup>46</sup> In her profile on Cameron for *The New Yorker*, Dana Goodyear describes the director as he was reshooting a scene that had been motion-captured months before: “He was alone, moving slowly, grapevining his left foot gingerly over his right leg as he made his way around the performance-capture volume [...] he was lost, like a gamer in a trance.” Yet more interesting is the anthropomorphic way in which Cameron describes his method of using the swingcam: “When I say, ‘Make me three to one,’ what I’m saying is ‘Make me eighteen feet tall,’ [...] At that point, I’ve become a techno crane. If I say, ‘Make me twenty to one,’ I’m a helicopter.”<sup>47</sup>

The union of body and “machine” that is prevalent throughout *Avatar*’s narrative—and that appears in Cameron’s manipulation of the mechanical and virtual camera—also finds its way into the analogies he uses to illustrate his use of the technology. This union can also be perceived in the images Cameron shot in this manner, such as the many sequences of flying featured in the film. This is most easily seen halfway through *Avatar* when Jake tames his *ikran* (flying dinosaur-like creature) and learns to fly with it. With some difficulty at first, Jake eventually learns to control the new bodily extension that is his *ikran*. He is soon joined by Neytiri (Zoe Saldana) and the two exalt in the joy of flying for the rest of this two-minute sequence. This scene is significant because it prepares Jake for the film’s conclusion (in which he must tame the mythical *toruk*), and because of his recurring dreams of flying he experiences since becoming paraplegic. “I was born to do this,” he says. (Fig. 11).



**Fig. 11** Screen capture from *Avatar*.

<sup>46</sup> Thompson, “How James Cameron’s Innovative New 3-D Tech Created *Avatar*.”

<sup>47</sup> *Ibid.*

The cathartic and liberating feeling of this scene also serves to underscore the achievements of the virtual camera in creating it. For one, the scene stresses the importance of the virtual camera's inherent freedom from traditional physical bonds, which allows it to fly through the Pandorian sky as skillfully as Jake and Neytiri. However, the virtual camera also remains somewhat grounded, since its movements are the product of careful displacements by a body that bridges the physical/virtual divide. Even though these images appear to have been made from the perspective of a flying vehicle of some sort (since it follows the characters throughout their flight), we know from accounts of Cameron's work with the virtual camera that *he* was the helicopter. According to Jenna Ng, in using the swingcam to shoot the motion capture scenes directly, Cameron was "no longer seeing *through* the camera; he was partaking – feeling, being – *in its own reality*."<sup>48</sup>

Interestingly, Cameron's take on the virtual camera introduces a conundrum that does not exist in other forms of the technique (in *The Polar Express* or *A Christmas Carol*). By introducing and relying on a physical element in what had precisely been an attempt to disembody the camera, the camera movements in *Avatar* follow the film's narrative in emphasizing the link between human and machine. The scenes of flying, among many others, expose the product of this union by displaying both a mastery of space that derives from the virtual camera, as well as a certain mass and anthropomorphic logic to those movements that stem from the body behind the camera.

## Conclusion

As sequences that take advantage of specific technical devices to showcase visual mastery, the virtuosic camera movements analyzed in this article can tell us a great deal about the technologies that helped create them. Significantly, these examples showcase the protean nature of cameras by illustrating how features that might be attributed solely to the technical characteristics of the machines are in fact *produced* by camera operators, and by the ways in which films deploy these camera movement technologies. Just as the technicians Keating cites offer ways of thinking through the camera's different abilities, so too can films emphasize the freedom of movement of the body-mounted camera, the ethereal potential of the Steadicam, and the anthropomorphic referentiality of the virtual camera. But there is only so much that a film will show us before it becomes necessary to look behind the image, directly at the cameras and technicians whose work make it possible. Taking *Avatar* as an example, the complex nature of the virtual camera means that it should not in fact be described simply by looking at the work of Cameron in handling the swingcam. Considering those who manipulate the virtual camera would require that we acknowledge the incredible labour of visual effects technicians who polish and refine the reference camera movements recorded by Cameron. Much like discourses on the motion capture acting of *Avatar* seldom consider the role played by these workers in creating the film's memorable performances, so too is the labour of visual effects technicians in creating and handling the virtual camera typically repressed by the mentality of traditional director-driven photographic filmmaking.

The rise of motion capture films has brought some attention on those whose work is typically hidden, but doing justice to the work of visual effects technicians—behind creating the images we attribute to the virtual camera—will require a different approach than that proposed in

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<sup>48</sup> Ng, "Seeing Movement," 277.

this article. For one, it will be necessary to engage in a sustained manner with theories of labour in film production. While I have hinted at the work of technicians behind the image at several points in this paper, serious commitment to an approach based on the notion of labour will demand specific accounts of those who work behind the image, and of the type of work they undertake. More specifically, further analyses of their labour could follow John Thornton Caldwell's work, and consider the way in which these technicians have come to critically discuss their own practices.<sup>49</sup> By acknowledging the work of these technicians, perhaps then we might finally produce a more complete portrait of camera movement technologies and of the ways they can be used in films.

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<sup>49</sup> John Thornton Caldwell, *Production Culture: Industrial Reflexivity and Critical Practice in Film and Television* (Durham and London: Duke University Press, 2008).

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