DOUBLE TROUBLE. DIGITAL AVATARS ON STAGE

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INTRODUCTION

The interplay of technologies from the film and gaming industries enables digital avatars to climb onto the stage. However, both media have prerequisites that affect the realization of digital characters. In film, it is primarily realism, both in terms of photorealistic surface textures arising from the depictive tradition and in terms of precise human motion, resulting from the tradition of animated films, wherein humanized movement contributes significantly to the audience's ability to empathize with a character. The realistic concepts lead to the ideal of lifelike digital humans as well as of animated movements and facial expressions that are confusingly human-like, regardless of whether characters are stylized toons, realistic animals or human characters. In computer games, on the other hand, the focus is on interactivity, and this results in the priority of ultrashort response times, to which other aspects such as graphic style and the impression of realism in texture and movement are subordinated. The same priority also applies to the performing arts, where the overriding premise is the experience of a live event with physically present actors, singers or dancers. Digital avatars on stage increase the demand for real-time performance even further, because not only the rendering of the characters, but also the animation based on performance capture needs a final output in real time. In distinction to this, movements in games are preproduced. Motion capture data is first recorded, cleaned and optimized in several processes before it is made available for retrieval from databases as animation loops. And in film, everything can be optimized for as long as it takes before the canned version hits the screen. Given these differences, it stands to reason that both in games and especially in the performing arts, photorealistic images have not been a top priority.

The emerging convergence and the increasing use of technology is seen by theorists from the fields of film and performing arts as a distinctive feature of digitalization. While computer games are digital by definition, film has gone through a groundbreaking transition from analog photographic to digital recording. However, theorists have other features in mind when they use the term *digital cinema*. According to Lev Manovich, the constituent element is essentially the combination of real image components (conventionally recorded by means of a lens) with digitally generated 3D spaces or 3D characters. In his view, the hybrid form leads to a particular case of animation film, in which live-action footage is used alongside many other image sources (Manovich, 2001; 2016). In addition, these phenomena can also be understood as defining components — among many others — of the term *post-cinema* (Denson/Leyda 2016, Iseli et al. 2021).

An approach similar to that taken in film studies is also used when determining the theoretical concepts of *digital theater, digital dance* or *digital performance*. These new forms of expression are primarliy defined by their hybrid quality, to which digital technology is

intrinsic (Dixon 2007; Salter 2010, Boucher 2011). In order to distinguish digital theater from traditional theater as well as from a broader sense of digital performance, Nadja Masura lists the presence of digital technology, both in the creation of a performance and its interactivity as a primary characteristic. She also assigns importance to fundamental ingredients that make up theater in the first place, such as the presence of verbal communication or the co-presence of audience and actors. (Masura 2020). Another parallel to film studies is that the integration of new digital technologies can also be seen as one of many defining components of *post-theatre* or *post-dramatic theatre* (Lehman 2006).

THE ALIVE, THE DEAD AND THE UNCANNY

In film, there is the traditional distinction between *live-action* and *animation*. The terms clarify how moving images are created. Live-action refers to what happens in front of a running camera that records multiple frames per seconds in the profilmic situation (Souriau 1951) and it usually simply refers to shooting with actors. Whereas animation in the conventional sense describes the process to produce moving images on the basis of single frames that can create the illusion of movement when played back at the standard rate of 24 frames per second (stop-motion animation). If we look at characters we could simply say that either a character moves on its own during the shooting process (and is thus alive), or a non-living representation needs to be set in motion (brought to life) through animation techniques.[1] But from very early on in film history the two basic approaches were mixed and formed a category that later was defined as *live-action/animated* with real actors appearing in cartoon worlds or cartoon characters in photorealistic words. An early example of a hybrid production were the film series *Alice Comedies* (Walt Disney Company, 1923–27), and a very successful historical example later on was *Who Framed Roger Rabbit?* (Robert Zemeckis, 1988). This brings us to the basic constellation that characters played by living actors meet animated or — to follow the logic of the terminology — dead characters, which at the same time appear to be very much alive.[2]

WHO FRAMED ROGER RABBIT?
ROBERT ZEMECKIS (1988)

The hybrid image production, in which a real human acts side by side with a synthetic non-human, has become quite common in mainstream cinema and it certainly has become substantially more popular in the last 20 years. It mainly started in the 1990s — with a few exceptions a bit earlier —, which is due to the growth of computer generated imagery CGI and 3D-animation in the ever expanding area of visual effects (Prince 2011).

The main shift towards realism that has taken place since then, regarding synthetic, animated characters, occurs on two levels: Firstly, in terms of photorealistic surface textures, due to the growing capacities of computer graphics, and secondly in terms of precise human-like movements, based on motion and performance capture technology. With this particular technology, animation films eventually obtained what we would call a proper shooting situation, or in Souriau's terms, a profilmic reality.

1 There are also methods for the mechanical or electromechanical animation of puppets or artificial creatures during a live-action recording process. The associated term here is animatronics (formed from animation and mechatronics, a term derived from robotics). Cf. Flueckiger 2008.

2 The special effects in Roger Rabbit were still basically pre-digital and were done with optical printers, puppetry, and stop-motion animation (Wolf 1995). In computer animation the frame-by-frame technique of analog times is replaced by keyframe-animation.

The growing importance of the live-action/animated genre gave rise to realistic virtual characters at a large scale. However, the term virtual character doesn't necessarily imply a human appearance. But it most certainly means — following the long tradition of animation film — that CGI characters have human-like movements, human mimicry, human-like emotions and human personalities. These anthropomorphic creatures are well-known and their naturalistic appearance and behavior have attained a level of perfection. For example, Golumn from the *Lord of the Rings* and *The Hobbit* franchises (Peter Jackson 2001–2014) or Ceasar from *War for the Planet of the Apes* (Matt Reeves, 2017), both created with the help of performance capture by British actor Andy Serkis.

At the same time, the photorealistic digital human remained the last frontier of the VFX industry. The human look-a-likes that were referred to as virtual humans, virtual actors, synthespians, digital doubles or avatars first appeared only partially, or in short scenes, as early as the 1980s. In the ensuing years they were often kept in the background, multiplied to simulate crowds, as in *Titanic* (James Cameron 1997), or used as digital doubles to avoid dangerous stunts as in *Matrix Reloaded* (Lana and Lilly Wachowski 2002). But as soon as they appeared in larger portions of the films, left the background and aspired to be leading characters with dialogue, close-ups and emotions, they got into trouble. *Final Fantasy: The Spirits Within* (Hironobu Sakaguchi 2001) was the first animation film which was entirely based on photo-realistically rendered characters. But the audience acceptance was rather weak, as it seemed difficult to emotionally relate to the still quite synthetic characters (Butler and Joschko 2009). This is connected to the so-called *Uncanny Valley* effect. First introduced by Masahiro Mori in 1970, the term describes the phenomenon that when artificial characters become similar to humans, the empathy curve of an audience suddenly drops sharply and only rises again when the characters appear indistinctively close to real humans, thus giving the graph the shape of a valley (Mori 1970).

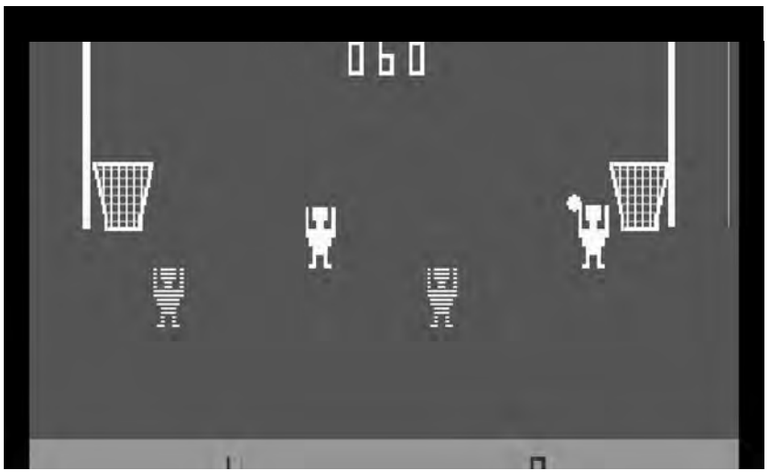
The debate about the uncanniness of computer-animated characters was conducted with vehemence with regard to films such as Robert Zemeckis' *Polar Express* (Robert Zemeckis, 2004), which relied entirely on performance capture technology (Flueckiger 2008, Aldred 2006, Kurtz 2004). But later, due to new aesthetic concepts and the technological progress demonstrated in, for example, *The Curious Case of Benjamin Button* (Fincher 2008), discussions of the uncanny valley effect seemed to recede into the background (Flueckiger 2012, Perry 2014). However, when it came to awakening the dead critical views reached a new peak and led to ethical concerns. In *Star Wars Rogue One* (Gareth Edwards, 2016), British actor Peter Cushing, who died in 1994, was digitally reconstructed and joined the cast again, appearing alongside a digitally reproduced Carrie Fischer.

GEMINI MAN, ANG LEE (2018)

In Ang Lee's *Gemini Man* (2018), the digital twin was finally assigned a leading part. In this thriller, the main character meets a much younger clone of himself. For this purpose, a state-of-the art digital double of Will Smith was produced and made significantly younger. In this context, the actor behind Golum and Ceasar, Andy Serkis, stepped forward in an interview and emphasized, that "there are a few serious problems in that we can create photorealistic characters, that we can digitally rejuvenate actors or digitally retrieve recordings of deceased actors" (Pennington 2019). Labeled by the Rolling Stone magazine the "king of post-human acting" (Hiatt 2014), Serkis cautioned that the technology allows the film studios to do what they want with these digital copies of real humans, and the legal issues seem complicated (Pennington 2019).

PLAYERS, THEIR AVATARS AND LOW LATENCY

In the field of computer games, one thing counts above all else. The graphics that appear on the display in front of the players must be calculated in real time. For decades, this basic requirement has led to a rather modest visual quality. In the first games in which humans were represented, the so-called "sprites" consisted of only a few pixels. They were the non-static elements within two-dimensional games, moving independently of the background and were player-controlled, as for instance in the arcade game *Basketball* (1974). The player controlling his digital representation in the game has been a characteristic feature of computer games from the beginning. And with the increasing complexity of games, it has evolved into what is often described as the player-avatar relationship (Gazzard 2009; Banks/Bowman 2013). It implies a role-play related experience that moviegoers don't expect to have.



BASKETBALL (1974)

With the expanding graphic capacities of computers, the number of pixels per character was on the rise and in the Nineties a landmark shift took place towards 3D graphics and avatars with three-dimensional bodies. Later, games went online, which limited creative animation solutions, due to limited internet bandwidths and the need for the simultaneous representation of actions across a high volume of players. The visual style remained mainly reduced and cartoonish, but the enhanced interactivity through the introduction of "massively multiplayer online role-playing games" (MMORPG) led to an increased identification between gamers and their avatars (Blinka 2008, You et al. 2017).

HEAVY RAIN (2010), *THE LAST OF US* (2013), *DETROIT: BECOME HUMAN* (2019)

Eventually the characters' design became more complex, and the new frontier of photorealism came into play as well. Obviously, the standards here seemed different than on the big silver screen and the uncanny valley never had a comparable significance, as computer games, unlike films, had never been considered a photographic medium and thus were hardly connected to corresponding expectations. But now that the graphic performance passed a certain threshold, cinema has become an important reference, both in terms of visual style and narrative approach. Cinematic Triple A Games that employ a third person view, like *Heavy Rain* (2010), *The Last of us* (2013), or *Detroit: Become Human* (2019) are considered milestones in the development of high-quality visuals and characters.

THE HERE, THE NOW AND THE MEDIATED

The integration of media content has a long and rich tradition in theater and dance and goes back to the 1910s, when film projections began to be included in stage performances. In addition to providing alternate backgrounds or providing additional content layers, the new practices also included the projection of filmed characters (Dixon 2007; Salter 2010). With the introduction of portable video equipment in the 1970s, the inclusion of media content increased rapidly. The use of video also offered the possibility of live transmission, which was frequently used as it corresponded to the liveness of the theatrical event (Georgi 2014). The fact that the video footage was captured live in the same time and space, was—and is—usually made transparent to the audience. Frank Castorf is a prime example of a director who repeatedly emphasized medial play by employing multiple cameras and including live editing (Carlson 2008, Kassay-Schuster 2017). Or similarly, Katie Mitchell who uses video to create an atmosphere of "live cinema", as for instance in *Forbidden Zone* (Mitchell 2014)

FORBIDDEN ZONE (2014) BY KATIE MITCHELL

The step towards digital characters that are animated by means of motion capture technology became possible in rudimentary form in the mid-Nineties through the use of mostly abstract forms. An example of this period is *Biped* (1999) by Merce Cunningham, in cooperation with the artist duo Shelly Eshkar and Paul Kaiser. At that period the motion capture data was often still pre-recorded in order to arrive at optimized animation sequences. Other groups of that period aspired to achieve real-time animation in their performances. Ruth Gibson and Bruno Martelli of the Igloo artist group achieved double appearances of dancers and their "dual identities" in their 2000 performance *Viking Shoppers* (Dixon 2007).

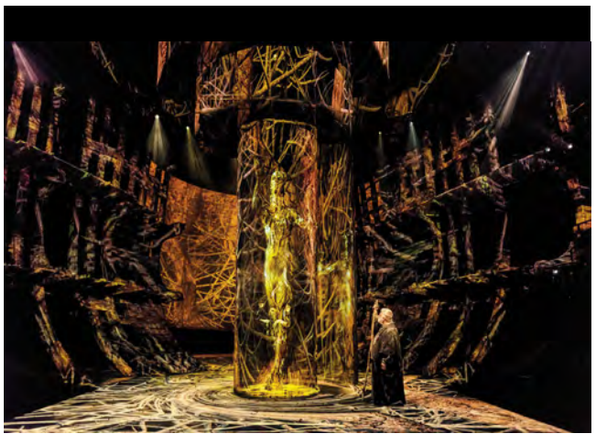
BIPED (1999) BY MERCE CUNNINGHAM

In order to confirm that the avatar's performance is indeed being created live and is not the result of a pre-recording, the audience usually gets to see both the performers (in motion capture suits) and their projected avatars. Even though the technical equipment is capable of a so called rea-time-processing, there is always a slight delay between a movement and its processed and projected counterpart. The so-called latency has been improved considerably, but still today it's always there, close to the threshold of noticeability, but giving the double appearance an additional artificiality, as the avatar seems to inhabit a slightly different time zone.

On large theater stages and with ambitious visual concepts, the required technical effort can reach enormous dimensions. In the Shakespeare anniversary year of 2016, it was the character Ariel of *The Tempest* (Gregory Doran, Royal Shakespeare Company, 2016) that could be experienced as a digital avatar animated live by actor Mark Quartley on stage, entangled in overwhelming digital stage designs. In addition to a large volume, state of the

art performance capture system, this required no fewer than 27 projectors and a massive array of the latest computer technology from the project partner Intel. (Billington 2016, Jimenez 2017).

DOUBLE TROUBLE



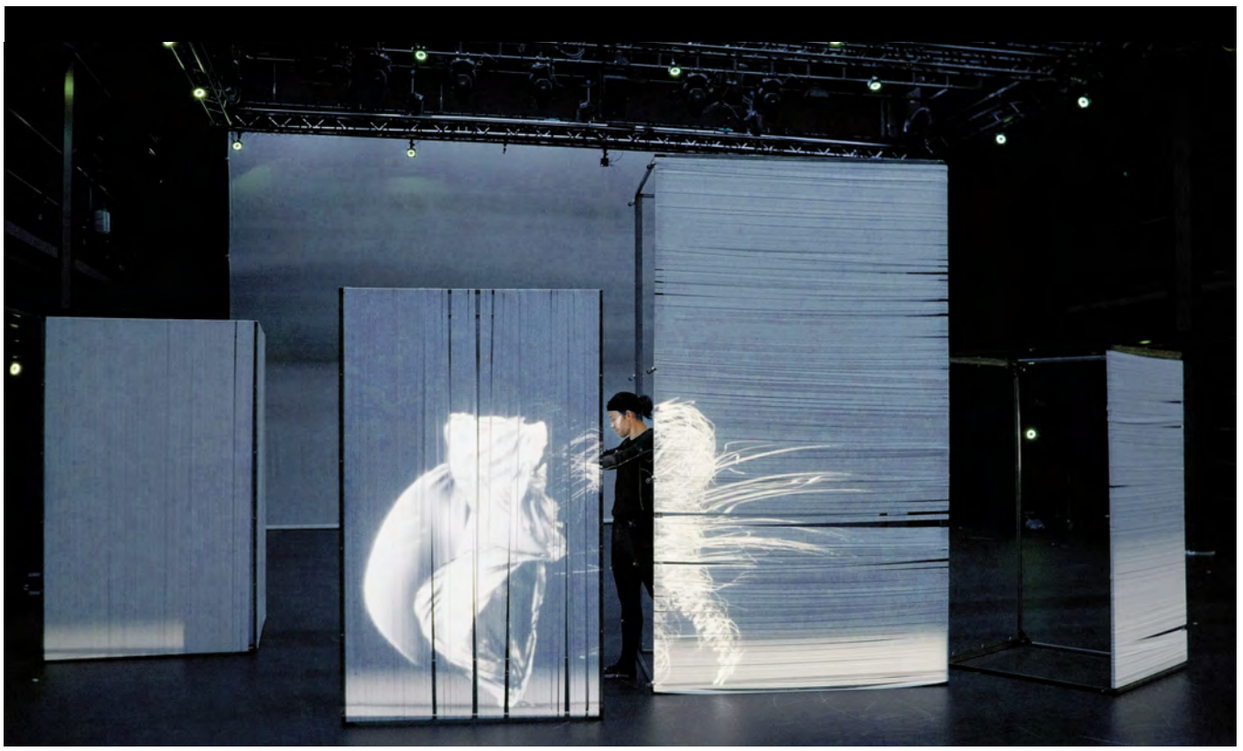
THE TEMPEST (GREGORY DORAN, ROYAL SHAKESPEARE COMPANY, 2016)

In his review of the premiere of *The Tempest,* critic Michael Billington (2016) of *The Guardian* described his experience of seeing the Ariel avatar simultaneously on stage with the actor Mark Quartley. "It is all impressive, even if it creates the odd sense that we are watching a double Ariel" (Ibid). This indeed describes a basic dilemma that inevitably arises when working with digital avatars, when at the same time the live character of the situation is made transparent. Certainly, it would be possible to have only the avatars appear on stage, while the actors' movements could be tracked in a separate room. However, this would deprive the actors of their very purpose for being on stage and prevent the necessary co-presence of the audience. It would also merely look like a preproduced video and not like a prestigious, cutting-edge digital live production. The simultaneous presence of actor and avatar eliminates these problems altogether. The price for this, however, is the effect of duplication that critic Michael Paulson of *The New York Times* referred to as the *"the double event"* (Paulson 2017).

The descriptions of the double effect caused by digital technology is all the more interesting as it seems to echo a more fundamental double phenomenon inherent to performance. In his comprehensive study on the performative arts, Marvin Carlson cites ethnolinguist Richard Bauman who noted that performance always involves "a consciousness of doubleness, through which the actual execution of an action is placed in mental comparison with a potential, an ideal, or a remembered model of that action" (Carlson 2013). And sketching the tradition of double concepts within the realm of digital theater and dance, Steve Dixon summarizes various phenomena and forms of doubles. (Dixon 2007). Thus, the "odd sense of the double" that *The Guardian* traced back to the spatial co-presence of actor and avatar in *The Tempest* (Billington 2016) echoes a whole variety of double concepts and even might have been influenced by the aforementioned temporal double phenomenon due to the latency of motion capture systems.

PRESENCE, ABSENCE AND BOTH AT THE SAME TIME

Presence and Absence is an artistic research project of the *Immersive Arts Space* at the Zurich University of the Arts that explored the phenomenon of double presence with virtual characters on stage and worked on playful solutions to overcome the scheme of doubleness without losing the transparency of liveness. The initial research interest arose from the earlier project *TwinLab,* a co-production with the experimental theater group Zuni Icosahedron in Hong Kong. In both locations the movements of dancers were simultaneously transferred to abstract 3D avatars by visual artist Tobias Gremmler and made visible in video projections.



PRESENCE AND ABSENCE: THE AVATARS APPEAR WHEN THE DANCERS ARE HIDDEN BEHIND THE STAGE ELEMENTS.

Despite the distance of more than 9000 kilometers, the performance could be followed by spectators in both cities. A fast data exchange enabled the virtual interaction of dancers and their avatars, simultaneously and at a distance.

With the *Twinlab* performance, the research team became aware of the dilemma of double presence. Visitors of the simultaneous performance described their experience of constantly having to decide whether to pay attention to the real actors or the virtual figures. After the debriefing session, Tobias Gremmler encouraged the research team to further explore the interaction between performers and their avatars in this respect. This resulted in the artistic research project, in which Gremmler's virtual characters from the *TwinLab* production served as a basis (Iseli 2021).

In close cooperation with Gremmler and the team, set designer Mariana Vieira Gruenig developed movable stage elements that allowed the dancers Aonghus Hode and Lucas del Rio Estevez, who were equipped with motion-capture suits, to disappear behind them while their avatars were projected onto the front of the elements. Conversely, the avatars were to disappear as soon as the dancers became visible. Technically, this is achieved with projection mapping, which is the expertise of engineer and artistic practitioner Martin Fröhlich, who developed open-source software for handling dynamic projection situations. The basis for this is a digital 3D model of the real space in which the projection takes place. All projection-relevant elements must be transferred to the virtual model true to scale, which is made possible with the dynamically captured position data of a motion capture system. This enables the software to precisely map the projected avatars onto the moving stage elements. As soon as a digital avatar moves over the edge of a projection surface, the projection switches to blank, so that only the real dancer becomes visible. Thus, the alternation of presence and absence results in a playful transparency. At the same time, it becomes apparent for the audience how the animation of the digital avatars comes about without being confronted with a rivalry for attention arising from the permanent double presence.

An important further feature of the stage elements is that the dancers can step through them. This is made possible by a surface that consist of elastic white ribbons strung together, instead of a solid screen. Thus, the dancers can push away the elastic white bands

with their bodies. They can also stick their heads, arms and legs through the flexible surface so that they appear only partially visible. And they can also simply jump through the wall of ribbons and thus quickly disappear or emerge.

The state of being both real and virtual at the same time, when the dancers remained partially visible, proved particularly fruitful in the exploratory approach. The spectators witnessed a character that appeared to be half avatar and half human, or that slowly passed from one state to the other. Finally, aesthetically, the rule that either only the dancers or their avatars should be present proved too rigid. By changing the software, this basic principle could be switched on and off during the performance. Alternating with the playful transformations, phases of simultaneous presence were introduced. This combination proved to be varied over a longer temporal distance and led to more dynamic sequences overall.

And what does all this have to do with artistic research? The project *Presence and Absence* consisted of experimental settings that produced explorative sequences with elements of the stage set, virtual characters, projection mapping and the dancers' play. Over several iterations, sequences were reset, discarded, adjusted, refined, and further developed. At first sight, this process seems indistinguishable from a standard rehearsal process. Typical elements of an artistic research scheme are a methodical approach that includes continuous reflection, a documentation of the process to ensure comprehensibility for outsiders as well as transferability, and an exchange with the peer community by means of publications and presentations. Throughout the process, guidance comes in the form of a precise initial question that makes reference to the state of the art. In this particular case it was, "How can the simultaneous stage presence of performers and avatars be transformed into a creative interplay of presence and absence but still guarantee a transparency of the process?"

The output of Presence and Absence is less a completed production but rather a set of prototypes. The primary goal is to enter into an exchange with the peer community of digital artists and the artistic research community by means of the publication of the results. Secondly, prototypical tools, ranging from open-source software to our newly acquired practical knowledge can be made available to artists in a variety of fields for further development.

TWINLAB: SIMULTANEOUS PERFORMANCE BETWEEN ZURICH AND HONG KONG.

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