Chapter 2

# Contemporary Film Technology

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## INTRODUCTION

Film technology has never been fixed within the mode of movie production. The development of cinema has seen the shift from silent to sound film, black and white to colour, and the move from 35mm film stock to recent formats such as High Definition (or HD) that capture and project images in digital form. Recent cinematic history includes advances in computer graphics and editing, stereoscopic imaging or 3D, motion capture, and sound recording, mixing and design. This chapter will demonstrate that film technology has developed based on a complex intersection of industrial and aesthetic factors, which include global and industrial economics, advances in other fields such as electronics and computing, shifts in audience expectations, and the needs of specific film productions as well as the preferences of filmmakers.

The first section of the chapter will present an overview of the phases of development for recent technology in cinema, and how these have been critically framed by theories of economics and culture. Subsequently, the focus will shift to a close analysis of three specific technological advances that influence film production and distribution today:

- The first technology to be considered will be computer graphic imaging systems, which have been used to create innovative special effects sequences and computer animation, and which have influenced all aspects of the visual field from set design to colour. The science fiction film *District 9* (2009), which explores issues of audio-visual as well as human-alien hybridism, serves as the case study for this section.
- Second, the chapter will unravel the complexities of multichannel sound formats, which record and encode multiple tracks of audio elements then deploy them within the theatre environment through an array of speakers surrounding the audience. This immersive sound technology has led, in part, to the rise of 'sound design', and in the accompanying case study of *Star Trek* (2009) issues of sound and space are explored in relation to both the technology and the themes of the film.
- Finally, the chapter will examine 3D technology, which currently mimics depth perception in movie theatres with the aid of special glasses. The film *Avatar* (2009), which serves as the case study in this section, has revitalised interest in 3D and pointed contemporary film in a new direction of imagining cinematic worlds in both depth and dimension.

These technologies have changed how filmgoers experience cinema by shifting expectations related to the variety of blockbuster genres, audio and visual design, spectacle and storytelling. As a result, previous distinctions between live action and animation have begun to erode; sound design has become less 'realistic' and more immersive and the notion of storytelling has begun to emphasise spectacle over causality. These innovations have also contributed to current trends related to global production and distribution. It seems the term 'Hollywood' no longer refers to a place, but rather to a process that is shared by many nations. Even the term 'film' does not seem to fit within the borders of the frame as some 'films' never make it to celluloid.

Using a range of theoretical approaches from traditional film studies to scholarship in new media and technology, this chapter aims to provide a technologically informed context for the various critical perspectives presented throughout *Introduction to Film Studies*.

## TECHNOLOGY IN MOTION: FROM INVENTION TO AGENCY

Film historian Douglas Gomery has categorised technological development within cinema into three overlapping phases: the first is 'invention', which refers to the concep-

tualisation and development phase of a technology; the second is 'innovation,' which encompasses the manufacturing and marketing of a technology; and the final phase is the 'diffusion' of a technology or 'the widespread use' within the industry (Allen and Gomery 1985: 114–15). Given the integration of computers and new digital technology into nearly every aspect of cinematic production, I would like to add another phase – the 'update', which can be defined as the ongoing and, often, unscheduled 'fixes' or 'patches' to software and hardware disseminated to users to address quality control concerns and system upgrades. Anyone with a computer should be familiar with this process. In the digital age, technology companies have begun to respond quickly to user complaints and concerns with updates and redesigned versions of software (often numbered 2.0 and so on), not simply to address quality control issues, but often to protect intellectual property rights. Within these broad phases, the path of development for a technology is never uniform. According to film historian John Belton, 'No one technology takes quite the same path to full diffusion as another' (Belton 2004: 901). By contrast, in the classical Hollywood period, the film studios were vertically integrated with control of film production, distribution and exhibition. This control allowed technological advances such as sound, for instance, to be implemented on the set with the assurance that re-recording and playback accommodations would be made through the process of printing the sound on the film reel exhibiting it in the motion picture theatre. The path of implementation assured a sense of quality control within the studio system.

Following the breakup of the studio system, however, the chain of technological invention, innovation and diffusion within the film industry broke down.[1] Significant quality control issues related to sound and picture plagued the US markets throughout the decades that followed, and at the same time, social upheaval, the rise of television and changing economics related to leisure activities all contributed to the decline in box-office receipts. According to film historian Thomas Schatz, 'Studio profits fell from an average of $64 million in the five-year span from 1964 to 1968, to $13 million from 1969 to 1973' (Schatz 1993: 15). By the mid-1970s, however, the film industry shifted strategies in relation to marketing, production and financing, and profits soared with the introduction of the 'blockbuster' film, exemplified by releases such as *The Godfather* (1972), *The Exorcist* (1973), *Jaws* (1975), *Star Wars* (1977) and *Raiders of the Lost Ark* (1981). Technological innovation became part of the strategy for the design and marketing of these 'event' films. 'Behind the scenes' television specials and print-based media revealed the 'secrets' of the audio and visual effects in these films, while new technologies and their inventors received special Oscars for their contributions. Theatre poster art began to include references to the newest innovations, such as 'Presented in Dolby Stereo'. So for filmgoers, new technology became one of the expectations for the blockbuster film, and these expectations then forced filmmakers to 'update' and innovate technology at a much more rapid pace.

*For further discussion on film production, film audiences and the studio system, see Chapter 1.*

Currently, new film technology makes its way into film production and exhibition through a variety of paths, from tradeshows to corporate collaborations. Large trade shows such as ShoWest, Cinema Expo International, and CineAsia often feature educational workshops and demonstrations of new products marketed specifically to the film theatre industry. It is at these trade shows that demonstrations of new digital and 3D exhibition technologies made their debut, as well as at film markets such as the Cannes Film Festival. But these are not simply consumer technologies that can be pulled off the shelf and sold; rather, they often involve customised installation and specialised training for filmmakers and operators.

With the development and integration of any technology, economic risks are inherent in the process, which has sometimes slowed the diffusion of new technologies. When theatre owners balked at the price tag of the first digital projectors, which at the time cost more than $150,000 dollars, some of the early manufacturers such as Technicolor Digital Cinema and Boeing Digital Systems installed their systems at no cost to theatres in major US cities in order to conduct test marketing and to collect data relating to audience

preferences and box-office receipts (Taub 2003: 1). Over the next several years, when economic trends indicated higher grosses from digital screens, theatres began to convert, though not without substantial underwriting from the studios, which realised substantial cost savings because they no longer had to strike or ship celluloid prints. Currently, three companies – BARCO, Christies Digital Systems and NEC – manufacture the majority of the Digital Light Processing (DLP) projectors used in the ongoing conversion of motion picture theatres today. These projectors offer high contrast ratios, precise delivery resolution and ease of use and maintenance, and fit within the footprint of older film projectors, thus making conversion easier.

It should be noted that such technological development is never conducted in isolation. Behind the scenes, the major studios, theatre chains and global manufacturers work together to make their innovation and integration possible. This collaboration helps to avoid a chaotic marketplace filled with multiple technologies that cannot communicate with one another. Through forums, summits and meeting of professional groups like the Society of Motion Picture and Television Engineers, various standards and practices have been established in all areas of film technology. For example, the Digital Cinema Initiatives (DCI) – a joint venture between Disney, Fox, Paramount, Sony Pictures Entertainment, Universal and Warner Bros – published various position papers and best practices to establish standards for audio and image encoding that addressed not only issues in the theatre, but also those related to broadcast technologies. These specifications, however, are by no means mandatory, and their integration into the system of exhibition is dependent on manufacturers, marketers and even audiences, who have been drawn into the process through communication forums such as surveys and mobile posts. With the increasing prices of movie tickets and downloadable media content, today's audiences have increasingly high expectations for picture and sound quality in theatres as well as on the screens of their mobile devices, computers and televisions. Media technophiles have also driven greater demand for new technology that interlinks voice and data, while providing access to media content and services. This process of synergy has become known as *convergence*, and continues to reshape media creation and delivery beyond the theatrical environment.

Technological development for motion pictures is also fostered by competitive collaborations between studios and high-tech labs and manufacturers, such as Dolby Laboratories, Sony and others. The transition to digital sound saw the development of


• **Plate 2.1**
NEC Projector. An image of one of the popular brands of digital projectors (NEC) used in the ongoing conversion of theatres today.

multiple audio formats including SDDS® (Sony Dynamic Digital Sound), DTS® (Digital Theatre Systems) and Dolby Digital, each of which is aligned with a particular studio or studios that had a stake in the product development and use. For example, the film *Jurassic Park* (1993) was released in the DTS® sound format (6.1 channels), which was produced by collaborative efforts between Universal Studios, Steven Spielberg's Amblin Entertainment and a technology company specialising in immersive surround sound. DTS® was innovative in that it did not deliver the sound on the film print, but on a CD-ROM, linking it to the image by time code (an electronic synchronisation system). The technique harkens back to the first Vitaphone sound-on-disc systems of the 1920s, presenting an excellent example of the cyclical nature of developments in film technology. In 1993, Sony and its subsidiary Columbia Pictures (with an outside company Semetex Corp.) also developed their competing format SDDS® (a variable 5 or 7.1 channel format), while Dolby Laboratories worked with many of the remaining studios to develop its 5.1 channel system, which debuted with the release of the Warner Bros film *Batman Returns* (1992). Ultimately, the Dolby system, with its superior market share and the ability rapidly to integrate its processes into consumer technologies, became the dominant sound encoding and decoding system in the field and its influence will be examined more fully in the section on multichannel sound.

Aside from industry-wide economic factors, perhaps one of the most fundamental drives in the development of new film technology can be found in the proverb: 'Necessity is the mother of invention.' In contemporary cinema, filmmakers and production units often develop new and innovative technologies for the needs of particular production circumstances. In the early 1940s, Disney invented the multi-plane camera, which utilised staggered platens for cel animation, to create the illusion of depth in animated films like *Pinocchio* (1940). In the 1990s, George Lucas encouraged his special effects company Industrial Light and Magic (ILM) to develop computer software that allowed the creation of digital characters for the *Star Wars* prequels (1999–2005), while filmmaker James Cameron, director of *Terminator* 2: *Judgment Day* (1991), *Titanic* (1997) and *Avatar* (2009), has been personally instrumental in the development of underwater remote filming technologies for both 2D and 3D imaging. These technologies were first developed to capture the documentary footage used in *Titanic* and later fostered the production of several IMAX films based on undersea topics, specifically *Bismark* (2002) and *Ghosts of the Abyss* (2003). More recently, computer technology has made its way onto the sets of many films, in part driven by economic factors to lower production costs. Paradoxically, with the integration of more computer technology into the filmmaking process, the cost of film production has grown greater and greater, in part due to expanding global markets, but also as a result of audience demands and expectations.

If the phases of technological development and integration are never uniform, they are also not bound by predetermined rules of use. Manufacturers and studios have been unable to dictate or limit the specific uses of new technology. For this reason, it is important to complicate the model by examining the unintended consequences of a technology's widespread diffusion and use. For example, the same computer technologies that have made it easier to record, edit and distribute digital films have also made these films more vulnerable to pirating, sampling and remediation. Everyone it seems can be a filmmaker or distributor, if they have the latest consumer editing software on their personal computer. Despite complex encryption protocols during postproduction, pirated digital versions of films often show up on peer-to-peer networks nearly to the day they are released in theatres, and sometimes well before their premiers as was the case with *X-Men Origins: Wolverine* (2009). In addition, fans engage in mash-ups, parodies and slash versions of their favourite films and post them on YouTube. The consequences of remediation are by no means entirely negative in economic terms. Remediated content often expands the mythologies and cultural significance of the original property, and provides fans with a sense of agency or control over the story worlds they have come to love.

## THEORIES OF TECHNOLOGY

In film studies, various theories of technology emerge which present both unique perspectives on advancements as well as critical pitfalls. There are three primary theories that are often engaged in the analysis of film technology: the *'great man theory'*, *technological determinism* and *economics*. The 'great man theory' cuts across many disciplines; however, in regard to film, it focuses on the lone inventor, working in a secluded workshop until a 'eureka' moment of discovery (Allen and Gomery 1985: 110). The familiar names that arise in relation to the invention of cinema are Louis Lumière, Eadweard Muybridge and Thomas Edison, and their mythologies are often framed in heroic terms. The notion of the singular inventor, however, is challenged by the fact that each was working in a time period that was steeped in developments from other fields, such as chemistry, engineering and physics, all of which contributed to the invention of cinema. These inventors were therefore not alone. A host of artists, scientists, engineers and craftspeople assisted in the process of creating cameras, film stock, sound and projection systems, and cinema as a mode of production was dependent on producers, directors, writers, technicians and the many individuals listed on film credits. The 'great men' of cinema are perhaps 'great' not because of a 'eureka' moment, but rather because of their ability to frame an understanding of the technology and the direction of its use.

Technological determinism presents a much broader theoretical question: Does the technology itself drive the aesthetic output of a particular period in history and by extension the expectations of society and culture? This critical approach suggests that technology determines what is possible within an art form and that in some measure personal agency and freedom of the artist is lost in the process of use. Science fiction films such as *THX 1138* (1971), *Terminator 2: Judgment Day* (1991) and *I, Robot* (2004) present this approach in the extreme as humanity embraces robotic technology as a kind of saviour, only to become enslaved by these mechanised creations. Popular media outlets, from news programmes to magazines, have co-opted the vocabulary of technological determinism without examining the underlying limitations of the approach. It is highly problematic to draw direct lines between the use of a technology and its social effect because this would ignore the web of interrelated influences, from economics to cultural context, involved in a technologies use. It also fails to address the fact that just because a technology exists this does not mean that a filmmaker or consumer will use it. Currently, we see a trend in which some film artists are reverting to older techniques of mechanical special effects, sound recording formats and make-up as a kind of backlash to the use of computer generated images and sounds. For example, filmmaker Christopher Nolan and his crew limited the use of computer generated effects in his film *Inception* (2010), and instead engaged the use of wiring rigs, rotating sets and slow motion photography for the action set pieces in the film. A similar backlash is forming around 3D releases as well, particularly around films that are converted to 3D after being conceived and shot for a 2D release.

Finally, technology in cinema can also be considered in terms of economics. Within these models, technology is understood and evaluated in relation to market needs and values. But in many ways, like the notions of determinism, this scope of inquiry can be limiting if not contextualised within cultural and creative contexts. To their detriment, these approaches often proceed with the underlying assumption that industries and markets move in ways that are self-sustaining and perpetually seeking advancement in regard to their market share. The history of the film industry (like many industries), however, is replete with examples of poor business decisions, the embrace of inferior technologies, and simple human self-interest and greed over the basic needs of a company or the marketplace. For example, economics does not always account for the rejection of superior technology in the marketplace. The VHS versus Beta (Betamax) formats for videotape were an example of this incongruity. Beta tapes and technology

were superior in recording and playback quality and were in fact embraced by many media production outlets, yet VHS format prevailed in part due to marketing, reviews and availability and preferences of consumers. Unexpected adoption patterns plagued the introduction of DVDs and Blu-ray formats as well. Ultimately, when considering technology within a critical framework, it is perhaps best to consider a multifaceted approach, which reflects a balance of theories of technology, economics and social considerations, as outlined above.

## COMPUTER GRAPHIC IMAGING SYSTEMS

One of the most transformative technologies to be introduced to contemporary cinema is not a single technology at all, but rather a host of convergent technologies related to computer imaging systems. These emerge in the form of computer hardware, software applications and input devices such as touchpads and pens. Computer graphic imaging systems come in a multiplicity of configurations and platforms, and are often tailored to support the particular needs of a production. Over the past two decades, these systems have transformed the visual field of films, television programmes, commercials and video games through the creation of computer generated images or CGI. Using these workstations, graphic artists control data to design images and forms in 2D and 3D and to establish simulated environments. For example, Image Engine, a special effects company based in British Columbia, used various computer programs to create the 3D wireframe models of the aliens in *District 9* (2009). These digital creatures were covered with various textured surfaces based on insects and bugs, and then placed within the context of the live-action footage that was shot on location in South Africa, creating a realistic composite that evokes the futuristic and the uncanny effects of the film. According to theorist Michele Pierson, 'Computer generated imagery has emerged as a new kind of visual spectacle on the postmodern mediascape' and it offers a 'techno-scientific tour-de-force for the special effects industry and a new kind of aesthetic object' (Pierson 1998: 3). With pixels and programs that simulate physical phenomena, a dead moon became a planet in *Star Trek II: The Wrath of Khan* (1982), and dinosaurs came to life in *Jurassic Park* (1993). These spectacles provide filmgoers with new pleasures that evoke a sense of 'grandeur', 'awe' and 'the sublime' by providing an experience that is outside 'the typical reality of everyday life' (King 2003: 118).

Within the past twenty years, computer generated images have supplanted many of the traditional visual effects techniques and have established a new mode of production within the special effects industry; while at the same time blurring the distinction between 'live action' and animation. Traditional visual effects production involves a host of techniques and technologies to create cinematic trickery. Some of the most common techniques are the use of small and large-scale models, matt paintings, stop-motion modelling, fire and explosive effects, and make-up and prosthetic appliances for creature effects. Examples can be found in the earliest Méliès shorts to the epics of Ray Harryhausen like *Jason and the Argonauts* (1963) and *Clash of the Titans* (1981). The processes to create these effects, however, are often labour intensive – involving long hours of design and manufacture before going in front of the camera. In addition, numerous duplicates must be created for repeated takes, especially when dealing with disaster sequences like those found in *Earthquake* (1974) or *Towering Inferno* (1974). As early as the 1970s, film producers sought to find low cost alternatives to special effects 'tricks', while also providing filmgoers with the newest cinematic spectacles that could then be featured in marketing campaigns. Over the past three decades, special effects houses such as Pacific Data Images, Industrial Light and Magic, Weta and Pixar began to experiment with computer technology as a means of creating effects within virtual environments. Hardware and software, such as the Pixar Image Computer and, later, RenderMan and Maya software, were developed to create digital models and characters,

render colours and surface textures, and create simulated landscapes and environmental effects. This technology is by no means limited to special effects, but extends to virtual lighting, camera motion effects and even set design and digital make-up. Early examples produced from the technology can be seen in such films as *Tron* (1982), *The Abyss* (1989), *Terminator 2: Judgment Day* (1991) and *Forrest Gump* (1994) as well as more recent film such as the *Lord of the Ring* series (2001–3), the *Star Wars* prequels (1999–2005) and *Avatar* (2009).

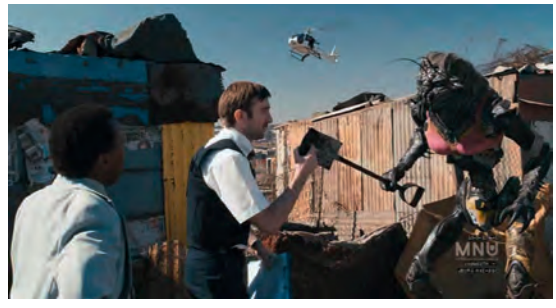
*For further discussion on computer animation, see Chapter 10.*

CGI technology has had a profound impact on our understanding of film form. The visual spectacles created with this technology have become part of the narrative dynamics of the blockbuster. One particularly interesting aspect of this shift can be found in the blurring of our understanding of 'live action' versus animation. It is important to first remember that this technology also fostered a new cinematic form – computer animation. Pixar is perhaps the most familiar studio in this regard, producing feature-length animated films such as *Toy Story* (1995), *Monsters Inc*. (2001), *Finding Nemo* (2003), *The Incredibles* (2004), *Cars* (2006), *Ratatouille* (2007) and, most recently, *Up* (2009), *Toy Story 3* (2010) and *Cars 2* (2011). The same technologies that create computer generated animated worlds have also been used to manipulate images of the 'real world'. Initially, when computer generated images were introduced into films, they often stood out because of their crude design or limited ability to integrate with the live-action footage. In a film like *The Last Starfighter* (1984), the digitally rendered spacecraft were boxy and geometric, and because of the screen capture methods, they were steeped in a bluish hue that caused them to separate from their backdrops when combined with live-action shots. The initial integration did not quite fit in the context of the story world. As a result, filmgoers and critics often limited their critical consideration of the 'work' of computer generated images by asking the question: 'Does it look like an effect?' However, this question lost its authority as the integration of live-action footage and computer images become more refined and seamless. Michele Pierson argues:

> If an effect is only *special* in relation to something else – something that it isn't – how do viewers decide what is a special effect in this context? Does the scope for the kind of transmutation of the visual field that might make an effect special even *exist* once a film begins to be made over in the mode of an animated feature?
>
> (Pierson 2002: 152–3)

The following case study of *District 9* (2009) gives an example of this re-imagining of the visual field and the resultant shifts in critical reception.

• **Plate 2.2**
*District 9* (Neill Blomkamp, 2009). On-set image of actor with reference marks on his costume to be used in the process of computer generated image (CGI) insert.



• **Plate 2.3**
*District 9* (Neill Blomkamp, 2009). Final image with the CGI alien inserted.

## CASE STUDY 1: *DISTRICT 9* (2009)

*District 9* (2009), directed by Neill Blomkam, follows the story of a bureaucrat named Wikus van de Merwe (Sharlto Copley), who has been assigned to lead a relocation effort of a stranded group of insect-like aliens that have been interned in a slum in Johannesburg, South Africa. Social unrest, xenophobia and violence mar the process of moving the 'prawns' away from the city into segregated camps. The style of the film embraces the inherent capabilities and strengths of digital technology in a kind of Next Wave Vérité style, and the computer graphics exemplifies the blurring of animation and 'live action' in the digital age. The film's Vérité style engages mock-documentary techniques, such as interviews, handheld news footage and overhead surveillance images from inside stores and helicopters to establish a sense of cinematic verisimilitude or truth. Culturally, we as filmgoers are acutely aware of these stylistic uses from modern media, and the filmmakers engaged them to foster a suspension of disbelief within the context of a genre blockbuster. Thematically, the film is about fusion or more specifically the reprogramming of human flesh with alien DNA, but it is equally about the reprogramming of media images and forms. Within the narrative, Wikus is exposed to alien DNA, which rapidly begins to transform his body into an alien-human hybrid. Government officials and criminal mercenaries grasp the importance of this fusion and seek to kidnap Wikus in order to exploit the weaponry brought by the aliens, which only they can use. Through the use of computers, the film style picks up these themes of hybridism and reprogramming in its visual lexicon. The alien creatures were based on the textures and structures of real bugs, crabs, grasshoppers and spiders and modelled in the 3D virtual environment using CGI technology. On set, actors provided reference positioning for the creature effects by wearing special suits with data markings that the computers would recognise and record. From this set of data, the creatures were created and seamlessly inserted into the documentary style footage with matching lighting and colour gradients. The footage itself then reprograms the tropes of the documentary style, evoking a new era in civil rights media, which also makes reference to the civil rights issues of South Africa. This approach to CGI goes beyond the manipulation of historical footage used to rewrite the past that we have seen in films like *JFK* (1991) and *Forrest Gump* (1994); rather, it present a 'live' cinematic moment that we might see on the news or in a documentary. The computer technology is used to create evidence of what science fiction is fond of calling 'the near future'. Through CGI, the character of Wikus is transformed into an alien 'prawn', recognisable only by his longing for what he has lost at the hands of men – his humanity.


• **Plate 2.4**
*District 9* (Neill Blomkamp, 2009). CGI technology evokes a News program stylistic, through the use of onscreen graphics and remapping of the visual field.

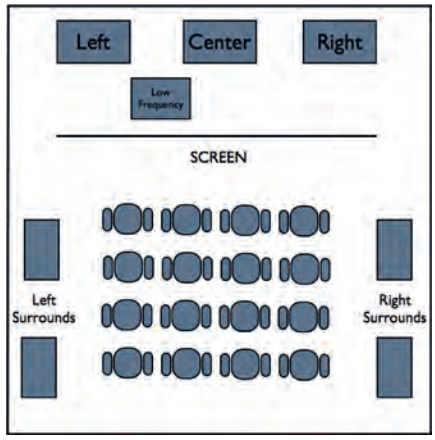
### Multichannel sound

Early experiments in multichannel sound sought to expand the spatial qualities of the cinematic experience, and as with computer imaging technologies, this new audio technology fostered an expansion of our understanding of cinematic form, particularly in regard to immersion and spectacle. In the 1940s, Disney developed 'Fantasound' for the animated feature *Fantasia* (1940), and this is widely considered the precursor to the multichannel sound formats we hear in theatres today. This early multichannel technology featured two synchronised soundtracks that delivered music and effects to fifty-four speakers in specially equipped theatres in the major film markets of New York and Los Angeles (Blake 1984: 20). The system failed to take hold due to synchronisation difficulties associated with interlinking the sound tracks with the 35mm print. The 1950s provided another opportunity for multichannel development with widescreen formats such as CinemaScope and Todd-AO releases. As a result of the introduction of magnetic audiotape, various studios began to experiment with new sound processes on the surface of film prints, stereophonic recording on set and designs for speaker arrays within theatrical venues.[2] With the advent of competition from television, Hollywood studios introduced this new technology in conjunction with various spectacles such as *This is Cinerama* (1952), epics like *Around the World in 80 Days* (1956) and musical extravaganzas like *Oklahoma* (1955) in order to draw filmgoers into theatres. The advantages of the new technology were clear: 'Magnetic sound provided unprecedented fidelity, a dramatically expanded frequency range, and significantly improved signal-to-noise ratio, and a larger dynamic volume range' (Belton 1992: 155). Despite the superiority of the technology and the support of the studios for these systems, though, theatre owners rejected the advance due the costs of conversion, and the 'revolution' stalled.

In the 1960s, however, Ray Dolby of Dolby Labs began experiments in audio noise reduction techniques and sound 'matrixing' or routing that led to an integrated and cost effective system for sound encoding and decoding, specifically tied to multichannel film sound. Filmmakers such as Francis Ford Coppola, George Lucas and Steven Spielberg also played a major role in the renewal of sound presentation in the 1970s and 1980s, demanding greater quality control and presentation of film sound for their films such as *Apocalypse Now* (1979) and *Close Encounters of the Third Kind* (1977). The producers of *Star Wars* (1977) are often credited with ushering Dolby Stereo into widespread use in the domestic US theatre circuit by requiring that prints of the film be Dolby Stereo encoded.

The Dolby Stereo format was introduced in 1974, and reviewed how the traditional optical track was being utilised. The system divided the allotted space on the celluloid near the sprocket holes into two optical soundtracks, and sent the signals through an electronic matrix. This matrix divided the audio streams into the left, right, centre and surround channels, producing what we have come to know as multichannel *surround sound*. The format provided superior fidelity with the added benefit of new audio streams that could fill up the theatre space, immersing filmgoers in sound and music. The box office success of *Star Wars*, as well as other films such as *Close Encounters of the Third Kind* (1977) and *Superman* (1979), meant theatre owners began converting to accommodate the new sound formats.

As digital technologies developed, sound moved completely into the digital realm, becoming integrated into the various processes from recording to exhibition, and by the 1990s, Dolby and other companies were creating digital sound formats that featured multichannel systems to deliver 'discrete' sound signals to the various speakers throughout the theatre. These new formats provided unprecedented dynamic range and sound fidelity. The Dolby Digital sound track, which runs between the sprocket holes along the edge of the film, provides 5.1 channels of sound. This encoding allows discrete sound channels to be directed to an array of speakers, consisting of left, right, centre, left surround, right surround and low frequency channels (Holman 2000: 42–3).




• **Plate 2.5**
Theatre design. Drawing of 5.1 multichannel speaker array in a motion picture theatre.

From a cultural perspective, multichannel sound has become an integral part of the cinematic spectacle of the blockbuster. In particular, 'tent pole' films or films designed to draw huge audiences such as science fiction, comic book or fantasy films are highly dependent on multichannel sound. These films attempt to create not just a narrative experience, but a cinematic experience that feels like an amusement park 'ride' with immersive images and sounds. For this type of genre cinema, multichannel sound technology has expanded cinematic form in three ways: it has provided greater localisation of sound effects and music, eliminated masking posed by different sounds, and provided sonic enhancement in regard to space. As an example of localisation, the image of a car moving from stage right to stage left and driven by the young James Kirk in *Star Trek* (2009) tracks precisely with the sound effects of the revving engine moving through the right, centre and left speakers, then off into the surrounds. Masking issues (or the condition of sounds lying on top of one another) are also eliminated with this technology. The separate speakers allow complex sound designs that span the dynamic range but do not to interfere with one another because they are separated in space. Low-frequency explosions aboard the Starship Kelvin are set well below the chatter of mid-range frequency dialogue and communications because they are presented in a separate speaker array. Finally, multichannel sound allows filmmakers to plot out sound use in different sound fields within the theatre space, expanding the diegesis of a film well beyond the borders of the screen image into the surrounds, as we will explore in the case study of *Star Trek* (2009).

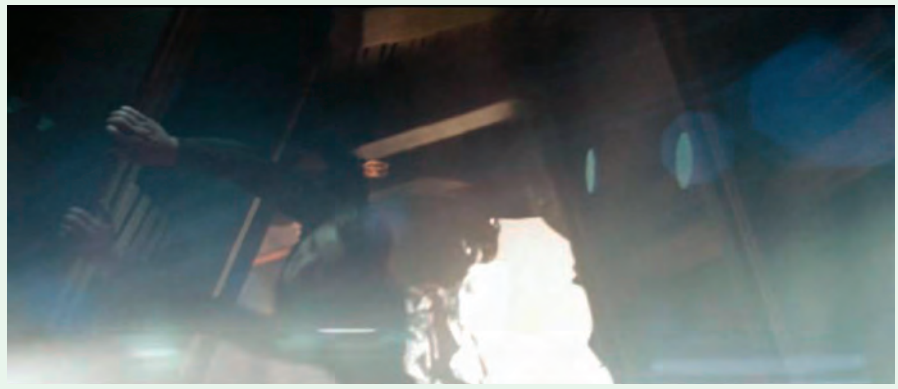
## □ CASE STUDY 2: *STAR TREK* (2009)

In 2009, producer and director J.J. Abrams took on the ambitious task of 'rebooting' the popular television and film franchise *Star Trek*. The original television show from the 1960s spawned several films with the original crew and a number of spin-off television shows and film series. In the opening sequence, Abrams altered the canonical timeline of the original series, collapsing the past and future to rewrite the origin story of the main characters. The first television series was known for its spare yet unique use of sound, inventing effects for hydraulic doors, phasers and scanning devices. The reboot revives all of these effects in the opening shots of the film to offer intertextual references to the earlier series, but then reshapes the overall sound design into a multichannel assault on the senses as a federation ship is attacked by a hostile Romulan ship and its captain bent on revenge.

Sound designer Ben Burtt, best known for his work on the *Star Wars* series, re-conceptualised many of the sounds for the new *Star Trek* feature. For example, he notes, 'In the original series, the steady blast of the phasers was derived from the [musical] wave with pink noise. The phasers in the new movie are more like the blasters in *Star Wars* in the sense that they are flying bolts … shorter and sharper', yet these effects 'recall' the originals in tonal design (Kunkes 2009: 1). Through multichannel sound design, Burtt engineered the opening sequence to function as an operatic and heroic overture, while preparing filmgoers with a preview of the overall sound design and themes that would pervade the film.

The attack on the federation vessel USS Kelvin is replete with the sounds of alarms, frantic voices over the communication systems, and explosions moving on and off the

• **Plate 2.6**
*Star Trek* (J.J. Abrams, 2009). Multichannel sound with action presents a sense of audio-visual chaos aboard U.S.S. Kelvin.



• **Plate 2.7**
*Star Trek* (J.J. Abrams, 2009). A multichannel blast creates an immersive cacophony as the hull breaches on the ship.

• **Plate 2.8**
*Star Trek* (J.J. Abrams, 2009). The point of audition shifts as the soundtrack falls silent to reveal the void of space.

screen into the surrounds, creating an immersive effect which is disorientating. But when a missile hits the ship, the sound perspective shifts and all sound ceases as a crew member, whose point of audition we are suddenly hearing, is pulled out into the void of space. The multichannel format allows for not only a rich tapestry of sounds from the highest frequency to the lowest, but also the removal of all sound. The spectacle of silence in space is overwhelming, and underscores the dangers of space travel and exploration through a metaphor of absence. The operatic elements overtake the sound design as a child (the future James T. Kirk) is born during the attack, and the filmmakers drop all sound effects to emphasise the orchestral score during the birth.

The original series' timeline is reclaimed somewhat through sound as well. Surround sound effects are used to explore outer space as well as the inner space of the mind. During the 'mind meld' between Kirk (Chris Pine) and the older Spock Prime (Leonard Nimoy), Spock's words fragment and echo into the surround speakers in order to evoke the sensation of inner thought and memory. In this way, we are allowed to see and hear the timeline that has been lost, while being presented with the sounds of the future that is to come.

• **Plate 2.9**
*Star Trek* (J.J. Abrams, 2009). Multichannel sound allows Spock Prime (Leonard Nimoy) to reveal his "thoughts" to the young Kirk (Chris Pine), revealing the sonic dimensions of the mindscape

## 3D EXHIBITION TECHNOLOGY

In the 1950s, Hollywood studios embraced 3D technology as a means of drawing filmgoers back into the theatre, but like the multichannel sound of the 1950s, the technology failed to take hold. Currently, there has been a revival of interest in stereoscopic imaging, which not surprisingly intersects with the advances in CGI and sound to create new and innovative ways of experiencing cinema. The 3D technique in cinema is a trick of perception. Humans perceive depth as a result of the separation of the eyes, which results in a slightly different view of an object. Three-dimensional cinema mimics this approach by projecting two images onto the screen, which are either differentiated by a two-colour system (most commonly red and green) or by the other commonly used technique that alternately blocks light to the left and right eye in a pattern of opposite polarisation. The filmgoer then views the images through glasses or polarised filters so the right eye sees one image and the left the other. The result mimics three-dimensional perception. Despite a wave of interest in 3D in the 1950s, the technology proved problematic for filmmakers, exhibitors and filmgoers. Filmmakers were unsure of how to best use the technique, raising questions about how often the technique should be used and to what end. The propensity of use fell into the category of 3D objects being thrust outward toward the audience, which often interrupted the narrative flow of a film. The visual poetic of 3D was given only a short time to develop in the 1950s, until filmgoers grew tired of the cluster of similar uses, and became even more frustrated by the lingering headaches that occurred after viewing films in 3D. While some historians

argue that the quality of the films alone stifled the diffusion of the technology, this line of criticism is perhaps overstated. A number of high-profile films were released in the format including *House of Wax* (1953), *Kiss Me Kate* (1953) and Hitchcock's *Dial M for Murder* (1954). More likely, complaints by filmmakers, exhibitors and filmgoers together doomed the technology. Exhibitors, in particular, found the images too dark, the glasses too expensive, and sightlines for optimal viewing too limited within the theatrical spaces.

In the current era of digital projection, 3D has experienced a significant revival, though some of the concerns about the technology still linger. The renewed interest in 3D began at amusement parks and in IMAX venues. *Captain EO* (1986), starring Michael Jackson, premiered at Disney theme parks in the mid-1980s, while *Terminator 2 3-D: Battle Across Time* (1996) debuted at Universal Studies a decade later, combining a live-action stage show with 3D projected images. The success of these 3D presentations led to its migration into IMAX theatres with short documentary films such as *Ghosts of the Abyss 3D* (2003), *Deep Sea 3D* (2006) and *Under the Sea 3D* (2009). The technique made the leap into mainstream filmmaking in conjunction with the IMAX format. In November 2004, approximately 25 per cent of the overall box-office receipts for the film *Polar Express* (2004) came from these mixed-format venues. As exhibitors began to refit theatres with digital projection systems, 3D systems were easily integrated into the technology chain, and with the 3D format came the potential for theatre owners to assess surcharges to filmgoers for this 'added value'. Currently, there are a number of competing 3D systems in the marketplace, including Dolby 3D, IMAX 3D, MasterImage 3D, Real D 3D, as well as a host of other systems in development, some of which do not require the use of special glasses.

The integration of 3D exhibition into contemporary cinema is by no means assured. Critics have noted continued problems with line of sight, murky and dark images, and simulation sickness, a kind of motion sickness that plagues some filmgoers. Also, some studios are converting films that were not shot or conceived in 3D and rushing them into the marketplace in order to gather the lucrative surcharges. *Clash of the Titans* (2010) was one such 3D film that suffered from murky images and unreadable action sequences due to the effects of conversion. Countering these criticisms, however, is that fact that new generations of filmgoers, under the age of eighteen, are learning to read the 3D visual poetic not just in the theatre spaces, but also on the screens of their gaming systems. It is perhaps these filmgoers who will set the new expectations for 3D technology, which may only be an intermediate step toward virtual environments and interactive narratives. The film *Avatar* (2009), which is the subject of the case study for this section, is perhaps a glimpse of the stereoscopic future that cinema has to offer.

## □ CASE STUDY 3: *AVATAR* (2009)

'I see you', Neytiri (Zoë Saldana) tells Jake Sully (Sam Worthington) in the science fiction epic *Avatar*, which is set on the lush planet of Pandora. During the course of the film, Sully, a young disabled marine, inhabits an avatar body in the form of an indigenous Na'Vi with the mission to infiltrate and seek the relocation of a Na'Vi tribe from their 'home tree'. A mining company seeking precious minerals beneath the surface of the planet drives this goal. The story becomes one of invasion, occupation and genocide; but the balance of power shifts when Sully begins to 'see' his mistake. In terms of narrative and design, then, the film is about seeing. It is about seeing these landscapes for their beauty, and the inner landscapes of body and soul for their interconnection to each other. Through the use of CGI and 3D technology, the film presents simulated locations such as floating mountains, thick forests and saturated horizons that embrace photorealism in their design and execution. Filmmaker James

• **Plate 2.10**
*Avatar* (James Cameron, 2009). In a film about perception, Neytiri (Zoë Saldana) tells Jake Sully (Sam Worthington): 'I see you.'

• **Plate 2.11**
*Avatar* (James Cameron, 2009). Jake Sully in his 'avatar' body in the science fiction epic Avatar.

Cameron and his team developed a web of interrelated technologies to make the 3D filming possible. Using over 140 digital cameras, including head-mounted cameras, the performances of the actors were 'captured' in various networked computers. These digitised performances provided the emotive and physical scaffolding for the virtual characters of the Na'Vi. The filmmakers used an integrated computer and monitoring system that allowed them to review the virtual characters within the context of the background designs. Using various tricks of perception, Cameron adjusted the scale of images in the foreground, middle ground and background to accentuate the dimensions of the locales, and to focus the filmgoers' eyes on specific planes of action. In this way, the eye tracks the image according to these compositions in depth, into the screen rather than outward. The real power of 3D in this instance is its ability to provide a window into the world of Pandora. This process is aided by the multi-channel sound design, particularly the mix of sound levels and localised placement of sound, which draw attention to specific actions in and around the visual field. The success of the system is measured not only in the visual design of the film, but also in the economics of the box-office returns. At the time of writing *Avatar* is the highest grossing blockbuster film to date.

• **Plate 2.12**
*Avatar* (James Cameron, 2009). 3D imaging maps the planes of action in the foreground, mid-ground, and background.

• **Plate 2.13**
*Avatar* (James Cameron, 2009). 3D accentuates movements from right to left across the visual field.

## CONCLUSION

Cinema technology continues to change with new developments in the fields of engineering, computing, audio, optics and architecture. When thinking about new technology and the subsequent changes to film form, it is important to consider the complex convergence of factors such as economics, industrial practices, history, patterns of adoption and cultural reception that shape the cinematic experience in and outside the theatre.

## SUMMARY

- The phases of invention, innovation, diffusion and update.
- Theories of technology and how they overlap and potentially contradict one another.
- The interplay of graphic technologies and how they transform the visual field.
- The continued development of audio technologies from recording devices to reproduction devices and formats, and how they create new immersive qualities.

- The dimensions of the screen space and how new technologies continue to pull our eyes and ears from the 2D plane into a 3D experience that mimics our perceptions in everyday life and directs us towards new understandings of cinematic form.

## QUESTIONS FOR DISCUSSION

1 How have computer generated images shaped our expectations for the blockbuster?
2 In what ways does *District 9* affirm these expectations and challenge them?
3 What role does computer graphics technology play in this process?
4 Some historians argue that sound and music are simply married to the image to create a 'realistic' effect. How does multichannel technology challenge this assumption?
5 In what ways does sound design in conjunction with sound technology create cinematic spectacle?
6 In what other ways do sound and sound technology create inner and outer space in *Star Trek* (2009)?
7 How does the immersive quality of 3D in *Avatar* change storytelling?
8 Will immersive technologies like 3D and multichannel sound become the new standard for all science fiction blockbusters? Why or why not?
9 How does the film challenge the idea of technological determinism? What are the contradictions that film presents in regard to technology?

## NOTES

1 In May 1948, the US Supreme Court handed down its decision in the antitrust lawsuit against the major Hollywood studios. The resolution of the case ended distribution practices of 'blind' and 'block' booking, which had forced exhibitors to take blocks of films, often without viewing them. As a result, studios divested theatres over the next decade.
2 Magnetic tape became the standard for on-set recording and postproduction mixing during this period in part because the medium was reusable. The technology also led to a host of portable recording devices, which further advanced the gathering of raw effects that could be combined later in the editing room. Magnetic tape was one of the foundational technologies that led to the rise of the sound design movement.

## FURTHER READING

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## FURTHER VIEWING

### Computer graphics

*300* (2006) (Dir.: Zack Snyder)
*The Abyss* (1989) (Dir.: James Cameron)
*Jurassic Park* (1993) (Dir.: Steven Spielberg)
*The Matrix* (1999) (Dirs: Andy Wachowski and Larry Wachowski)
*Terminator 2: Judgment Day* (1991) (Dir.: James Cameron)
*Toy Story* (1995) (Dir.: John Lasseter)
*Watchman* (2009) (Dir.: Zack Snyder)

### Multichannel sound

*Amélie* (2001) (Dir.: Jean-Pierre Jeunet)
*Apocalypse Now* (1979) (Dir.: Francis Ford Coppola)
*The Dark Knight* (2008) (Dir.: Christopher Nolan)
*Exorcist* (1973) (Dir.: William Friedkin)
*Fight Club* (1999) (Dir.: David Fincher)
*Master and Commander: The Far Side of the World* (2003) (Dir.: Peter Weir)
*Saving Private Ryan* (1998) (Dir.: Steven Spielberg)
*Star Wars: A New Hope* (1977) (Dir.: George Lucas)
*Terminator 2: Judgment Day* (1991) (Dir.: James Cameron)

### 3D

*Cave of Forgotten Dreams* (2010) (Dir.: Werner Herzog)
*Clash of the Titans* (2010) (Dir.: Louis Leterrier)
*Creature from the Black Lagoon* (1954) (Dir.: Jack Arnold)
*Dial M for Murder* (1954) (Dir.: Alfred Hitchcock)
*Harry Potter and the Deathly Hallows Part 1, Part 2* (2010–11) (Dir.: David Yates)
*Piranha 3D* (2010) (Dir.: Alexandre Aja)
*Superman Returns* (2008) (Dir.: Bryan Singer)
*Toy Story 3* (2010) (Dir.: Lee Unkrich)
*Under the Sea 3D* (2009) (Dir.: Howard Hall)

### Resource centres

**http://www.theasc.com/ac_magazine/podcasts.php**
American Cinematographer Podcasts.

**http://www.filmsound.org**
Comprehensive site devoted to sound and sound design.

**http://www.dolby.com**
Corporate website.

**http://www.cinefex.com**
Premier effects publication with historical and practical entries.