

9 Electronic music and the moving image

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In the composer, [Tarkovsky] sought not the author of music, but the organiser of audio space of the film . . . E. ARTEMIEV¹

Washington, Virginia, USA, 1951; the Washington Obelisk; Lincoln Memorial. A strange low pulsing sound fills the air; it has a bell-like quality. You think you recognise the swelling of a tam-tam roll, but there is also a strange low pulsing sound which does not seem to match anything you have ever heard before. As you see a bright gigantic white disc overfly the Capitol, you recognise the familiar sound of some kind of aircraft. People stop and stare at the skies. A high-pitched bleep is heard momentarily as the disc flies overhead. Now both the pulse and the flying roar seem to modulate together varying in speed and timbral colour. People run and scream as the object prepares to land and the sound becomes more intense: a strong wind, static electricity, a motor sound; all fuse in and out of a pitch-bending tonal hum. The sound of a short servomechanism punctuates the landing. It has arrived!

Within *The Day The Earth Stood Still* (1951), the real and the imaginary become one through the magic of the soundtrack. As the film progresses, the leading musical themes are played by two Theremins. Thanks to their unfamiliarity to the listener, their characteristic gliding sound endows the music of the film with an otherworldly quality by visual association with UFO imagery. The soundtrack of the film contains, then, two main musical elements: the organisation of processed sounds to represent the noises of extraterrestrial elements and atmospheric moods, and the use of electronic instrumentation to imbue the orchestral film score with a futuristic sheen.

As a narrative accompaniment to familiar visuals, electronic and pre-recorded sounds colour our perception in a unique way, arguably beyond the possibilities of conventional instruments, when trying to affect our emotions. The omnipresent warnings of beeping mobile phones, pop-music ringtones and of course the sounds and music from video game consoles affirm that electronic music is not only functional, but almost mandatory. Electronic music has been influenced by the visual and in turn, the visual has been enriched by electronic music.

That musique concrète was born in the studios of the nascent French TV is a telling fact. It is in the context of media production environments in Paris, Cologne and Milan that electronic music began to be thoroughly investigated. In the rest of the world a similar relationship would rapidly become evident. The same technology that made the earliest ‘talking films’ possible also enabled much sound experimentation.

This chapter aims to examine some examples that will illustrate the fruitful relationship between moving images and electronic music. As well as looking into the incorporation of electronic instruments into the film orchestra, we will delve into the creative manipulation of recorded sound for film. We will also comment on the use of electronic music on TV and new media.

‘Film music scoring’ versus ‘sound design’

While much has been written about the use of electronic instruments in film and television music (Chadabe 1999; Hayward 2004; Manning 2004; Wierzbicki 2005; Davis 2006), sound design has traditionally not been evaluated as music. This is interesting since one of the fruits of the electronic music genre has been precisely to open our ears to any sound being potentially musical. In the twenty-first century no serious contemporary music aficionado would deny this, yet evaluations of film music always seem to refer exclusively to the work of the music composer. I would argue that the sound designer is also a music composer and further, that the acoustic compositional techniques of Pierre Schaeffer, Pierre Henry and later electroacoustic composers were prefigured by the experiments of directors and sound artists in film. In fact, it could be said that electroacoustic (as opposed to electronic) experimentation actually starts with filmmaking, perhaps even up to seventeen years before Schaeffer began formulating his musique concrète theories.

Schaeffer, being involved in broadcast media as an employee of the Office de Radiodiffusion Télévision Française (ORTF) in Paris, must have been exposed to the cinema and familiar with the ‘blockbusters’ of the time; their sonic experiments perhaps stimulated his natural curiosity towards the ways in which we listen. Although radio had broadcast ‘canned music’ since the 1920s (Fischer 1922) and even radio drama was making use of sound effects, it is arguably in cinema where they found their first home as the raw material for ‘studio art’. Radio plays were read live and the sound effects artist would perform their door-closing, horse-galloping and so on with props. In cinema, however, ‘off-line’ performance was made possible. When the first of the ‘talkies’, *The Jazz Singer*, appeared in 1927, the magnetic

tape recorder, which would enable extensive editing techniques, had not yet been invented, so film editing was really the only viable technology for assembling and mixing sounds. It is no coincidence that in John Cage's 'The Future of Music: Credo', written in 1937, we read this reference to the use of film sound machines to make music:

The sound of a truck at 50 m.p.h. Static between the stations. Rain. We want to capture and control these sounds, to use them, not as sound effects, but as musical instruments. Every film studio has a library of 'sound effects' recorded on film. With a film phonograph it is now possible to control the amplitude and frequency of any one of these sounds and to give to it rhythms within or beyond the reach of anyone's imagination. Given four film phonographs, we can compose and perform a quartet for explosive motor, wind, heart beat, and landslide. (Cage 1995, p. 3)

The aim of the film sound designer, typically, is to give credibility to the picture through the organisation and re-creation of sound. And sometimes their work seems closer to Cage's 'Credo' than to simply re-syncing production sound to visuals. Even though this may sometimes be transparent for the audience, their work is musical in so far as it involves the organisation of sound events and creative modes of listening. At once, familiar elements can be identified through a process of 'causal' and 'reduced' listening modes² (Schaeffer 1966; Chion 1990), but the meaning of these sounds, that which clearly indexes them to reality and should contextualise them, has been hijacked by the visuals; a sound which on reduced listening should represent something, by visual coincidence ends up representing something else. In this respect, the sound designer is in a position to arrange a relationship of coincidence or opposition between what is heard and what is seen.³

Composer and film-music theorist Michel Chion refers to the 'spontaneous and irresistible weld' of sounds to visuals as *synchresis* (synchronism + synthesis) (Chion 1994). Chion also explains how this relationship between visuals and sound 'is also a function of meaning, and is organised according to gestaltist laws and contextual determinations' (Chion 1994, p. 63). *Synchresis*, however, seems to refer to that fleeting moment in which sound and visual coincide for the viewer. It leaves open questions of longer-term form such as the overarching structure. It could be argued that helping establish these is part of the remit of the sound designer. In considering their work in the terms of Cage's 'Credo', this may aid grand-scale compositional coherence. The question that remains, then, is how to create this larger semantic context; perhaps techniques from electroacoustic music composition could be applied? As we've been implying, the sound designer already does something like this – I would argue that a more conscious compositional intent can be utilised. In this respect, a view such as Chion's idea that there is

‘no soundtrack’ (Chion 1994, p. 40), that the sounds of film have no real coherence separate from the image, might be taken. Yet radiophonic works already show us how easily implied images are evoked through sound.

The sound designer has practical experience of these issues, and one thing that they share with acousmatics is the sonic imagination that liberates sound from its original context. In choosing sound sources for syncing they tend to proceed in ‘reverse’, not by deducing a sound source but by inducing it from a given sound. In *Star Wars*, in order to give the robot R2D2 a friendly nature, Ben Burtt mixed robotic bleeps and buzzes with recordings of himself whistling. This helps humanise and give warmth to the robot, it endears it to us. Burtt imagined what R2D2 could sound like. In treating a fictional creation, he had no real sound source for this robot, so he induced from ‘whistling’ the humanness that he wished to bestow upon it, and the machineness he induced from various bleeps and servomechanism sounds. Burtt, as arguably all sound designers do, listened imaginatively in his search for useful sounds. It could not be termed causal listening, although this mode can be applied to the finished sound sync. It could not be termed reduced listening although this could also be applied to the sound effect. In view of this, maybe one could propose an additional mode of listening, that of ‘imaginary listening’.

Electronic music and film

For those readers unfamiliar with film-music terminology I will briefly introduce two terms that will help us throughout this discussion. When music is perceived as belonging to the narrative space in which the film action takes place, it is called *diegetic*. An example of this would be the music from a radio which we can see onscreen. By contrast, *non-diegetic* music, also known as *incidental*, is that which the film composer has created for the accompaniment of the image and runs parallel to the actual narrative we can see.

In the late 1920s an age of sound experimentation was dawning. Thanks to the introduction of sound in film, most of the early sonic experiments were actually being carried out in film soundstages. In the relationship between electronic music⁴ and film, two trends have become evident. One is the use of electronic sounds to portray the psychology of the characters, the ‘inner space’ as it were. The other is their use to portray futuristic elements, and aliens, or outer space.

In Rouben Mamoulian’s *Jekyll and Hyde* (1932), the sounds that accompany the appearance of the psychotic Mr Hyde could easily be found in later musique concrète. Reverberation, close microphony, backwards sounds and

even 'artificial sounds created by photographing light frequencies directly onto the soundtrack' (Hayward 2004)⁵ were used for this film. More illustrations of character psychology are found in later films such as Alfred Hitchcock's *The Lost Weekend* (1945) through the use of the Theremin. Although this instrument had been used earlier in Max Steiner's *King Kong* (1933) and Franz Waxman's *Bride of Frankenstein* (1935), the first movie in which the Theremin is really used as a main soloistic timbre was *The Day the Earth Stood Still* (1951).⁶ And it is here that it acquires a new association, that of outer space.

The 1950s spawned an interesting repertoire of sci-fi films. The use of electronic instruments and sonorities increased as the post-war world became fascinated with notions of the atom and outer space (Taylor 2001). In sci-fi films, electronic music was allowed to flow easily between diegetic and non-diegetic roles (Leydon 2004; Wierzbicki 2005). This is evident in Louis and Bebe Barron's music for *The Bells of Atlantis* (1952) and later *Forbidden Planet* (1956), where incidental music and sound effects are born out of the same haunting electric tones.

It is worth at this point to trace the artistic thinking that allowed this development to take place. In the late 1940s, Oskar Fischinger, an experimental filmmaker, was advising John Cage that 'there is a spirit . . . inside each of the objects of this world . . . all we need to do to liberate that spirit is to brush past the object, and to draw forth its sound' (Nicholls 2002). Fischinger himself would experiment with the synchrony of sound and film and with the direct 'painting of sound' on film. This encounter between Cage and Fischinger would prove important, as Cage later employed Louis and Bebe Barron to prepare the tape material for *Williams Mix* (1951–2). Perhaps the actual compositional scheme used for the preparation of its sonic material owes much to this meeting (Pritchett 1996). Cage's experiments with indeterminacy and 'noise' would also reinforce the Barrons' own unprejudiced creative attitude in their 'studio composition' methods. Arguably, this also makes them figurative heirs to Fischinger, whose ideas reverberate through them, back onto film. In fact one can just imagine the historic crossroads at which the Barrons found themselves, as their work for Cage also meant that they would come into contact with Morton Feldman, Earle Brown, Christian Wolff and David Tudor through the 'Project of Music for Magnetic Tape' (Manning 1985; Bernstein 2002). The Barrons' studio was operational from 1948 and their first electronic composition *Heavenly Menagerie* (1951) also predated the work of the more famous 'Stúdio für Elektronische Musik' at *Nordwestdeutscher Rundfunk* in Cologne in October 1951 (Leydon 2004).

By the time the Barrons received the workprint of *Forbidden Planet*, before Christmas 1955 (Wierzbicki 2005), a mature compositional voice was

already in place to reach beyond film-music conventions. Their score was truly novel for the time and even today sounds futuristic and intriguing. An example of this is found in their depiction of romantic love between the male and female lead. It is unusual in sound and style (Leydon 2004; Wierzbicki 2005), setting itself apart from any known cinematic cliché at the time with the use of electronics to convey emotional warmth. The music for *Forbidden Planet* is closer to the avant-garde than it is to the music of the Hollywood studio system. But perhaps one could speculate that the approach of the Barrons, who would let a circuit burn down just to be able to record it (Leydon 2004), is closer to modern day experimental electronica.⁷

Rather like the UFO from the opening scene of *The Day The Earth Stood Still*, in becoming associated with the mass media distribution of film, electronic music and studio composition landed upon our collective consciousness. Filmmakers, radio producers and other creators of media have taken advantage of this and in so doing have enabled electronic sound to become a powerful signifier of all the things that seem to lie beyond our grasp.

Disembodied electronica in film

The most likely precursor to ‘disembodied’ electric sound creation is drawn sound.⁸ This is achieved by actually drawing with ink on the film’s optical soundtrack. When talkies were introduced in the late 1920s, the technology to ‘print sound’ on film became available. If you physically held the film to the light you could see the waveform of the sound printed on it within its own sidetrack to the visuals. In fact, until quite recently, even though you could already record sound to 35mm magnetic tape (‘mag’), which would then be synced when editing the film, in order to be projected with the film, sound had to be ‘developed’ just like the film picture. This practice was still in vogue in the early 1990s and has mostly died out now thanks to the spread of the Dolby digital audio formats.

Even though the avant-garde scoring approach espoused by the Barrons didn’t become widespread, there are a few interesting examples to recall at this point. One would be the electronic music score for Kurt Maetzig’s *Silent Star* (1960), an East German and Polish production where composer Andrezej Markowski provides both acoustic and electronic music. The former only graces the opening and closing of the film; the rest of this story about a mission to Venus is completely scored with electronic music. Synthesised sounds were produced in the *Experimentalstudio* at Polish Radio, playing the alternating role of non-diegetic music and ambient sound effect. The versatility of the sounds is truly breathtaking, at times simulating the

decoding of an alien message found in a rock from the Gobi Desert and at other times simulating a storm on Venus. Every device on the Kosmokrator spaceship has a sound but also an 'alter sound', as is illustrated when radio communications with the moon space station and with other cosmonauts are accompanied by incidental sounds. It is sometimes impossible to know if what you hear is an effect or an incidental musical commentary on the action. This in part is due to the fact that the sounds used seem to bear no evidence of human effort or corporeality. *Solaris* (1972), a sci-fi film by Andrei Tarkovsky, features an electronic score by Eduard Artemiev which focuses on the creation of ambient sequences that colour the psychology of the characters as well as representing the sonic atmosphere inside a space station orbiting the planet Solaris. In a theme reminiscent of *Forbidden Planet's* 'monster from the Id', the fears and longings of the characters are made reality and pose all sorts of problems, driving the scientists to near madness. Even though in certain moments of the film, the F minor *Chorale Prelude* by J. S. Bach is used, traditional music with its gestural evidence of human action is less apt than the studio manipulations of sound to represent the world of the space station.

The approach to film music which we have discussed can further be explained by the imaginary listening mode proposed earlier; sonic representations of the unknown require speculation. In the tradition of illustrating mind processes through sound, in *Apocalypse Now* (1979), Walter Murch has the sound of a helicopter match the image of a ceiling fan. Through imaginary listening, the helicopter rotor is believable as a hyperreal ceiling fan and this tricks the audience into a false sense of confidence which is disrupted as the actual helicopters come on screen. Through creating possible imagined sounds, the sound designer can influence the audience's perception of the size or proximity of an object. They can add a layer of emotion that was previously lacking, create immaterial objects which the audience believes it is about to see and make the invisible believable by virtue of its sonic footprint.

In the 1970s sound designers became recognised in their own right, as seen in the work of Ben Burtt for *Star Wars* and later Walter Murch with his Oscar for the sound of *Apocalypse Now*. The term 'sound designer' as it is used today was actually coined by Burtt. Although his contributions remain firmly in the diegetic or narrative domain, the atmospheric overtones of his sound mixes help impregnate the film soundtrack with new meanings. A true virtuoso of imaginary listening, Burtt devised his now famous laser-gun sounds for *Star Wars* by recording a guy-wire from a radio tower in the Mojave desert. Having been out hiking in the Pocono mountains, his backpack got caught on one of these wires when walking under a tower and the 'twang' it made when released 'had an otherworldly sound to it.'⁹ He

immediately thought it was perfect for a laser-gun sound, and set about testing the guy-wires of many different radio towers until he found the best one. Burt called himself a 'sound designer' on the strength of his involvement with film sound at all levels (recording, editing and mixing), but it could be argued that his contribution to the narrative through the creation of synthesised sound worlds is closer to electronic music than it is to foley-walking.¹⁰

Instrumental electronica in films

The use of electronic instruments in film scoring has, arguably, just extended the orchestral palette without making any real impact on the musical language itself. Film music in the tradition of *The Day the Earth Stood Still* is only quantitatively different from, say, *Clockwork Orange* (1971) with its all-electronic orchestration by Walter Carlos.¹¹ In these films, it is rather a question of how much of an 'orchestral' role is taken on by electronic instruments. We might agree with Cage's attitude to the Theremin as portrayed in the quotation in chapter 3.

After the initial use of electronic instruments as an addition to the film orchestra, the next important development was to use them as a substitute for the orchestra itself. From John Carpenter's soundtracks for his own films, to Hollywood blockbusters such as *Beverly Hills Cop* (1984) and its *Axel F* theme tune by Harold Faltermeyer, electronic instrumentation lends both a 'modern' sound, but also, conveniently saves the expense of performers' buyouts or royalties. With the introduction of MIDI instruments and computer sequencing, an arguable 'deregulation' of film music production ensued.¹² Advances in sampling instruments and the sampling of orchestral film clichés, such as can be found in many popular sound libraries today, have also contributed to the use of electronic scores. Most contemporary orchestral movie scores start at a computer sequencer. A fine recent excellent example of combining both electronica instrumentality and the disembodied sounds of the studio is in the soundtrack to the psychotic process that the character Max Cohen undergoes in the independent film π (1997) by Darren Aronofsky (composed by Clint Mansell). Here the electronic sound world illustrates the psychology of the character but also the technology that surrounds him and his scientific elaborations.

Electronic music on TV

Although Raymond Scott (1908–94) is far from being a well-known electronic music composer in the mass media, his name should rank among

those of Schaeffer, Stockhausen *et al.* Although a neglected pioneer of electronic music, his 1946 patent disclosure for an 'orchestra machine' must surely be the first description of a sampling instrument. Equally concerned with composition and sound lutherie, Scott designed and built several new electronic instruments which he used for scoring his commercials and orchestrating his jingles, including the first sequencer (mid-50s), the *Clavivox* keyboard (1960), a rhythm machine called *Bandito the bongo artist* (1968) and an algorithmic composing machine without a music keyboard called the *Electronium* (late 50s). Scott was truly ahead of his time in using electronic instruments and sequencers for commercials. Perhaps he has been overlooked by many academics to this day on the grounds of being too involved with the commercial world. What he accomplished in compositional studio work in the late 1950s and 60s only became widespread practice in music for media by the mid-80s. Partly this is due to Scott wanting to protect the exclusive use of his inventions, confound his competitors, and so ensure his financial success. Just a provocative pause here . . . how much electroacoustic music would have been written since the 1940s if its survival had depended on audiences paying to listen to it? Or buying the recordings?¹³

As we have discussed earlier, electronic music had become strongly clichéd when used to accompany visuals, always illustrating psychotic states or alien beings. When incorporating electronica into commercials Scott helped widen the perceived emotional scope of electronic sounds. In 1960, in his commercial *Vicks: Medicated Cough Drops*, a straightforward jingle is entirely made of electronic sounds including a programmed rhythm track. The music here does not allude to any kind of altered state or outer-space imagery; the electronics make instrumental sounds that resemble a Hammond organ, except that the rhythm track is programmed and the sounds are sequenced by a machine which would eventually become the *Electronium* in the late 1960s. Scott nicknamed it the *Karloff*,¹⁴ but one of his employees suggested it should be called the *Audimation* since it seemed to do for audio what cell animation did for pictures. The Vicks commercial was, according to Scott himself¹⁵ (and nobody has claimed otherwise), the first commercial to use electronics. The ad executives from New York's famous Madison Avenue needed a distinctive sound, something that would be different and set the product apart. In the process they contributed to the history of electronic music by broadcasting the first electronic music made with a sequencer. Other electronic music commercials would follow, such as the 'lounge' styled *Lightworks*, the futuristic *Bendix 1: the Tomorrow People*, or the rhythmic piece made with bean shaking sounds for Nescafé. Scott also scored industrial films such as his *IBM MT/St The Paperwork Explosion*, as well as experimental films such as *Limbo: The Organized Mind* by puppeteer and animator Jim Henson.¹⁶

Music in advertising truly reaped the rewards, creative and financial, of Scott's contribution around the mid-80s when tracks could be easily produced in MIDI studios and overlaid with vocals and acoustic instruments on tape synchronised with 'SMPTE' timecode.¹⁷ The advent of available consumer sampling instruments, such as the *S900* by AKAI, made it even easier to substitute live players for sampled versions of musical instruments. The workflow of creating music for commercials was still complicated though, as SMPTE had to be read off video tape and converted into MIDI in order to drive the sequencer (software or hardware). It was not until the widespread use of Apple's *QuickTime* video format in the late 1990s that issues of synchronisation ceased to be a problem for media composers. Computer software sequencers during this time began to allow QuickTime files to run concurrently with the music. It finally became possible to do on a desktop computer what Scott did in the late 1950s when using his *Videola* invention. He could compose music synchronised directly to film by controlling the transport of a remote machine from his keyboard, which projected film onto a small TV-like screen as he played and recorded his piano and electronic instruments.

One of the consequences of music for audiovisual pieces being created on desktop computers has been the increased use of electronic music to accompany moving images. Three aesthetic strands seem to have developed from this. Firstly, a 'natural' aesthetic: acoustic music is recorded, produced and edited on digital systems and a virtual performance of the piece is arranged and mixed to suit the visuals. Most acoustic film music is made like this. Secondly, a 'synthesis' aesthetic: music which owes its discourse to traditional musical forms but is made with electronic instruments. Works like *Blade Runner*, *Chariots of Fire*, Carlos's *Clockwork Orange* or Mansell's π fall into this category. Thirdly, an 'organised sound' (to paraphrase Varèse) aesthetic: music which is structured around *sound objects* and their development, without necessary reference to melody or harmony. Works like *Forbidden Planet* by the Barrons and *Silent Star* by Andrezej Markowski are examples of this. In so far as *soundscapes* are created by sound designers without a 'one-to-one' relationship with the visuals, these also fall in this category as they illustrate the narrative musically. Examples of this are also found in Mansell's music for π , and in much of *Blade Runner's* atmospheric sequences.

In the medium of commercials, the composer is nowadays expected to provide electroacoustic sound textures as necessary, either in addition to or as the unique element of the soundtrack. In this case, the formal issues of acousmatic music come into play with the added apparent contradiction of having to adapt to actual images, thus negating the initial acousmatic nature of the music. Initiated also by the work of Raymond Scott in the 1950s, and perhaps best illustrated by pieces such as *GMGM 1A*, part of his *Futurama*

commercials for General Motors,¹⁸ this trend has spread widely and is found almost continually in music for commercials. The term ‘sound designer’ is true here not only in the sense that Ben Burtt intended but also in the wider sense that we have been attributing to it throughout this chapter, namely that all sound, diegetic and non-diegetic, should be organised musically.

Electronic music and games

Electronic music and video games are natural partners. Video games reach their audience in a personalised and unique way, and in no small measure thanks to the sound and the music – both of which, if not electronic in source, will be electronic in processing, rendering and realtime arranging. The intention here is to recognise the importance of video games as a new form of media and to inform the reader on some of the basics of this fascinating field, without any claims to exhaustiveness.¹⁹ We do not intend to provide here a comprehensive description of video games and their different types, but rather to discuss how they interact with electronic music and sound. There are also whole trends of electronica spawned from the aesthetics of game sound, forming another fast-growing area of musical interest.

Although there are a few early instances of using cathode ray tubes (CRT) for projecting games graphics, video games proper are those developed for raster video equipment such as TV sets or computer monitors and consoles that connect to them. And it is with the appearance of the latter that electronic sound began to be used. The first video game to include sound was named as a pun on the real-life game that inspired it. In 1972 ‘Pong’, by Atari,²⁰ quickly became a mass phenomenon as young people across the US queued outside bars waiting for their turn to play the arcade version. The very naming of this game illustrated the dynamic relationship that would ensue between video games and electronic music: that music is firstly a means of aural feedback to the gamer, indicating his success or failure. And secondly, but not least important, it becomes a mood setter rendering the psychology of the game in sound.

The diegesis of games is in the progression through the game world, and here is where games offer a different challenge for electronic music composers from that encountered in other media: namely, that a composer must write music whose final structure will be determined by the gamer. There have been three main technological approaches for producing audio and music in games. Soundcard synths which can be played/controlled by the game via MIDI and pre-structured into tracks by using sequencer software; *redbook* audio which consists of streaming complete recorded tracks from

a CD; and digital modules or *MODs* which are similar to redbook audio but closer to a sampling instrument.²¹ Early games used electronic sounds programmed by the software designers working on them, but as the computing power of video games improved, the music made for them became more sophisticated.

Space Invaders (1978) by Toshihiro Nishikado²² was the first game to have continuous music; it was available as an arcade game and later on such TV set-top boxes as the Mattel Intellivision console, and also had sound effects. The level of interactivity was quite low but nevertheless it was there: the tempo of the music accelerated as the player improved his score; a simple yet effective way of increasing tension and excitement throughout the game.

Early arcade games included simple fanfare tunes to announce the start and end of the game. In this sense the music was a branding tool. Some games also provided 'cut scenes' or interludes in which the players could watch a little audiovisual display intended as a reward for moving on to another level²³ (Collins 2004). Still to this day, interludes are inserted at points where it may be necessary to articulate the narrative or simply to give the computing engine the time to load the next sections of data required for the game to proceed (Wolf 2002). In games like *Myst* (1993) this is accomplished with sound effects and fade-outs when moving between 'ages'. As the game is itself so sedate, these pauses do not seem strange to the player and preserve the continuity of the game experience. In more recent games such as *Tomb Raider: Legend* (2006), video interludes are necessary for the story of the game to unfold and to give the player her next assignment within the game.

The music that was possible on the early games was very primitive in terms of sound generation, as the composer would at most be able to play one or two simultaneous voices. The music for *Space Invaders* gives a good idea of what this sounded like.²⁴ The quality of the sound was rather low, but as often happens, this very limitation eventually gave it a sort of 'cult' status. The use of 8-bit computing later became the inspiration for styles such as *clip-hop*, *micromusic* or *chiptunes* and other trends of *lo-fi* in electronica. Today, artists such as Bit Shifter, Bubblyfish, Random and Covox, who create their music using Nintendo *Gameboy* mini consoles or other handheld or retro technologies, represent the creative dynamism of this trend. Today, synthesiser/sequencer/tracker programs, such as *nanoloop*²⁵ for the gameboy, potentially allow anybody to get into the video game-inspired music scene. In fact most 'flagship' sequencers now bring noise-adding, bit-downgrading plugins to achieve 'vintage' lo-fi sound.

In the early 1980s, *Defender* (1980) and *Donkey Kong* (1981) helped establish the sound we typically associate with video games. By the mid-80s the use of MIDI sequencers began to spread, as did FM synthesis (Frequency Modulation allowed more complex sounds to be produced with the same

computing power; see chapter 11). The use of sound modules such as the *Roland MT32* allowed for fuller orchestration of MIDI soundtracks for video games. Nevertheless, the quality of the music often tended to be rather mechanical and 'gamey', although very catchy, as exemplified by the music for *Super Mario Brothers* (1985). In the 1990s, with the advent of the CD-ROM, full quality sound could be streamed during the game. This was good for quality but not so good for interactivity, as the more pre-recorded the music was, the fewer variations became possible. As the 90s progressed, the technology became capable of both streaming high-quality audio and providing for interactivity. In the early 2000s, games such as *Donkey Konga* combined interactivity and high quality sound.

Audio interactivity in some modern games can be viewed as an extension of algorithmic composition and generative music techniques (chapters 5 and 6 in particular deal more comprehensively with these subjects). In the context of games, this is often dubbed *adaptive* music: the musical structure is selected depending on the player's actions.²⁶ This interactive audio for games helps to endow characters with emotions, adding depth of sentiment to the playing experience (Eladhari *et al.* 2006). Abundant examples are found in recent games: *Legend of Zelda: Ocarina of Time* requires the player to interact by performing musical tasks; adaptive audio techniques have found their way into games such as *Lara Croft/Tomb Raider: Legend*,²⁷ signalling greater levels of musical interactivity in games.

The adaptive audio technique used in *Tomb Raider*, though not so effective in the 'chase' sequences, is very clear when Lara has to try and rescue some friends in an underground complex of tunnels. As she runs, jumps and hangs from every available handle in order to traverse the tunnels, the orchestral music offers an ever-changing rendition of its melodic elements. The music relies heavily on frequent changes of metre and slight changes of harmonic emphasis. The result is pleasing and exciting. As Lara's manoeuvres control new renderings of musical combinations, a potential for new forms that defy old compositional logics can be glimpsed.

From the compositional point of view the goal of creating game music which does not repeat but is continuous throughout the game is indeed a challenge, yet from an aesthetic point of view, the emphasis on repetition (Grodal 2003) is clearly a poetic element shared with many forms of electronica; as the rise and development of the latter has been parallel to that of video games, one cannot help but wonder whether an emphasis on hypnotic repetitiveness is indeed the result of a cross-fertilisation. The association between games and electronica was acknowledged 'officially' in 1995 when Sony released the game *Wipeout* including tracks by *Orbital*, *Leftfield* and *Chemical Brothers*, and when they later installed a Playstation room at the Ministry of Sound club in London (Poole 2000).

Rather like algorithmic music itself, video-game music will continue to surprise us with increasing structural flexibility, high sound quality and the possibility for a set of rules to create many valid renditions from similar raw material. Other electronic and electroacoustic music trends should benefit from this as they take their cue from video games when adopting their road-tested multimedia techniques. Finally, the limitations of game sound are and will continue to provide aesthetic challenges which create virtue out of necessity; for instance, finding aesthetic beauty in the imperfection of lo-fi.

Future media?

Although it is not possible for reasons of space to go further into other trends, it is worth mentioning some new directions. An exciting area in electronica to watch for will be the interaction with video games and video game-like environments: as technologies for machine listening and algorithmic music develop, ever more subtle reactions to visuals can be planned by composers. As visual worlds become alive in synthesised 3D environments, so does the soundscape that accompanies them. This means that composers of music for media will now need to become more computer-literate than ever before; the new film orchestra will demand a healthy dose of programming.

As connection speeds increase, the 'live' interaction with the internet will require more creative ways of using sound and music to enhance the experience; innovative mappings between sound and vision (Collins and Olofsson 2006) will become enabled by greater literacy of software tools. Interactive cinema will ask for new musical responses and solutions from composers, probably in a way that is closer to video games; composing for film will increasingly make use of algorithmic techniques (Rohrhuber 2007). Generative techniques in both video and audio will probably become more popular in advertising and communication: 'master' messages may be re-cut on successive deliveries, to continually present fresh perspectives for the same idea. Mobile telephony, now audiovisual, will continue to present new challenges for composers and sound designers; musical ideas will populate future portable media.

As we have seen, electronic music has become inseparable from the visual arts. In our urban and networked life we are surrounded by media which in turn are made alive by the sounds of electronic music. In film and TV, electronic music was born out of the technology that makes it possible for the image to move: this parentage ensures a fruitful relationship of which we have witnessed only the beginning. Sound design is becoming, increasingly, a more musical activity than previously thought. Electronic music

instruments have found their 'desk' in the film orchestra. The Theremin has always enjoyed a presence in pop music, and perhaps looks to become a 'traditional' instrument. Synthesisers and samplers are more common than pianos in any music studio: they are also found in ensembles for almost every musical style one can think of.

Audiences who would not step into an acousmatic music concert are quite happy to enjoy the same electroacoustic sounds when they appear on screen in films such as *Bladerunner* or the *Terminator* series. Perhaps youngsters who have never heard Stravinsky's *Rite of Spring* (1913) are now ready to enjoy it, as Lara Croft has introduced them to polyrhythm and extended harmony; though they might demand that they interactively explore it, with a 3D animated orchestra and incidental visuals, such that it is never heard the same way twice.