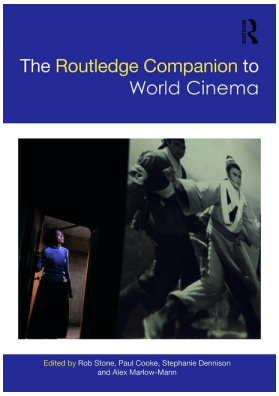

The Routledge Companion to World Cinema

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Digital cinemas

Publication details
https://test.routledgehandbooks.com/doi/10.4324/9781315688251.ch36
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Published online on: 27 Sep 2017

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DIGITAL CINEMAS

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Introduction

All contemporary cinema is digital. Analogue cinema still lives on in archives, specialist theatres and collections showing celluloid or nitrate film, but otherwise we make and view cinema digitally in the twenty-first century. Financing, production management and accounting, sound and image generation, recording and post-production, distribution, marketing, audience intelligence and critical response all use digital tools. In this sense, cinema is digital from conception to delivery. However, in many instances, digital tools make little difference: accountancy software is only a more efficient update of double-entry book-keeping. Meanwhile, some things have not changed at all. There is no such thing, for example, as a digital lens: glass technology and lens housings remain more or less as they have been since the late 1940s. The art and craft of filmmaking still demands real people to do real things in real places. Stunts still require stunt artists; animals still require wranglers; even synthespians (digital actors such as Gollum in *The Lord of the Rings,* 2001–2003, New Zealand/USA/Germany, Peter Jackson: see King 2011; Prince 2012: 112–157) rely on specialist performances by live actors. Animations still require voice artists (though the music industry has employed synthetic modulations and overlays as effects since the arrival of analogue electronics in the 1960s, no studio or effects house lays claim to viable voice synthesis, making any claim to "totally digital cinema" to that degree incorrect). A script hammered out on a typewriter is not distinguishable from one crafted in Movie Magic. Props, make up, locations, sets, cranes, dollies, transport, catering, crew and actors remain obdurately physical. The machinery inside edit suites has changed but the architecture remains, as do executive offices and auditoria. Nothing has changed, and yet everything has.

The political economy of World Cinema

One of the ways everything changes concerns the political economy of world cinema. One aspect of digitisation is that once circulated as files, transmitted or on DVD, movies can also circulate in pirate forms, leading to an escalating war between pirates and studios to create or break miscellaneous digital rights management (DRM) software. The same struggle has led to increasing use of streaming rather than download as a way of protecting intellectual property rights in films, as well as new forms of licensing through industry-dominating online services

such as Amazon, Netflix and Apple's iTunes. Here, as well as in the theatrical and sell-through markets, contactless and mobile payment are the retail end of a massive movement from physical to electronic money. Since cinema is a business, the dematerialisation of money has significant implications. It increases the speed of financial flows and introduces new challenges for monitoring expenditure and revenue. Pre-production now routinely uses digital tools to integrate the translation of scripts into workflows, shoot planning, crew management, post-production tasks and timetables, and, at every stage, integration into budgets. Grant-aided and crowd-funded producers have new machineries of Paypal and electronic banking to learn and work with. New opportunities to syphon off cash arise when the dark arts of studio accountants meet those of "black hat" hackers. Digital financing and revenues are now integral to the global film industry, placing it squarely inside the new economics of financialisation. Similarly, labour in the film industry shares the new configurations of flexibility, precarity, offshoring and outsourcing as sub-contracting cascades from major to minor specialist suppliers, for example, of effects and code services, where bitter competition reduces profit margins and wages drastically (Turnock 2014). Even if we disregard the decades-old tradition of self-exploitation among creatives committed to making their work and getting it seen with little or no pay for their efforts, we can observe that digital cinema is as deeply involved in the global economy, and as deeply implicated in the speeds of transaction and vulnerability of self-employment as any other business.

Like digital money, new technologies also enable a radical globalisation of cinema production. Network media allow transnational productions to synchronise shoots, effects and post-production across time-zones. Compositors match location dailies from one city with effects footage from another and send results back to producers in a third, often using differences in time-zones to create a 24-hour production process. Specialist software allows directors and producers to synchronise sound and visual edits conducted hemispheres apart. Rapid broadband network communication erases the temporal distinction between shoot and edit: postproduction is no longer necessarily "post" but concurrent with production. In one of the most significant changes, whether shot digitally or analogue, the laboratory processing and grading over which directors and editors had little control is now undertaken in digital intermediates (Belton 2008). Where films used to pass out of the direct control of creative staff into the hands of expert chemists, creative staff are in control, although that control also permits the intervention of producers and financiers. While cheaper equipment democratises production and opens the cinema to smaller, even individual projects, at the same time digitisation encourages participation and collaboration, but not necessarily in democratic mode: the hierarchy that places financiers at the pinnacle of decision making, with craft and talent often far lower down, is if anything strengthened by digital means of production and distribution. It is equally notable that, with the partial exception of arthouse and festival films, global distribution is remarkably dominated by English-language, especially Hollywood exports, while English-speaking markets are equally remarkably impervious to popular cinemas from the rest of the world. Ease of circulation and diminishing transaction costs seem not to have encouraged genuinely open circulation of non-Hollywood product. Indeed, this seems to have coincided with a closing of the market to such films.

Digital data in production

On set, digital tools are now ubiquitous. Aaton, ARRI and Panavision stopped making film cameras in 2011, and although Kodak continue to manufacture motion film stock, Fujifilm abandoned production in 2012. In their place are cameras based on CMOS and CCD chips boasting 4K and higher resolution, with light and colour responses equal to 35mm film. Microphones record using a variety of techniques, including some still based in the analogue carbon mic, but

many now use lasers in optic fibre mics, while MEMS (Micro Electrical-Mechanical System) microphones, in which the pressure-sensitive diaphragm is built directly into a chip that encodes directly to digital, are increasingly the industry norm. Lighting rigs now use digital dimmers extensively, and traditional lamps have been exchanged for LED arrays that give directors of photography fine control over colour as well as brightness. Digital motion sensors track and record camera moves for matching with computer-generated or managed assets for compositing. Lidar (light-based radar) was already in use in films such as *Déjà Vu* (2006, USA, Tony Scott) to record the spatial data of a set, rather than its visual appearance. The mass of data gathered in production is now the centre of a new profession, that of data management, whose goal is to minimise the unavoidable loss of data consequent on its passage from recording device to storage media, editing software and final product. Production data—including not only sound and vision recordings but light, acoustic and spatial readings from locations and motion capture data from performers—could potentially be completely integrated, in the way CGI characters, buildings and landscapes already are, as libraries from which new combinations, new movies, can be made. Digitisation of archive footage also creates a resource for new films. Pre-digital movies such as *Dead Men Don't Wear Plaid* (1982, USA, Carl Reiner) were precursors of wholly digital films recycling pre-digital footage, from *Tarnation* (2003, USA, Jonathan Caouette) to *Decasia* (2002, USA, Bill Morrison), the latter especially a reminder that a good deal of the work of film archives now involves digital restoration (Fossati, 2009).

Not only archival restoration but the circulation of historic films originally made on celluloid depends on digital media. The formats in which they circulate—optical media, broadcasts, online repositories—share in a radically normative group of technical standards. From the biggest theatres to the most personal screens, and from blockbusters to home video, video transmission and display requires codecs (compression-decompression algorithms used to transport audiovisual content with the greatest possible efficiency). The market in codecs is dominated by MPEG, a standard established through a combination of international engineering bodies and corporate interests (there are minor contenders, embroiled in what promise to be decade-long lawsuits over patents, but they work on the same basic principles). Codecs manage audiovisual data by reducing non-essential elements, using software to reinstate the most likely details otherwise lost in transmission. Even so-called 'lossless' formats such as RAW files lose data, where necessary replacing it with what in a human would be called intelligent best guesses as to what has been mislaid en route. These processes fit to the now standard form of the pixel grids, rectilinear arrays of standard red, green and blue picture elements. Whether projected or backlit, all screens are scanned from top left to bottom right, in rigid lines and numerically placed points to which arithmetic colour and luminance (brightness) values can be ascribed. In many respects scanning—which dates back to the earliest electronic images—and the grid are the most ubiquitous features of digital imaging that distinguish it from its analogue predecessors. It could be argued that the greatest distinction between analogue and digital film is the disciplining of the random scatter of photochemicals into the rigid lines of digital screens, and the fact that electronic images, being scanned, are never complete in the way that a single frame of celluloid is, when, as Garrett Stewart (2007: 53) has it, motion "is located not in the photogram's continual disappearance across the frame of the aperture but in an internal remaking of the digital frame itself".

The distinction between analogue and digital imaging dominated the critical literature on digital cinema in the late 2000s. However, the central debate concerned the term "indexicality", deriving from the philosopher C. S. Peirce's description of a particular kind of sign, the index that, like the index finger, points at something (a "referent") in the real world. Smoke, for Peirce, is an index of fire: it "means" fire, but is also directly caused by it. For a tradition in film

criticism extending back to André Bazin (1967) and Siegfried Kracauer (1960), photography and cinematography have an indexical relation to reality: a photograph or film frame is caused by events occurring in front of the lens. Thus, unlike language and painting which describe the world using something different from the world—words and paint—photographs have an indexical relation to reality that more recent critiques, notably D. N. Rodowick (2007) and Mary-Anne Doane (2007), claim that digital media do not. Analogue film, they argue, being made of random scatterings of light-sensitive silver salts, catches the real light reflected into the lens and holds it faithfully, through all the processing that ensues on its way to projection on screen. There are technical reasons to doubt that this is significantly different to the way digital cameras work. Both use lenses to control the activity of light before it is recorded. Both rely on the physical properties of a light-sensitive material—analogue film undergoes a chemical change, electronic cameras react to light by releasing electrons. Both require amplification—chemical "fixing" in analogue, conversion from charge to voltage in digital cameras. Both use filters—tripack film in analogue, Bayer masks in digital—to control colour responses. Most of all, both are open to the same critiques concerning the choices made of what to shoot, how to shoot it, and what to leave out, topics addressed by ideological, feminist and postcolonial criticism. Doane and Rodowick assert, however, that the arithmetic processing of digital data removes it from the direct account of the real that analogue film was capable of.

In reply it might be said that such a broad description inadvertently throws entire sections of world cinema out of the realm of realism, for example the Nigerian video feature film industry colloquially known as Nollywood. It is also the case that digital recording is, if anything, more accurate in its account of the world than analogue, as its extensive use in scientific instruments indicates. The key difference, as far as indexicality is concerned, can also be mapped onto the history of scientific instruments. As Peter Galison (1997) observes, these come in two types, picturing and counting. One, like the images associated with the discovery of the Higgs' Boson, gives complex coverage of a single and possibly unique event; the other gives a numerical overview of many events. The unexpected feature of these two traditions in instrumentation is that they are regularly combined in contemporary scientific practice. In analogue cinema, films such as *Pyaasa* (Thirsty, 1957, India, Guru Dutt) and *Greed* (1927, USA, Eric von Stroheim) are as capable of addressing universals at the same time as particulars as are digital films such as Jia Zhangke's *Sanxia haoren* (Still Life, 2006, China). The Tamil action comedy *Naduvula Konjam Pakkatha Kaanom* (A Few Pages Are Missing in Between, 2012, Balaji Tharaneetharan) is no less faithful to its locations for being shot on DSLR, if less meticulously observational, than Frederick Wiseman's *Belfast, Maine* (1999), shot on similarly domestic format 16mm film. At the same time, as Kristen Whissel (2014) argues, digital visual effects allow for a heightened from of allegory she dubs "effects emblems", in which major and often highly complex thematic content is distilled into spectacular scenes of massed crowds or scenes of flight or falling. The compression of themes mirrors the composition of cinematic elements into composite shots, a radical intensification of the semantic carrying capacity of the frame, even as the frame itself becomes subject to the new micro-temporality, and radical incompletion, of scanning.

Digital cinema and the posthuman condition

Where digital tools are content to record any quality of the world, whether humanly perceptible or not, the canon of realist cinema embraced by critics such as Doane and Rodowick is concerned with reproducing, not the world as it is, but as it appears or would appear to a human observer. In this sense, we might then argue, with another group of critics (Brown 2013; Pick and Narraway 2013; Hauskeller *et al.* 2015), that an increasingly digital cinema corresponds to

an increasingly posthuman condition, a term that, since its development by Cary Wolfe (2009), has been increasingly reflected in cultural and Film Studies (Shaviro 2010; Braidotti 2013). The term has a double edge. On the one hand, it speaks of a philosophy that comes after the humanism that lay at the heart of the European Enlightenment and the subsequent Romantic and Modernist periods; on the other it suggests that human beings are in some way no longer or no longer only "human", and that our increasingly complex and dense physical involvement and emotional investment in machines and networks has led us to a point where we are free of, or cast adrift from, anything we might look back on as human nature. The idea of digital cinema as posthuman chimes with the numerous films produced in the twenty-first century concerned with enhanced humans or human-machine hybrids (Short 2005), predominantly in the English-speaking world, but with important examples in European (*Renaissance*, Paris 2054: Renaissance, 2006, France, Christian Volckman; *The Thirteenth Floor*, 1999, USA/Germany, Josef Bosma) and East Asian cinema (*The One*, 2001, USA, James Wong; *Tetsuo*, Tetsuo: The Iron Man, 1989, Japan, Shinya Tsukamoto; *Naechureol siti*, Natural City, 2003, South Korea, Min Byung Chow). At the same time, however, as Michele Pierson (2002) recounts, a significant amount of effort has been spent in creating visual effects that emulate what a human observer might have seen, for example at the maiden voyage dockside in *Titanic* (1997, USA, James Cameron). Ubiquitous use of digital post-production to remove unwanted elements from cinematography, such as anachronistic location features or the wires used in stunt work, often comes under this general heading of creating verisimilitude, rather than impossible or fantastic spectacles: the mundane, often unavailable for filming, is itself then open to digital recreation. However, Lisa Purse is at pains to point out that in many instances the same shot might have been achieved by analogue means, requiring careful analysis to understand whether the tools employed are relevant to the audience's work of interpretation (Purse 2013: 15).

The banal and the everyday form a central value in the critical work of André Bazin, the doyen of realist film critics, as evidence that cinema confronts the uncontrolled and uncontrollable contingency of the real world. Comparisons between, for example, the massed extras forming battle ranks in a film such as *Cleopatra* (1963, USA, Joseph L. Mankiewicz) and the synthetic armies of *The Mummy* (1999, USA, Stephen Sommers) show the effects of randomness—of wind and weather conditions, or aberrations from set actions—in the former, while even programmed multiplication of possible behaviours in synthespians leaves a sense that the visual world is under control of its makers. This level of control echoes the rigidity of the pixel grid, and communicates far more than even the total cinema of wide-screen epics from the late classical period in Hollywood the appetite of cinema for a baroque command over the emotional and intellectual responses of audiences (Ndalianis 2004; Klein 2004). The everyday captured in long takes, deep focus and staging in depth that Bazin set such store by has instead become a feature of fantastic settings in the diegesis and cinematography of spectacular effects movies, blending elaborate set dressing with digital set extensions carefully matched to Steadicam and crane moves. As Purse points out in the case of the closing shots in Alfonso Cuarón's 2006 *Children of Men*, where physical and digitally enhanced fog shrouds the vessel that might or might not rescue our protagonists, both individual frames and editing imply "that the ship is both 'here' and 'not here'" (Purse 2013: 16).

This complex relation to ontology of the referent, of the apparatus and potentially of the viewing relationship is in many respects at the heart of a digital aesthetics. In one way, it might be argued that digital cinema expresses an advanced moment in the development of the "integrated spectacle" (Debord 1990), in which community, dialogue and logic have all been lost in a condition where absolute knowledge is ascribed to a computational Other, even by our rulers. In the same vein, digital cinema partakes in Baudrillard's "perfect crime", the murder of reality,

perfect because in the end there was no victim (Baudrillard 1996). To stigmatise spectacular effects films as vacuous would then simply be to say that they express, with the perfection of ideological clockwork, the vacuity of late capitalism. If, however, we must also acknowledge the capacity of digital recordings to capture sound and light in motion with exquisite detail, in the realist mode of Dick Pope's cinematography for *Mr Turner* (2014, UK/France/Germany, Mike Leigh), but also in the capture of landscapes for compositing in fantastic landscapes, as in Peter Jackson's *Lord of the Rings* trilogy, then we must recognise at the least digital cinematography's ability to emulate analogue film. The contrary directions of faithfulness to perception, the hallmark of cinematic realism, and the fantastic create a deep ambiguity in representation that critics generally see as a major task of cinema. Critics of the 1970s were adamant that all cinema, insofar as it was representational, was also therefore ideological. In this sense, therefore, we might understand digital cinema as a cinema that embraces its own ideological formation in the form of a significant ambiguity about its truth status.

Moreover, while the music industry has used autotuning and vocoders extensively to generate artificial voices, cinema sound has largely been very conservative in its use not only of actors' own voices but in its approach to electronic musical scores, even when both are recorded digitally. The enhancement of theatrical and domestic sound through stereophony, noise cancellation and Dolby and other surround sound systems has in general sought verisimilitude, with the exception of sounds made by imaginary objects such as flying saucers. However, Foley and generated sound effects have a long history, and the practice of overdubbing equally so, notably in the Italian post-war cinema and in the profession of Indian playback singers. Though Renoir (1974: 106) believed that "Dubbing is equivalent to a belief in the duality of the soul", the practice is old enough to have been satirised in *Singin' in the Rain* (1952, USA, Gene Kelly and Stanley Donen). Anchoring a voice to a character other than the one producing the voice, or even dubbing a retake of the same actor's voice over the original performance at a later date, would already constitute the kind of witchcraft Renoir refused in direct sound films of the Popular Front era. Yet few directors subsequently would have had any compunctions in re-recording or re-voicing where a performance failed to live up to expectations. Indeed, in many digital animations, the same actor that voices a character is employed for motion-capture to create gestures, movements and facial expressions for their character, for example Tom Hanks in the *Toy Story* franchise (1995–, USA), or Johnny Depp in *Rango* (2011, USA, Gore Verbinski). This simultaneous matching and displacement of voice and actor parallels the ontological uncertainty of the digital frame that composites imagery gathered from the coincidences of location filming with the controlled environment of computer-generated imagery.

In motion capture, the contingencies of human action are extrapolated in order to be reperformed by synthespians, specifically in order to retain elements that escape control. In composite performances such as that of Shah Rukh Khan in *Ra.One* (2011, India, Anubhav Sinha), the star is retained not only as box office draw but in order to provide precisely those details of performance, including unconscious effects such as the movement of hair, that digital procedures cannot produce adequately. The flood of improvements in animation technique have not altered the inhumanity of pure synthespians, such as those featured in *Final Fantasy: The Spirits Within* (2001, USA, Hironobu Sakaguchi and Moto Sakakibara), even with the benefit of a decade and a half of work. If anything, the extreme apparent proximity required for 3D presentations, as in the case of *Ra.One*, make even greater claims on versimilitude in performances. At the same time, such doubling of human and digital performers creates an uncanny hint of duplicity that needs to be either explained or healed through narrative, as in the storyline explaining the doubling of the lead characters in *Avatar* (2009, USA, James Cameron).

From *Kōkaku Kidōtai Gōsuto In Za Sheru* (*Ghost in the Shell*, 1995, Japan, Mamoru Oshii) and *Mononoke-hime* (Princess Mononoke, 1997, Japan, Hayao Miyazaki), which employed Canadian firm Softimage's Toonshader filter to make CG animations look like cels, to *Uchū Kaizoku Kyaputen Hārokku* (Space Pirate Captain Harlock, 2013, Japan, Shinji Aramaki), which rejoices in its computer-generated sheen, animated film has been at the forefront of digital cinema. Intriguingly, Japanese animation has been outsourced increasingly to offshore drawing and computer-aided illustration labs throughout Southeast Asia to provide the labour required to produce the hours of animation demanded by TV, and now also film outlets. The globalisation of animation production echoes that of the effects houses engaged in live-action effects movies. Animation has the benefit of being less anchored in the specifics of its home culture, and therefore more open to the scale of export that cinema has not really known otherwise since the days of silent stars such as Charlie Chaplin. The US market for Japanese anime is now well over 2 billion dollars a year; while US animations also have particularly successful mass markets in China and Japan. At the same time, it is worth reiterating that even the open field of internet distribution and streaming services is not enough to break down the hegemony of Hollywood product in the English-speaking world and well beyond it, or to overcome the traditional lack of interest in Indian, Chinese and Japanese cinema, as well as popular cinemas of the rest of the world. This despite the fact that, for example, major international company Gaumont invested heavily in *Bakemono no Ko* (The Boy and The Beast, Japan), Mamoru Hosoda's 2016 anime, with a view to breaking the international market (Hosoda is widely seen as the heir to the globally successful Miyazaki, with whom he trained). A feature of these films is that they deal with characters who discover or have revealed to them a truth about the world, or hidden within them, effectively learning that they have been living double lives, or that the world has a hidden double. The is trope carried over into recent Hollywood animations such as Pixar's *Inside Out* (2015, USA, Pete Docter), which within a saccharine tale reveals the schizophrenic structure of the contemporary psyche.

This multiplication of identities also holds of films themselves in the digital era. Although theatrical release still provides the trigger for a mass of pre- and post-release marketing, the film itself appears as trailers and teasers for weeks, sometimes months ahead of release; backed with leaked material to fan sites in the case of major franchises such as *Harry Potter* (2001–2011, UK/USA), *The Hobbit* (2012, 2013, 2014, New Zealand/USA) and *Star Wars* (1977–, USA). Subsequent releases in multiple formats engage audiences in multiple experiences (Klinger 2006), from the physical (theme parks, toys, clothing, pioneered by *Star Wars* marketing in the late 1970s) to the digital (apps, games, social media). Such extensive and intensive marketing creates (apparent?) communities of interest and (actual?) extremely individual fantasy investment in the narratives and storyworlds of favoured films. Here too the mass circulation combines with intensely personalised experience and cultural capital so as to create a curiously contradictory intersection of individual and mass in the digital consumption of films.

Conclusion

There is, then, a trajectory in the analysis and interpretation of cinema that sees it as tending towards increasing control over perception and dissemination of moving image media, stretching from codecs to digital rights management. In certain respects, this continues the trajectory of mechanical media, whose standard aspect ratios, frame rates and lenses still underpin digital media, but take the principle of control to a new level by offering producers far greater control over the contingent features of reality. Control extends to the sub-perceptual scales of temporal order in scanning and algorithmic processing of images and sounds, and appears in the distance

between digital representations and the natural appearance of the world to an ordinary human observer. To take one more example, digital colour is organised around a psychological model of a standard observer first formulated in 1931.

At the same time, the vulnerability of encoded audiovisual data to manipulation by producers also means that it is open to remaking by end-users, as in the cultures of mash-ups, revoicings and crash editing of scenes, even whole movies; the culture of parody of features documented by Klinger (2006: 191ff.), and the emergent culture of mobile phone movie making, with its own festival and distribution circuits. The reduction of picture elements to enumerable points of colour and luminance arrayed in geometric order in digital displays, dominated by bitmap or raster technology, is at odds with the major form of digital image generation that uses the vector principle (Smith 2014). The construction of coherent space, one of the major goals of compositing, is constantly undermined by 3D display technologies that emphasise their planar discontinuities. And while the foregoing survey emphasises uncanny and unstable elements of screen and audio presentations, other scholars note their implications for spectators. Sobchack (2000) and Bukatman (2012) tend toward the control end of the spectrum when analysing morphing technologies through which the spectacle of characters turning into something other than themselves can be shown on screen. At the other end, while sympathetic to such claims, Brown (2013: 74) suggests that morphs "do not so much make all 'objects' (or other people) 'subjective' (or 'the same') as challenge the very distinction between subject and object", noting in particular the positive implications such uncertainty has for the imposition of gender identities. There is, then, a genuine dialectic between control and democratisation, between commodification and liberation, and between identity as imposition and as community building both enabled and represented by digital media. It may indeed be that digital cinema has difficulty picturing the real as it appeared in the twentieth century, but if so it is because, as Dudley Andrew (2011: Ch. 3) argues in his major contribution to this debate, "cinema must press forward into the new century, by taking into itself the subject matter that surrounds it, increasingly a new media culture".

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