

## 4K cinema: a technological innovation in the film industry

### *Cinema 4K: uma inovação tecnológica na indústria cinematográfica*

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#### Abstract

This paper focuses on the cinematic image influenced by contemporary digital technologies. Through bibliographic research, the study provides an overview of technological innovation in the film industry and its relationship with sustainable development. Thus, remarks will be presented here towards a better understanding and perception of technical processes and significant changes in film economic sustainability. The results obtained evince that 4K significantly improves the viewers' experience of attending the cinema, providing them with an unprecedented viewing experience, implying a new aesthetic conception of the images.

**Keywords:** cinema; 4K; innovation; technology.

#### Resumo

O foco deste artigo é a imagem cinematográfica influenciada pelas tecnologias digitais contemporâneas. A partir da metodologia bibliográfica, apresenta-se um panorama da inovação tecnológica na indústria do cinema e sua relação com o desenvolvimento sustentável. Desse modo, serão aqui apresentados apontamentos a fim de compreender os processos técnicos e perceber as significativas transformações na sustentabilidade econômica cinematográfica. Os resultados obtidos demonstram que o 4K aprimora expressivamente a experiência dos espectadores ao frequentarem o cinema, proporcionando-lhes uma visualização sem precedentes, implicando em uma nova concepção estética das imagens.

**Palavras-chave:** cinema; 4k; inovação; tecnologia.

## 1. INTRODUÇÃO

4K cinema is a technological innovation in the film industry that was created and adopted by seven Hollywood movie studios. The 4K image has 8,847,360 (eight million, eight hundred and forty-seven thousand, three hundred and sixty) pixels in each frame, as explained by Santana and Rocha.

4K, the usual term indicating an image consisting of 4096 x 2160 pixels, came about partly out of a need of the Hollywood film industry. With the advent of digital equipment, Hollywood studios established standards to ensure good viewing quality. In 2002, Disney, Fox, MGM, Universal Studios, Paramount, Sony, and Warner Bros created Digital Cinema Initiatives (DCI), the entity responsible for this work, whose definitions were published in July 2005 and later transformed into standards by the Society of Motion Picture and Television Engineers (SMPTE). Two standards were chosen: 2K (2048 x 1080 pixels resolution) and 4K. The result is more than 8 million pixels. (SANTANA and ROCHA, 2014:110)

The DCI's main goal was to institute the standards of definitions that would normatize Digital Cinema to guarantee a high coefficient in technical execution, credibility, and verification of ownership. Moreover, DCI member production companies believe that disseminating new digital cinema standards can provide a reliable advantage for a wide range of audiences: artists, producers, and filmmakers alike, who believe that the spread of 4K cinema will significantly enhance the moviegoing experience for viewers.

From that moment on, the cinematographic chain has been employing this

modern support in a magnificent technical capacity, firstly in terms of technological apparatuses — both capture and reproduction — to only then be able to provide viewers with unprecedented visualization.

The symbol K consists of the abbreviation word kilo — from the Greek χίλιοι (chílioi), meaning one thousand — is a prefix of the International System of Units<sup>1</sup> that indicates that the standard unit of measure has been multiplied by one thousand (INMETRO, 2021). ComoZed, on the other hand, provides more details by explaining that the letter K is equivalent to kilo, which means (in base 10) thousand, although K can also mean kilobit or kilobyte, in which case it represents 2 to the 10 or 1024 (ComoZed, 2020). Therefore, to understand the resolution of any K format — for cinema — we multiply the value of K (1024) by its predecessor number, for example,  $4K = 4 \times 1,024 = 4,096$ . This multiplication is specific to movie screens, which have a proportion of approximately 2.35:1. As for commercial televisions available on the market, despite some adopting 4K, they have 16:9 or 16:10 aspect ratios because they do not support real 4K, delivering images with 3,840 lines, which is something around 7% less than movie screens.

The resolution is dependent on the number of pixels shown in the image. Therefore, the greater the number of pixels, the better the attribute of the image; this is called resolution. The pixel is the minimum unit that makes up the digital image. The word came from the confluence of the picture element, where Pix is the abbreviation for picture (i.e., Pix + el = Pixel). To get the total number of pixels in a picture, multiply the number supported horizontally x vertically. The Full HD format has 1,920 x 1,080 pixels (i.e., 1,920 horizontal pixels x 1,080 vertical pixels), yielding 2,073,600 total pixels; 4K has 4,096 x

1 SI, from the French *Système international d'unités*.

2,160, which conceives a display with 8,847,360 million pixels in an image. This is why 4K produces four times larger images than Full HD, producing images in post-high-definition<sup>2</sup>. Not only is more data added, but 4K also makes it possible for us to get closer to the screen without ruining sharpness.

In reality, what this very high resolution allows, even on a huge screen, is that the sharpness of the images is not dispersed, and we can see the texturing and many other fine details that our vision could not perceive before. In this way, we hope to have some enchantment in the audience here, given the image propensity.

The process also includes the production of stereoscopic images (3D) that, according to Alfredo Suppia, “produce new configurations in terms of the experience of seeing and perceiving an image” (SUPPIA, 2010:62), in addition to the support of network storage, from cloud computing<sup>3</sup>.

The method used in this article is bibliographic research by investigating and analyzing previously published studies that served to conduct and support this scientific work. For Antonio Gil, bibliographical research “is developed based on already elaborated material, consisting mainly of books and scientific articles” (2022, p:44).

## 2. TRADITION AND TECHNICAL DEVELOPMENT

When analyzing from a historical perspective, one can perceive the respective evolution of the history of human society. Three sectors

have propelled media technology forward: **entertainment**, especially art and culture; **science**, especially medicine and educational research; and **military intelligence**, especially security. During the analog media period, the three aforementioned sectors acted autonomously and employed different technologies and media to achieve their goals. Today, with digital media, these three sectors have entered the same confluence of needs, all requiring more speed for their uses, more accessible access, specialized computers, mass storage, collaborative tools, distribution, better security, and better picture and sound capacity. They are looking to develop the next generation of skilled professionals. Because quality and, at the same time, real information are required, these sectors have embraced the innovations of digital technologies, propitiating the evolution and dispersion of such technologies to other sectors of human society.

This diachrony has especially benefited the field of digital cinema and post-high-definition images, which have recently been employed to analyze both macroscopic and microscopic elements, including images representing the universe and its planets, such as Mars, which in 2020 had “a slideshow that NASA’s Mars Rovers transmitted. Sending the images is a challenging, and it took 20 hours to transmit 250 megabits straight to Earth” (FHOX, 2020).

Before the advent of the current technological stage in which contemporary society finds itself, some experiments were evaluated, and in Figure 1, we see the pioneering apparatus in high-definition imaging (HD). Francis Ford Coppola was a prestigious filmmaker because of the film *The Godfather*, with Dr.

<sup>2</sup> About post-high-definition images:

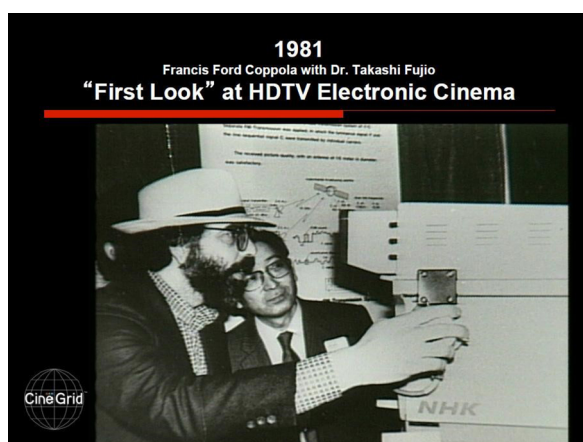
SANTANA, A. (2017). Visualization of images in post-high-definition. 254 f. Thesis (Doctorate in Art and Visual Culture) - Graduate Program in Art and Visual Culture, Federal University of Goiás, Goiânia.

SANTANA, A. (2022). Characterization of post-high-definition images. TechRxiv. <https://doi.org/10.36227/techrxiv.19668612.v1>.

<sup>3</sup> Cloud computing allows one to access different online services, since the data will not be on a computer itself, but rather on a network.

Takashi Fujio, leader of the group that conceived high definition TV by the laboratory of NHK (Nippon Hōsō Kyōkai)/ Japan Broadcasting Corporation — the Japanese public television network, in 1981. In a lecture in Los Angeles, Coppola considered this equipment as likely to be employed to give rise to the electronic cinema. It took over 20 years for this to materialize, and in the meantime, the technology has outgrown the conception of HDTV.

Figure 1 - “First Look” at HDTV Electronic Cinema



Source: Herr (2013)

We can see the first model of the NTT lab In Figure 2, which influenced future evolution and helped to make preliminary estimates of cinema standards, thereby implying 4K in the so-called DCI standard.

Figure 2 - World's First 4K Digital Cinema System



Source: Herr (2013)

Post-high-definition does not exclusively cooperate with the cinema but also influences science in general, particularly medicine and astronomy; it also plays an entertaining role in products such as TV, cell phones, and game consoles.

### 3. 4K CINEMA

When the time comes when 4K broadcasts are fully implemented, with broadcasts to major theaters, the costs of film copies and transportation to each of the theaters where the films will be shown will be eliminated. This will favor sustainable development through economic sustainability via environmental and socioeconomic parameters, consequently generating value for the film industry, articulating the interests of producers and society, and carrying out product development with an emphasis on innovative technology.

4K cinema expands opportunities for production companies to lower the costs of a release. A film copy of a 120 (one hundred and twenty) minute feature film costs an average of \$4,000.00 (four thousand US dollars) (ANCINE, 2022:30). A mega cinematic production, such as Iron Man 3 (2013), for example, premiered in an average of five thousand theaters in the US alone. The cost to just make the film copies was around US\$ 20 million, not including logistics. A 4K film, on the other hand, must be transmitted via a photonics network at no extra cost or sent on a hard disk (Digital Cinema Package — DCP), which costs on average US\$ 500.00 (five hundred US dollars) (ANCINE, 2022:30), and after the screening, it can be reused for other releases. As for the famous trilogy The Lord of the Rings (2001–2003), with its 558 minutes of duration, or the Harry Potter saga, a series with seven fantasy novels written by the British author J. K. Rowling and transformed into eight movies, between 2001 and 2011, total-



ing 19 hours and 30 minutes, or 1170 minutes, amounted to a significant sum for the film copies and much logistical work for the carriers due to the sheer volume of reels generated. The implementation of 4K cinema means savings in the budgets of a super-production, even making it possible to show it in a more significant number of theaters.

The first 4K movie theater opened in Brazil on December 18, 2010, by the UCI network at the Shopping Palladium mall in Curitiba, through an agreement between the UCI network and Sony, which intends to expand 4K projector installations in movie theaters in Brazil, Argentina, England, and the USA. Notably, Sony's 4K projectors can also be used for 3D movie projection. Currently, 13 of the 26 UCI theaters in the country have 4K-3D Digital theaters. According to Monica Portella, UCI Brazil's Marketing Director, "new technologies allow for totally different experiences, making our spectators want to go to the movies even more (PORTELLA, in: Bem Paraná, 2011).

The new technologies allow completely different experiences, making our spectators want to go to the movies, even more, says Monica Portella, Marketing Director at UCI Brasil. The new technology, with much action and special effects, promises to make spectators even more involved with the movie.

The cinema network Cinépolis, on the other hand, inaugurated a new room at Shopping JK Iguatemi in 2019, in São Paulo, using the first 4K LED screen in Brazil — and the third in Latin America, after Colombia and Mexico. It is produced by Samsung, with 455 inches, totaling 55 square meters, which is even bigger since the display is made with modular boards of ~20 centimeters and can grow by adding other boards on the sides; the only limit is the physical space. The screen does not require a projector and has HDR technology for more vivid colors, which

means that the display generates all the images and light. Since the screen is made of tiny LEDs, two very interesting features exist. The first is that the lights in the room can be left on as the display achieves a brightness output of up to 400 nits of brightness (maximum light emitted by LEDs) — traditional cinema screens emit only 48 nits. The second is that, as with OLED TVs, each LED emits its light and the black image is one pixel off. With this, the contrast is fundamentally infinite (FOGAÇA, 2019).

Another relevant factor is the likelihood of the fight against piracy: without the circulation of digital copies, it is easier to prevent the production of illegal copies. Nonetheless, if this is the perspective in the cinema, it turns out that until 2010, 4K only made sense there because it allowed and required large screens. Domestic TV sets did not need such a high resolution, as there would be no noticeable difference in the images between the 4K, 2K, or full HD formats.

We have done the test, and the 4K TV does not lose to a 2k TV. Now, things look very different on an 18 x 8m screen. The brightness, depth, detail, and intensity of the colors in 4K are much more enhanced than in the other settings. And 4K combined with 3D greatly enhances the image immersion experience. (SILVA, 2011, s/p).

Today, this reality is already different, according to Guido Lemos Souza Filho (in CARVALHO):

TV always follows cinema. Cinema is going to 4k, the TV will follow. Compression and transmission technologies are being developed, and the first tests are already being conducted (SOUZA FILHO, in CARVALHO, 2013: s/p).

Television companies do not stop investing in this new format and announce the launch of 4K TVs. A Japanese TV manufacturer launched two 4K TV models in Brazil in the second half of 2013 and claimed that “observed from a distance of 1.3 meters (for 65-inch TVs), the individual pixels of a 4K TV are not seen because of the higher definition of the images” (G1, 2013).

#### 4. FINAL CONSIDERATIONS

According to McLuhan (2011), visual communication is now perceived not as a mere reproduction of reality but as an extension of it. Cinema, as a narrative apparatus, is established in such a way as an “extension” of the gaze. “It is a fact that man knows the world by acting on it, and for such action, he creates extensions of his senses, increasing his knowledge in time and space” (FERREIRA, 2002:08). McLuhan (2011) also reported that all media, from the phonetic alphabet to the computer, are extensions of man that bring about significant and lasting changes in himself and transform his space. This extension is an intensification, an enlargement of an organ, sense, or function. In this way, the definition of media is broad and includes any technology that can create extensions of the human body and senses based on computer interfaces. Societies have always been fond more of the nature of the media with which men communicate than of the content of the communication. All technologies have the attribute of the Midas touch; whenever a society develops an extension of itself, all the other functions of society tend to be rearranged and re-accommodated, adapting to the new socio-cultural singularity. From this point of view, technology is revolutionary, not only in itself but because of its impact on an entire system.

The revolution caused by technological innovations is part of an evolutionary program, as Lucia Santaella argues:

(...) I do not believe that the advent and development of technology is simply a consequence of capitalist insatiability, but it is also part of an evolutionary program. (SANTAELLA, 2009: 500)

Therefore, it is worth reaffirming that revolution is linked to evolution, transformation, or modification of society.

Thus, we can infer that 4K cinema is a revolutionary and evolving agent of image technology as it revolutionizes not only a format or resolution of image and sound but also potentializes the evolution of an entire chain of data capture and transmission, in addition to establishing new parameters for thinking about image. In addition, it implies a new aesthetic conception of images, characterized by the sharpness and very high resolution, aspects little considered in video art, for instance.

The signatures of technical images expand, glimpsing technical aspects of the first order, linking them to the conceptions of immersion and enchantment, given the quality of what is seen. As new parameters of image sharpness are established, the eye is also readjusted, seeking to see there, in the emitted and/or reflected light, aspects previously unknown, details that were lost, favoring new dialogues and imagetic conjectures. Hence, visual culture gains a new chapter with 4K, and not just technical.

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