

CINEMA OVER PHOTONIC NETWORKS

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The paper presents a reflection on how high definition 4K films are reorienting cinema towards science, invention and technology. It also describes and reflects on experiments with 4K moving images, transmission over photonic networks, and stereoscopic film in gigantic dimensions.



Fig 1. StereoEssays anaglyphic film still. Copyright Jane de Almeida.



Fig 2. StereoEssays anaglyphic film still. Copyright Jane de Almeida.

Cinema, "the invention without a future" according to the Lumière brothers, marked the twentieth century in a profound and enriching manner. Much of what will be said in the future about the twentieth century will point to the wonder of the motion picture. In constant evolution, film production technology has undergone profound changes with the advent of computer technology; and today we are able to achieve and design images of unquestionable quality, with aesthetic results that astound even 'print' lovers.

Cinema pioneers were also considered inventors and scientists, as the 'filmmaker' profession did not exist. "Apporter au monde le monde" – to bring the world into the world, was the slogan of Lumière Brothers and Pathé-Film. As observed by German filmmaker Alexander Kluge, [1] the phrase has dual meaning: the birth of new images and of a new world, but also that the filmed world was being shown in Paris, considering Paris as the real world. Back then cameras were sent around the world to record far-off cultures, looking for "never-seen-before pictures." Today, the technological apparatus of super high definition images can be rendered visible on a micro and macro scale, from distant, never visited, places. After years of fictional narrative, scientists and inventors are once again seeking never-seen-before images, now to bring the universe to the world. Moreover, these images can be broadcast. It is no longer a matter of "bringing the world into the world," but of sharing the world through a two-ended device, with images to be seen and which also see.

When producing new technology, much care is required to present it. Despite what the Lumière brothers said about the future of cinema, the first images were carefully framed, using Impressionist paintings as references. When they decided to stage sketches, the Lumière family assembled their servants to perform a Cézanne painting, *The Card Players (Les Joueurs de Cartes)*, in motion. *The Arrival of a Train at a Station* is famous for the legend that it caused panic among viewers, startled by the real possibility of a train hitting them. Although this did not actually happen, the audience was really astonished and the Lumière brothers knew they would succeed by positioning the camera very close to the platform and waiting for the train's arrival. Besides home films and comedies, they explored figures in motion, such as the wall falling down and being 'rebuilt' in a reverse effect – *Démolition d'un mur* – or the blacksmith's smoke in *Le Forgeron*.

More than one hundred and ten years later, digital technology once again aspires to replace cinema, now with the power of projecting an image resolution of over 8 million pixels per frame. 4K resolution has recently been established as the standard image for digital cinema recommended by the DCI (Digital Cinema Initiatives), an association of the seven major Hollywood studios. 4K refers to the number of horizontal pixels, 4,096, which multiplied by 2,160 vertical pixels, gives 8,847,360 pixels in total. It is an image four times more precise than HD and 24 times more precise than traditional television, [2] but what scenes, what framing, and what kind of image is cinema unveiling? First and foremost, an incredibly sharp image, with vivid colors and details, intense brightness and impressive sheerness. An image in which one sees background details with the sharpness of a close-up shot. That trompe-l'oeil effect of the Lumières – or of Masaccio, in his paintings of the *Holy Trinity* at Santa Maria Novella, which produced the effect of a cave on a two-dimensional canvas in 1425 – can also be seen in the Japanese concert of the String Ensemble, broadcast live from Tokyo to San Diego in 2006. To enhance its reality effect, the concert was partially filmed with a row of seats framed in the lower part of the screen, strengthening the impression that it was performed right there, just a few rows ahead of the viewer.

In recent years, a new event has managed to further stretch the boundaries of cinema – considered here as large screen projection: transmission over photonic networks. Since iGrid 2002, the Cinegrid consortium has been designed as another event emerging from the LambdaGrid framework, the wavelength 'grid.' The 'lambda network' in a nutshell is the composite technology of fiber optic connections capable of transmitting light. Just like Glif, an international organization that promotes the paradigm of lambda networking and the research for developing an international fiber optic infrastructure, Cinegrid fosters an international and interdisciplinary community focused on very-high-quality digital media over photonic networks. At that instant, the cinema lights meet the photon light, combining to produce the transmission of a powerful image with hardly any loss of quality (or none at all).

Besides the network connections of the physical support, another requirement is a network of scientists, researchers and inventors seeking to accomplish the technological leap of the ubiquity dream. In other words, the characteristic property of television – transmission – is now within the reach of cinema. Cinegrid, however, in promoting this meeting between high quality image film producers, has also promoted a unique meeting that relates back to pre-cinema times. Since 2006, Cinegrid has been attended by photonic network engineers, film software developers, camera and projection equipment companies, computer scientists, new media scholars, film studios, sound studios for cinema, scientific visualization professionals, all sorts of artists and people interested in the matter. In fact, people's interests in Cinegrid are wide-ranging, involving various terminologies and idiosyncrasies. The films presented are short samples of pictures to demonstrate the equipment and the evolution of the transmission power and capacity. Except in rare cases, the films have no narrative, or even such intention. In fact, the most interesting are the views of museums, planetariums and other ways of seeing the world.

The whole community dreams of the moment when an observatory in a specific site will be capable of transmitting very high resolution images of its observations to other observatories around the world. Another interesting perspective for this community is the ability to view microscopic beings in very high definition, transforming them into characters of a unusual narrative, from a world known through the optical lens and old biology books and now in giant-sized living form, composed by digital language. This whole environment of the future reminds us of the great European technology exhibitions of the past, such as the *Exposition Universelles* in Paris or the *Great Exhibitions* in nineteenth century London, but without the same gigantic proportions and public. Several of the devices of the contemporary world had their precursors exhibited in those fairs. Many artists and filmmakers marveled at the viewing devices of the era, such as the Panoramas, the Mareoramas and Kaiserpanoramas. [3] The Lumière brothers presented in that edition of the exhibition the "Cinématographe Géant" with a 60x70 ft screen in a theater that could seat 15,000 people. All those experiments followed traditional cinema before it took shape as we know it: the dark room, projector, seats, screen at the front, a movie of roughly 90 minutes, the queue, the ticket.

The intention here is not to compare the great expositions to an event like Cinegrid in terms of proportions or public, but rather to highlight the hybrid environment where inventors, engineers, producers and artists gather to display and admire new technologies and the scope that each new device can achieve. Such an environment, however, is not exclusive to Cinegrid. It is a proper space for meetings, seminars and art fairs dazzled by the possibilities with technology driven by the advent of the computer. However, what is of particular interest in this event is precisely the axis that determines what 'cinema' is and its forthcoming configuration over the next 110 years. This configuration is the one that embanked all the inventive chaos of optical-cinematographic devices.

The photonic networks represent huge freedom for cinematic applications, as they enable a collaborative future for image distribution. These networks will enable on-line transmission of film festivals in real time, with premières all over the world. Some Cinegrid demonstrations show colormetric sessions being made, for example in the San Diego laboratory in conjunction with the Czech Republic (CESNET); [4] or sound editing sessions in San Diego, Los Angeles and Chicago happening at the same time without any acoustic quality loss. It is also known that these networks will reconfigure the telecommunications system, with a high quality image television and a far more flexible arrangement of a single point television, with the rigid transceiver structure. The end of network neutrality, a much discussed subject today, could lead cinema back to the studios to determine the end of a creative chaos of the cinematic arts.

Photonics Network Experiments

Inspired by the creative chaos of the time, we have produced some events in Brazil related to super-high definition cinema and its transmission. In 2008, during FILE (Electronic Language International Festival), fourteen short 4K movies were presented in Brazil for the first time for cultural purposes. For one week, more than 3,500 people attended the projections and the seminars about 4K technology and the future of the images using high-definition projection in cinema. FILE has unveiled highly advanced and bold pieces in terms of art, science and innovation in Brazil and abroad. For the 2008 edition, FILE was called FILE 2008 000 000 (Two thousand and eight million pixels), a pun for the eight million pixels per frame of the 4K image. Considering the success of the projection the next natural step seemed to be the streaming of 4K content using high-speed network infrastructure. This was proposed during the Cinegrid Workshop 2008 and the main challenges were the upgrade of the Brazilian network and its extension from Mackenzie University to FIESP where FILE takes place. Since the 4K film *Enquanto a Noite não Chega* (*While the Night Does not Come*), by Beto Souza and Renato Falcão, was about to be finished, it was decided that its première would take place in São Paulo, San Diego and Yokohama.

The project *FILE 4K Transcontinental* was an initiative taken and led by researchers of Mackenzie University and the Center for Research in Computing and the Arts –CRCA/UCSD (University of California, San Diego). After one year of research and production, in 2009 the results of the work developed by Mackenzie University and CRCA were presented at FILE. A theater with more than 600 people witnessed the première and the streaming at the FIESP Auditorium. The exhibition in Brazil was attended by film directors, as well as the presenters. In San Diego, the Calit2's division director at UCSD, Ramesh Rao hosted the exhibition and in Yokohama, the directors of the Research Institute for DMC at Keio University, Naohisa Ohta and Inakage Masahiko hosted the movie in Japan. The *FILE 4K Transcontinental* venue was considered by specialists in data transmission, such as Ramesh Rao, director of the CALIT2 at the UCSD, a benchmark in digital cinema research.

A new project led us to produce a promotional film with 4K/3D resolution in order to show the intentions of Project 2014K, which purports to broadcast live the games of the 2014 Soccer World Cup in Brazil, with 4K/3D resolution through photonic networks to ultra-definition movie theatres on all five continents. This is a collaborative and experimental hi-tech project involving research and technological innovation organizations as well as private enterprises. This promotional film led us to shoot the first soccer match with such resolution, which was shown at the 2010 World Cup in Johannesburg in the FIFA Pavillion named *Casa Brasil*.

Stereoscopic Gigantic Views

More recently, further experimentation has been performed as part of a research project developed by the Advanced Applications of Remote Visualization Working Group supported by the RNP (National Education and Research Network). This Working Group's proposal is the execution, production, organization and cataloguing of the creative process of audiovisual content in 4K/3D format. Thus, a test-film was produced with Red Epic cameras, capable of capturing 5K images, rigged to obtain stereoscopic images. The film, called *StereoEssays: Five or Six Stereoscopic Essays in Search of a Narrative*, was presented at Cinegrid@Rio. It is a high-tech audiovisual essay that explores ultra-definition images. As in the legendary *Views of the Guanabara Bay* (1898), considered the first Brazilian movie, made by the Segreto brothers, Rio de Janeiro is once again the focus of pioneering cameras. The difference now is that the 'views' can be observed in three dimensions and ultra-high definition.

Since the outset, the film project has tackled the technological challenges of the major research laboratories. From the single camera pair, a piece of equipment still unknown to experts, to the processing of images with roughly 10 million pixels, and screening the film with special projectors, still in the phase of stabilization. In the stereoscopic projection of the film (3D), the resolution reaches 20 million pixels per frame on the screen, counting the images corresponding to the left and right eyes.

This experiment recalls the challenges faced by the pioneers of cinema and retrieves the fantasy of the 19th century stereoscopic apparatus. In 1891, Edison already intended to bestow stereoscopic depth on the kinetograph images that would be seen through the kinetoscope. In 1856, only two years after being founded, the London Stereoscopic Company sold half a million stereoscopic viewers. In the pre-cinema age, stereoscopic photography provided a new experience of perceiving reality, giving viewers a new level of immersion into the images, as if traveling to remote places and personally partaking in far-off events.

In 1935, Louis Lumière remade *The Arrival of a Train at a Station* (*L'arrivée d'un train en gare de La Ciotat*, 1895) in a stereoscopic version, which was possibly the true motive for the famous amazement at the realism of the images usually attributed to the public projection of *L'arrivée d'un train* in 1896. Walter Benjamin [5] has reported on more than one occasion his stereoscopic experience with the Kaiserpanorama in Berlin in 1900. The German thinker mentions the public's fascination with travel photographs and uses the stereoscope as a metaphor of the new configuration of modernity, with images "arranged as if they had come out of drawers," [6] brightly colored scenes and objects against backdrops with towering buildings and forts, inherited from the Tsarist regime in the city of Riga. Later, Benjamin draws attention to the time required to give such detail to these new three-dimensional scenes, and suggests that the "stereoscopic look" should be cultivated in order to tackle deep down the "historical shadows." [7] All this "stereoscopic heritage" of still and moving images served as inspiration for the *StereoEnsaïos* project: scenes that take us back to the history of equipment that shows 'views,' the arbitrary movement of nature, machines and the human body, full of sensuality in light of the stereoscopic device.

The stereoscopic vision generated by new ultra-definition (5K) technologies urges us to consider new possibilities of image, new metaphors for cinema and a new level of sensations – in short, a whole new aesthesis. The gigantic, digital ultra-definition images set the stage for a new visual upscale.

Whereas before we had the 'cine eye' (in the singular), with Dziga Vertov and the centrality of the monocular perspective that accompanies his story, now the stereoscopic image allows perception of the visual world around us through a 'stereopsis.' It can be considered a shift from the Cyclops (single eye) movie camera to a dual camera, stereoscopic view. In this regard, how are we to contemplate a whole new world of moving images captured mechanically and electronically through a binocular perspective? In simpler and more direct terms, how are we to shoot and assemble a three-dimensional film, narratively speaking? What do our eyes, saturated by over 110 years of motion pictures, support –and expect – of the images revisited by stereoscopy in colossal proportions? Above all, the issue tackled by *StereoEssays* is: is 3D a language or an effect?

The questions are only just beginning.

References and Notes:

1. Alexander Kluge, "Apporter au monde le monde" and "Triumph of the Arriflex. The Return of a Scientifically Oriented Application," in *Cinema Stories* trans. Martin Brady (New York: New Directions Books, 2007), 09-17.
2. Several resolution options are considered 4K digital standards. The standard full aperture 4K is 4096×3112 and represents 12,746,752 pixels. The academy 4K is 3656×2664 and has 9,739,584 pixels per frame. Digital cinema 4K is 4096×1714 and shows 7,020,544 pixels per frame or 3996×2160 with 8,631,360 pixels per frame.
3. According to Wikipedia, in 1851 "six million people –equivalent to a third of the entire population of Britain at the time – visited the exhibition. The Great Exhibition made a surplus of £186,000 (£16,190,000 as of 2011)." Wikipedia, "The Great Exhibition," http://en.wikipedia.org/wiki/The_Great_Exhibition (accessed September 3, 2011).
4. Lecture by Jeff Kleiser at Cinegrid about the use of tools such as CineSync for coloring, editing and post-production. Cinegrid's official website, <http://video-jsoc.ucsd.edu/asx/CineGrid2008/Monday/Kleiser.asx> (accessed September 3, 2011).
5. Walter Benjamin, *One Way Street and Other Writings* (London: NBL, 1979), 86–87.