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Resolution: Digital materialities, thresholds of visibility

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Often used as a synonym of 'definition', the term 'resolution' indicates the quantity of detail an image holds, and may be interpreted in different ways when applied to digital visual technologies. It may refer to the resolution of a *raster digital image* (that is, the size of a digital image file, organised and stored in one of the many lossy or lossless compression formats, such as jpeg, png, tiff, gif, mp4, etc.), to the resolution of a *screen* (the number of pixels that a screen may display), to the optical resolution of a *camera* (the amount of detail its sensors can capture and record), or to the resolution of a *printing device* (the number of individual dots a printer can produce within a given space). In all these cases, resolution can be *measured*, by calculating either the *total number of pixels* (pixel columns x pixel rows), or the *pixel density* (in terms of ppi or dpi, pixels-per-inch or dots-per-inch) that can be displayed within a given space. Be it *image resolution*, *display resolution*, or *optical resolution*, resolution may always be quantified, and the higher the resolution, the larger the amount of optical detail that may be captured and visualised.

Resolution may be increased or decreased, and its various degrees determine not only the visual appearance of a digital image, but also the conditions of its production, storage, and circulation. If tackled from the diferent perspectives of media theory, media archaeology, and visual culture theory, the question of resolution raises a whole series of aesthetic, epistemological, and political implications.

To begin with, resolution is a property of images that are *rasterised*: that is, images that are visualised as an orthogonal grid of picture elements or pixels, which represent continuous visual phenomena through a series of distinct, discrete elements. This in itself conditions the *plasticity* of digital images, the transformations they may undergo and the visual artefacts they produce within the rectangular space of a screen, and locates them, from a media-archaeological standpoint, within the *longue durée* of a history of grid-like, point-based images, which includes certain kinds of machine-woven or hand-woven textiles (from Jacquard loom punch cards to *petit point*), pictorial styles such as *pointillisme*, printing techniques such as halftone and Ben-Day dots, all the way up, along a genealogical line leading 'from print to pixels',[1] to the luminous points of cathode ray tube screens and fixed-pixel-array displays (including plasma display panels, liquid crystal displays, light-emitting diode displays, digital light processing projectors).

Since technological progress and marketing strategies based on planned obsolescence tend to constantly push towards higher and higher degrees of resolution of visual displays – as in the gradual move from Standard Definition (SD), a resolution of 720×576 pixels, to High Definition (HD) with its 1280×720 pixels, and then to Full HD, 4K and 8K Ultra High Definition (UHD), respectively with 1920×1080, 3840×2160, and 7680×4320 pixels – the higher or lower degree of resolution of a digital image or display may be interpeted as *a sign of its temporal status*, of its belonging to a specific phase in the history of digital visual technologies. This introduces the possibility of altering the temporal, historical connotations of an image by altering its resolution, as it happens in the case of the so-called '8-bits' aesthetics, in which low resolution is presented as a property of images stemming from the early years of digital visual imaging.

Given that the resolution of a digital image may change depending on the format it is stored in, on the transmission technology that allows it to circulate, and on the display through which it is visualised, focusing on the question of resolution and of its various degrees is a way of emphasising *the specific, layered materialities of digital technologies*, thereby countering a whole ideology that tends to present digital images as dematerialised. When watching a film on our computer monitor or television screen, a sudden loss of resolution reminds us of the material conditions of possibility that allow for that specific image to be recorded, processed, stored, and visualised.

Since resolution is an indicator of the quantity of detail contained in an image, controlling resolution is a way of *controlling visibility*, with all the aesthetic, epistemological, ethical, and political implications that this entails. As we will see later when we discuss the question of pixelisation in the work of the artist Thomas Hirschhorn, the choice of lowering the resolution of an image or of part of an image is a way of blocking the access to its content by presenting the viewer with a blurred, pixelated surface, and raises the question of who has the authority to make such a choice, and in the name of which principles.

To all these reasons why the question of resolution deserves to be taken seriously, we may add another one, which was at the origin of the idea of organising this special section: the need to explain what seems to be a double, contrasting tendency within contemporary visual culture. On the one hand, a tendency towards higher and higher degrees of resolution of digital images, cameras, and screens, which is promoted by marketing and advertising, and is often associated with a whole ideology that weaves together values such as mimetic precision, sensory enhancement, immersive participation, technical performance, and a view of technological progress which inevitably turns the high definition of today in the low definition of tomorrow. On the other hand, the persistence, one could almost say the *survival*, of images in low resolution: images that are blurred, grainy, pixelated and degraded in different ways, sometimes through software that allows digital image to regain some of the visual properties of earlier, analog images, such as 16mm film or 35mm slides.[2] How to explain this contrast? What functions, what values, what connotations distinguish low resolution images from high resolution ones? How to explain the survival of the pixelated and the blurred in a visual world that seems to become sharper and sharper? Where do we locate the connotations of realism, authenticity, evidence, faithfulness, truthfulness – on the side of the high, or on the side of the low resolution?

In a regularly quoted essay published in 2009, the German artist and theorist Hito Steyerl explains the reasons why one should act 'in the defense of the poor image', as the title of her essay states. Steyerl sees in contemporary visual culture a 'class society of appearances'[3] in which 'rich', high resolution images, recorded and visualised through expensive, high-end digital devices, coexist next to 'poor' images, images whose resolution is low either because they are saved in lossy compression formats, or because of the increasing degradation caused by multiple uploading and downloading, reediting and reformatting.[4] As she writes in the opening lines of her essay:

> The poor image is a copy in motion. Its quality is bad, its resolution substandard. As it accelerates, it deteriorates. It is a ghost of an image, a preview, a thumbnail, an errant idea, an itinerant image distributed for free, squeezed through slow digital connections, compressed, reproduced, ripped, remixed, as well as copied and pasted into other channels of distribution. The poor image is a rag or a rip; an AVI or a JPEG, a lumpen proletarian in the class society of appearances, ranked and valued according to its resolution. [*5*]

'As it accelerates, it deteriorates.' In her article, Steyerl undelines this point very clearly: low resolution – at least according to the parameters that were valid in 2009 – determines a loss of quality but it also implies easier and faster circulation, while high resolution preserves quality but slows down circulation and makes it more difficult. The poor image, in other words, 'transforms quality into accessibility',[6] giving access, although in low resolution, to a vast array of visual materials (16 or 35mm experimental films, rare archive collections) which would otherwise be difficult to see. Even though it is 'perfectly integrated in an information capitalism thriving on compressed attention spans, on impression rather than immersion, on intensity rather than contemplation, on previews rather than screenings', low resolution allows for Steyerl the creation of new 'visual bonds', of networks of production, exchange, and circulation which emphasise the values of 'velocity, intensity, and spread'.[7]

Over 50 years ago, in a historical phase characterised by the rise of television as a mass medium, the aesthetic, epistemological, and political implications of the distinction between high and low definition were explored by Marshall McLuhan in his *Understanding Media: The Extensions of Man* (1964). McLuhan's famous distinction between 'hot' and 'cold' (or 'cool') media is based precisely on the distinction between high and low definition, with definition being considered by him as a way of measuring the *quantity of information* carried by a visual or non-visual medium, rather than the *quantity of picture elements*, as in the more specific case of resolution. At the roots of McLuhan's analysis of the implications of high and low definition exists the idea that low definition demands a higher perceptual and cognitive participation from the subject to whom the message is addressed. As we read in a crucial passage from Chapter 2 of *Understanding Media*:

> There is a basic principle that distinguishes a hot medium like radio from a cool one like the telephone, or a hot medium like the movie from a cool one like TV. A hot medium is one that extends one single sense in 'high definition'. High definition is the state of being well filled with data. A photograph is, visually, 'high definition'. A

> cartoon is 'low definition', simply because very little visual information is provided. Telephone is a cool medium, or one of low definition, because the ear is given a meager amount of information. And speech is a cool medium of low definition, because so little is given and so much has to be filled in by the listener. On the other hand, hot media do not leave so much to be filled in or completed by the audience. Hot media are, therefore, low in participation, and cool media are high in participation or completion by the audience. [8]

The low resolution of the television screen – keeping in mind the fact that McLuhan was thinking about the television sets of the 1960s – is presented in *Understanding Media* as the reason why television is a 'cold medium' which demands from the viewer a deep perceptual involvement. Similarly to what happens with comic strips, and at the opposite pole of the high definition of a photograph or a film, 'the TV image is visually low in data'.[9] Its grid-like, orthogonal display of luminous points forms a 'mosaic mesh of light and dark spots'[10] which the viewer needs to somehow 'complete' in order to form a full image:

> The TV image offers some three million dots per second to the receiver. From these he accepts only a few dozen each instant, from which to make an image. [11]

In other words: 'The TV image requires each instant that we "close" the spaces in the mesh by a convulsive sensuous participation.'[12]

Throughout the chapters of *Understanding Media*, McLuhan explicitly connects the television screen, with its 'mosaic mesh of dots',[13] to a whole tradition of visual media whose images are organised as grids or formed by individual, monochrome points. Besides the obvious reference to the colored pieces of mosaics – 'the mosaic is not uniform, continuous, or repetitive. It is discontinuous, skew, and nonlineal, like the tactual TV image'[14] – we find the idea that the work of artists such as 'Cézanne, Seuraut, Rouault' provide 'an indispensable approach to understanding TV'.[15]

The reference to Georges Seuraut is particularly interesting, since his name – together with Paul Signac – is linked to development of the post-impressionist technique of *pointillisme* which was first introduced in 1886, on the occasion of the eighth and last Impressionist exhibition in Paris.[16] In a special room, separated from the rest of the exhibition, Seurat presented *A Sunday on La Grande Jatte* (1884-86), while Signac presented *The Milliners* (1885-86), two paintings whose figures and colors were produced by a widespread raster pattern of dots or pure, unmixed paint meticulously placed through a pointed paintbrush. Instead of attempting to intuitively reproduce,

through improvised patches and spontaneous strokes of color, the volatility of visual impressions, as it happened in the paintings of the Impressionists, the dot technique employed by Seurat and Signac was a carefully planned pictorial process which emphasised the materiality of paint, surface, and technique, while at the same time depicting a world of static, orthogonal figures portrayed either in perfect frontality or perfect 90-degree profiles, as happens in Seurat's *A Sunday on La Grande Jatte* and Signac's *The Dining Room, Opus 152* (1886-87).

Influenced by Michel-Eugène Chevreul's color theories – in particular his idea of 'simultaneous contrast' (developed after being named director of the dye works at the Gobelins Manufactory in Paris), according to which the human eye tends to blend into a new color, when they are perceived at a certain distance, dots of different colors placed closely next to each other – *pointillisme* developed during a period which saw the widespread diffusion of other point-based forms of representation. For example, printing techniques such as the halftone screen, used in order to reproduce black-and-white photographs in the press through variably sized ink dots spaced closer and farther from one another, as well as weaving techniques such as *petit point* embroidery, with its grid-like, matrixial texture. Not surprisingly, Paul Gauguin, who despised the *pointillisme* of Seurat and Signac, described the latter as 'an explorer in *petit point*':[17] that is, in a technique which seemed more suited to the serial technical reproduction of a standardised, stereotype images (such as certain paintings by 18th century artists like Watteau, Boucher, and Fragonard, which were reproduced in large numbers during the end of the 19th century), than to the subjective, intuitive *élan* of inspired painting.[18]

McLuhan considered Seurat's *pointillisme* to be a precursor not only of 'the TV image or mosaic made by the scanning finger',[19] but also of halftone printing, of 'the newspaper mesh of dots that is called wirephoto',[20] as well as of 'the digital computer with its multiple yes-no dots and dashes'.[21] During the 1960s, these different grid-like, point-based visual techniques were explored in various directions by a whole series of artists working with painting, photography, and the newly emerging field of computer graphics.

Among the various examples one might mention, we may recall Roy Lichtenstein's use, throughout his entire artistic trajectory, of the Ben-Day dots used in comic books of the 1950s and 1960s; Andy Warhol's frequent use of the silk screen printing process (also known as screenprint or serigraphy)

with its fine mesh; Alain Jacquet's *Mec'Art* reinterpretation of Manet's *Déjeuner sur l'herbe* through a dot-based painting technique that recalls the dots of halftone printing (1964); Karl Otto Götz's modular grid paintings trying to reproduce the total number of dots (approximately 450,000) of a television screen in the early 1960s, as in the case of a painting such as *Density 10:3:2:1* (1961); finally, Sigmar Polke's fascination for raster images beginning with the 1960s (for example, *Raster Drawing. Portrait of Lee Harvey Oswald*, 1963) and continuing all the way up to his late paintings (*Putti. You Experience Countless Moments of Joy in Your Private Life Today*, 2007). In a text published in 1966 and titled 'Kultur des Rasters' ['Culture of the Raster'], Polke – whose raster images refer to pre-existing photographs but are always hand-painted, dot by dot – explains his interest for the raster as an interest for a technique with far-reaching cultural implications:

> I like the technical character of the raster images, as well as their cliché quality. This quality makes me think of multiplication and reproduction, which is also related to imitation. I like the impersonal, neutral, and manufactured quality of these images. The raster, to me, is a system, a principle, a method, a structure. It divides, disperses, arranges and makes everything the same. I also like it that enlarging the pictures makes them blurry and sets the dots in motion; I like that the motifs switch between being recognizable and being unrecognizable, the ambiguity of the situation, the fact that it stays open… In that perspective I think that the raster I am using does show a specific view, that it is a general situation and interpretation: the structure of our time, the structure of a social order, of a culture. Standardized, divided, fragmented, rationed, grouped, specialized. [22]

During the 1960s, the question of resolution began to be explored also in the emergent field of computer graphics, through a number of collaborations between artists and engineers such as the one that took place, within the context of the Bell Labs laboratories, between the artist Stan VanDerBeek and the programmer and computer graphics pionner Ken Knowlton.[23] Working with a program called BeFlix (a short term for 'Bell Flicks') and with a complex intertwining of digital and analog technologies – an IBM 7094 mainframe computer connected to a Stromberg-Carlson peripheral called S-C 4020, which combined a *display*, a cathode tube screen called Charactron CRT with a resolution of 252×184 alphanumeric characters, and a *camera* turned towards the screen and acting as a microfilm recorder – VanDerBeek and Knowlton produced, between 1964 and 1968, a series of eight computer-generated animation films entitled *Poemfields*.

Imagined by VanDerBeek to be projected inside his 'experience machine' called 'Movie-Drome'[24] – a metal, dome-like structure he had built in the woods surrounding his house in Stony Point (New York), which was supposed to be the prototype of a series of multi-projection spaces connected to one another by satellite, a way of 'expand[ing] cinema' in the direction of a 'world picture language', 'an international art and education form, called Culture-Intercom'[25] – the *Poemfields* reinterpret the tradition of concrete, visual poetry by exploring the plasticity of the Charactron screen. Through a complex, digital-analog process leading from the punch cards feeding instructions into the IBM 7094 to the final result of a colored 16mm celluloid film, VanDerBeek and Knowlton produced a new kind of animated computer graphics in which words appear and then disappear, emerging from and then being reabsorbed by a mosaic-like background of 252×184=46.368 flickering, luminous points, in which small, pixel-like units keep on aggregating and disaggregating.

In an article published in the journal *Art in America* in 1970 with the title 'New Talent: The Computer', Stan VanDerBeek highlighted what was for him the most interesting aspect of the *Poemfields*: the fact that the 'computer' – in this case, the combination of the IBM 7094 mainframe and the S-C 4020 peripheral – had become a machine capable of generating, storing, and visualising images. For VanDerBeek – who before the *Poemfields* had realised a series of films based on photo-collage and animation such as *Science Friction* (1959) – the computer was a new 'graphic tool' capable of opening still unexplored paths towards new ways of movie-making. As a 'technically oriented film-artist', what fascinated him the most was the non-human *speed* of such 'graphic tool', which could 'plot points and draw lines a million times faster than a human draftsman'.[26]

Clearly influenced by McLuhan's *Understanding Media*, VanDerBeek saw in television a medium which had been capable of 'touch[ing] the nerve-ends of all the world', introducing a new 'ecology of the senses' replacing the one that cinema had introduced at the turn of the century. According to him, movie-making, 'for long the most revolutionary art form of our time', had to embrace the revolution triggered by the television screen, with its cathode tube and its pixelated surface, and needed to further develop it by turning 'to computer graphics, to computer controls of environment, to a new cybernetic *movie art*'. The computer was for him 'an extension of the mind with a tool technically as responsive as ourselves': its 'abstract notation systems', its

techniques for 'image storage' and 'retrieval' introduced a new 'mental attitude to movie making', in which images were produced through pure computer programming, without ever encountering any kind of profilmic reality. 'Programming', writes Stan VanDerBeek at the end of his article, will become in the near future 'one of the new psycho-skills of the new technician-artist-citizen'.[27] A 'psycho-skill' because of its analogies with the functioning of the human mind, since computers, VanDerBeek believed, had 'reached the speed of human computation in 1967'. A 'psycho-skill', also, because of the analogies between the eye – 'a miniaturized computer predetermining information before getting to the brain' through a 'mosaic of nerve ends (rods and cones)' – and the 'graphics display systems' of the time, with their 'small points of light turned on or off at high speeds', recalling Seurat's Pointillism and half-tone newsprint, just as McLuhan had observed in *Understanding Media*.[28]

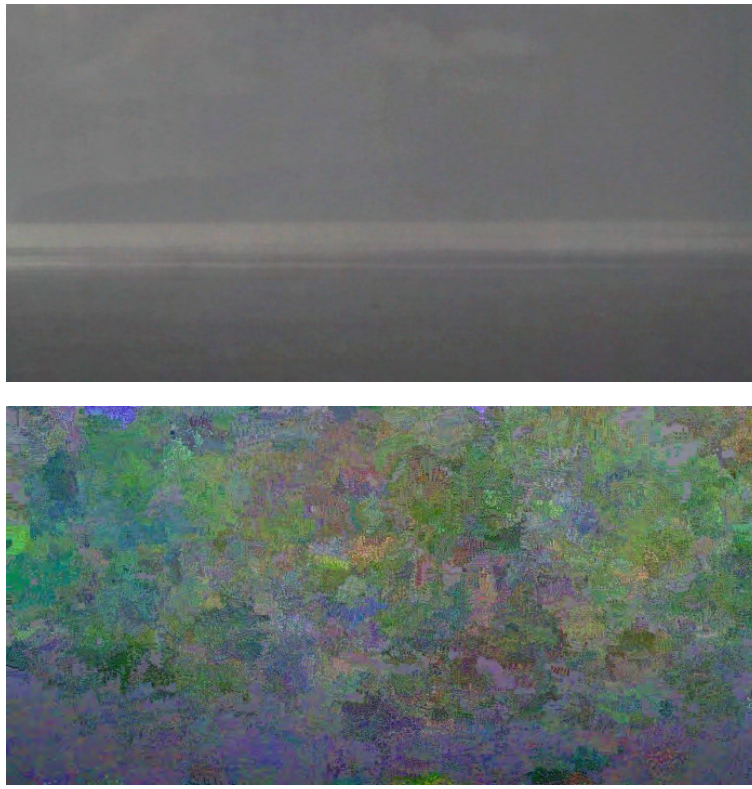
During the early 2000s, the widespread diffusion of digital visual technologies, begun a decade earlier, brings to the foreground once more the question of resolution with its various aesthetic, epistemological, and political implications. Artists, photographers, and experimental filmmakers tackle it from different viewpoints, focusing in many cases on the status of pixels and on their visualisation. Making pixels visible becomes a way of exhibiting the materiality of digital images while at the same time emphasising the fact that degrees of resolution determine thresholds of visibility, as we can see in the work of figures such as Thomas Ruff, Jacques Perconte, Harun Farocki, Hito Steyerl, Eyal Weizman, and Thomas Hirschhorn.

Between 2004 and 2009, the German photographer Thomas Ruff produces a series of photographs entitled *Jpegs*, in which images freely circulating across the internet in low resolution are downloaded and then printed in a very large format (188×188 or 297×364 cm) in such a way that what appears is a blocky, blurred, pixelated surface.[29] Among the images we find scenes of man-made catastrophes – nuclear explosions during atomic tests, iconic images from the 9/11 terrorist attacks, the burning oil fields during the second Gulf War – but also vast, natural landscapes. Paradoxically, the low resolution of the images found online by Ruff is printed in very high resolution, in order to allow the viewer a full, sharp access to every monochrome pixel, and a full awareness of the way in which resolution conditions perception. The result is an act that brings to the surface a grid-like, matrixial texture that reminds the viewer of the materiality and of the technological conditions of possibil-

ity of digital images that are often perceived to be free-floating and dematerialised. The title, *Jpegs*, refers to the standard compression format for digital photographic files named after the association that created it at the beginning of the 1990s, the Joint Photographic Experts Group, and underlines the fact that a major factor in determining the visual appearance of a digital image is the compression format in which the image itself has been coded and stored.

Compression formats are also at the center of the work of the French experimental filmmaker Jacques Perconte, whose work can be considered, among other things, as a way of revisiting the traditions of Impressionism through digital means. Working meticulously on the different ways in which one may sabotage or hack the well-functioning of compression formats – a practice which in its more popular, widespread, and often repetitive forms is known as *datamoshing* – Perconte produces films which often begin by positing a camera in front of some kind of natural, atmospheric, environmental scenery. As it happens in films like *Chuva (Madeira)* (2012) [Figs 1, 2], which begins with the grey view of a storm over the sea and turns into a pulsating landscape of colored pixels, the images filmed with the videocamera begin gradually to be distorted and destructured, producing all kinds of restless, glitch-like, pixelated compression artifacts, and transforming the screen into a matrixial field whose plasticity – whose capacity of generating forms by aggregating and disaggregating pixels – appears to be limitless.

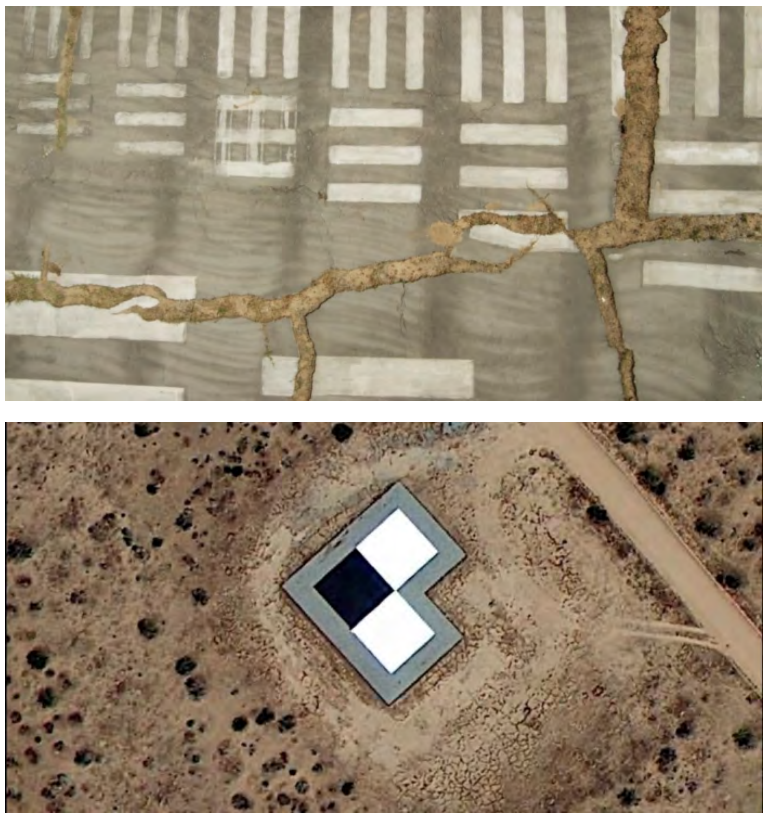
In recent years – while commercial films such as *Pixels* (Chris Columbus, 2015, based on a video by Patrick Jean also titled *Pixels*, 2010) play with the imaginary associated with the pixelated world of the early years of videogames such as Space Invaders (1978) and Pac-Man (1980), and while Harun Farocki, in one of his last installations (*Parallel I-IV*, 2012-14), investigates the digital fabric of the virtual worlds of videogames, highlighting a tendency towards greater and greater realism propelled by an increase in image resolution[30] – artists such as Hito Steyerl and Thomas Hirschhorn, and architects such as Eyal Weizman, insist on the connections between the different degrees of resolution and the power to control visibility.



Figs 1, 2: Jacques Perconte, Chuva (Madeira) (2012), 2K Scope 24p film, courtesy of the artist.

In her *How Not to Be Seen: A Fucking Didactic Educational .MOV File* (2013), Steyerl develops a reflection articulated in a series of different 'lessons' on how to become invisible in a world which tends more and more to a condition of widespread panopticism. 'Lesson I' explains through a voiceover that there are 'four ways to make something invisible for a camera': 'to hide', 'to remove', 'to go off screen', 'to disappear', or to stay below the resolution threshold of a camera. Steyerl refers explicitly to 'resolution targets', the patterns drawn on the surface of the clear-skied, desert areas in order to measure the visibility of satellite cameras, and underlines the fact that the rectangular patterns used by the US Air Force in 1950s and 1960s have been replaced around 2000 with a new standard for resolution targets: a series of pixel-based resolution charts with black and white squares [Figs 3, 4]. The voiceover reminds us that 'resolution measures visibility', and that 'whatever is not captured by resolution is invisible'. Given that in 1996 the resolution of a satellite camera was about 12 meters per pixel, while in 2013 it is approximately

one foot per pixel, in order to become invisible from a satellite camera 'one has to become smaller or equal to one pixel', that is, smaller or equal to one square foot.



Figs 3, 4: Hito Steyerl, How Not to Be Seen: A Fucking Didactic Educational .MOV File (2013), video (color, sound).

We find a similar series of observations in one of the visual investigations produced by Forensic Architecture, the independent research agency founded by Eyal Weizman at Goldsmiths in London.[31] Searching for 'forensic evidence' concerning the damage caused by a US drone strike in March 2012 in the town of Miranshah, in North Waziristan (Pakistan), the analysts of Forensic Architecture use a whole series of visual means to investigate the site, combining rare video footage with 3D animation and satellite images. Over the course of the video documenting the investigation they underline the fact that the publicly-accessible satellite images of the area are degraded to low degrees of resolution, 'in order to preserve the visual advantage of military and state agencies'. Given that in such publicly-available

images one pixel represents a 50×50 centimeter square of terrain, whatever lies below that resolution threshold remains invisible, erecting an impenetrable barrier that limits any form of independent investigation. As the voiceover says, 'the destruction is captured at the threshold of visibility in the image'.

A very insightful reflection on the question of pixelisation – the intentional lowering of the degree of resolution of an image or of part of an image – may be found in a recent series of works by the Swiss artist Thomas Hirschhorn titled *Pixel Collages* (2016). Hirschhorn is not interested in the degrading of satellite image resolution pointed out by Weizman, but in the widespread media practice of pixelating images stemming from war zones and showing dead bodies in order to protect the viewer's sensibility. In a text accompanying a recent exhibition of the *Pixel Collages* at the Galerie Chantal Crousel in Paris, Hirschhorn highlights the complex implications of pixelisation, and sees in it a form of *authentification*:

> Pixelating or blurring has taken over the role of authenticity. A pixelated picture must surely be authentic if it has unacceptable areas which are concealed. […] It therefore seems clear that pixels stand for authentification: authentification through authority. [32]

The question, therefore, becomes that of determining where lies such authority, and who has the power to decide what is acceptable and what is unacceptable, what needs to be pixelated and what does not. Hirschhorn highlights this dilemma by producing works which associate brutal war images with images of a completely different kind, such as fashion magazine cutouts, and emphasises the artificial gesture of pixelisation by pasting onto the image a series of hand-made, square pixels made of colored cut-out acetate sheets. The result is literally a collage of pixels, which reminds us, in the artist's own words, of how pixelisation is always 'an authoritarian gesture' which 'infantilizes or manipulates the viewer',[33] by imposing onto him or her a hierarchy between what can be seen and what cannot be seen, between what is sharp and what is blurred.

The seven articles published in this special section examine the question of resolution from several different viewpoints, and extend the questions we have raised so far in different directions. Nikita Braguinski tackles the widespread labelling of retro-themed musical products as '8-bit' and analyses both the specific qualities of 1980s game audio, and the imaginaries connected to its recent imitations. Jonathan Larcher and Leyokki, members of the Brèches artist collective, reflect, through the viewpoint of their own practice in 'hand-

crafting' digital images, on the hierarchies usually associated with high and low resolution when dealing with vernacular digital images stemming from family footage. Diego Cavallotti deconstructs the widespread idea according to which film archives are transitioning 'from grain to pixel', and shows instead the coexistence of analog and digital techniques, of chemical/analog and electronic/digital layers, in the restoration of a family film archive. Susanne Østby Saether analyses how artists have responsed to the new conditions of image mobility and transience made possible by the internet by focusing on a specific time frame, the year 2005, and on two video-based works by Slater Bradley and Seth Price that purposefully employ low resolution images in order to emphasise their circulation through a network. Federico Pierotti and Alessandra Ronetti explore the archaeology of contemporary infrared images and their contemporary uses in mapping what is invisible to the human eye, in tracking data, and in managing information flows. Kuhu Tanvir examines the widespread viewing of popular Hindi films through the small screen of mobile cellphones, and studies the intersections between cinema, mobility, and piracy. Carloalberto Treccani tackles the complex question of algorithmic machine vision and the human work involved in image labelling, and highlights the role that image resolution plays in the processes of 'image segmentation'.

Taken together, this introduction and the seven essays published in this special section contribute the analysis of a question – that of the aesthetic, epistemic, and political implications of the different degrees of resolution of digital images and visual displays – that lies at the center of one of the founding texts of the field of media theory, Marshall McLuhan's *Understanding Media*, and that will most likely continue to engage media and visual culture theorists for the coming years, since the development of digital visual technologies continues to introduce new, higher levels of resolution which, in turn, reveal new digital materialities and establish new thresholds of visibility.

Authors

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Notes

[1] See Cubitt 2014, pp. 79-111.

[2] See Habib 2019 (forthcoming).

[3] Steyerl 2009, p. 1.

[4] On this, see also Gaboury 2019 (forthcoming).

[5] Steyerl 2009, p. 1.

[6] Ibid.

[7] Ibid., p. 7.

[8] McLuhan 1994 (orig. in 1964), pp. 22-3. On the implications of high and low definition in McLuhan, see Casetti & Somaini 2013.

[9] Ibid., p. 313.

[10] Ibid.

[11] Ibid., pp. 312-3.

[12] Ibid., p. 314.

[13] Ibid., pp. 160-1.

[14] Ibid., p. 334.

[15] Ibid.

[16] On *pointillisme*, see Windauer 2016.

[17] Quoted in Windauer 2016, p. 17.

[18] See Armstrong 2015.

[19] McLuhan 1994 (orig. in 1964), p. 249.

[20] Ibid., pp. 189-90.

[21] Ibid., p. 249.

[22] Quoted in Rottmann 2014, p. 53.

[23] See Patterson 2015.

[24] See Sutton 2015.

[25] VanDerBeek 1966, p. 1.

[26] VanDerBeek 1970, p. 86.

[27] Ibid., p. 91.

[28] VanDerBeek, not dated, pp. 4-6.

[29] On Thomas Ruff's *Jpegs* see Simpson 2009.

[30] On Harun Farocki's installation *Parallel* see Blümlinger 2014.

[31] On the agency Forensic Architecture see https://www.forensic-architecture.org/.

[32] Hirschhorn 2016.

[33] Ibid.