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STELLA BARAKLIANOU
University of Huddersfield

Pixel

Pixel is a contraction of the terms pic (pix) and either 'element' or 'cell'. Whilst definitions of the term vary, as do its applications, a pixel is basically the smallest element of a discrete and non-continuous dataset captured through a process of digital sampling and arranged via an address on a grid location (x, y).

The term has a long and varied history that does not necessarily relate to familiar still-photographic practices or outputs. For instance, the German term *Bildpunkte* was used in a scanning patent of 1884 to describe picture points. In 1927, Alfred Dinsdale wrote about television using terms such as 'mosaic of dots' and 'little areas of varying brilliance' to describe its picture elements. Between 1964 and 1965, NASA Jet Propulsion scientists rendered the first images of Mars using colour crayons to map out the numerical data of transmission signals (Mitchell 1998: 69–72). The precise term pixel appeared in an article of 1967 on Jet Propulsion by Fred C. Billingsley, and its

conventional use was, arguably, consolidated in a range of IBM patents taken out by IBM in the 1980s, after which time it was widely adopted (Lyon 2006).

By way of contrast, analogue film technology is reliant on silver halide crystals held in emulsion, which are extremely sensitive to light. When exposed, different structures of crystal formation lead to different degrees of sensitivity of the film, allowing for controlled variation of light sensitivity and a more or less fine 'grain' in resulting images. The apparently unmediated nature of this process has long underwritten interpretation of the photograph as an 'emanation of the referent' (Barthes 2000: 80). With digital photography this originary presence becomes a sample, an 'abstracted data bank of information that contains the *look* of the photographic' (Batchen 2002: 129–44 original emphasis). Certainly, this means that the authority of the photographic index is rendered tendentious, a quality assigned through algorithms and differential circuits that loses its sense of direct and ontologically determining reference to an object out in the world.

In digital image capture, a pixel is commonly known as the smallest component that is capable of resolving detail in a light-sensitive image sensor and that can be individually processed. Pixels on charged-couple device (CCD) or complementary metal-oxide-semiconductor (CMOS) sensors are described in terms of millions per mm. In cameras with CCDs the light captured through a lens is formed onto a sensor that contains millions of photosensitive sites or photosites, which convert electrical signals into a two-dimensional array of information. A single pixel in isolation is a register of data that, in combination with other pixels in array, is used to encode spatial characteristics and tonal range. If it makes sense to think of this stage as an image, it is one in which the information captured is encoded as grayscale or monochrome. Any colour values it might come to possess are assigned at a later stage, in a process known as interpolation and bitmapping.[1]

The pixel is a sample encoded in a long set of binary codes. This contextualizing information is vital as it dictates how the pixel will behave in connection to the others in the frame. As a mosaic of fixed picture elements, any resulting image is resolution-dependent meaning that manipulations beyond a certain point will not yield any clearer or sharper detail, leading to contoured appearance on the surface of the image, known as pixellation. Because human vision can seamlessly integrate its separate elements, a high resolution digital image will appear continuous in tonal range and colour and thus like a photograph made using film. The continuity of tones in the latter, particularly in black and white film, is due to overlapping of the grains on the film (Langford and Bilissi [1969] 2011: 199). This is not the case with digital images, in which separate pixel elements are discrete codings of data. Indeed, this enables one to observe a possible ontological distinction between the analogue and the digital, that is dependant upon their different material bases, but it also indicates that the conventional binding of the pixel to its expression in a visual image is not its necessary feature. The pixel, at the level of its definition as a unit of data, remains fundamentally ambivalent to vision. It can equally well be resolved into non-visual terms. The fact that it isn't, and that it is

1. A colour filter is arranged prior to light reaching the photosites, to assign a colour value to the pixel. The most widely used pattern resembling a mosaic of the primaries – red, green and blue – is known as the Bayer array system, proposed in 1976 by Bayer of the Eastman Kodak Company (Langford and Bilissi [1969] 2011: 150). Each pixel will only detect one set of information pertaining to one of those primary colours. This is true of single area array sensors, Bayer type filters, which are also considered similar to how autochrome plates used to record colour (Romano 2007: 365). Further developments in image sensor technology have led to multilayer area array sensors, such as the Foveon sensor or the honeycomb sensor, where the octagonally shaped pixels are arranged in a honeycomb grid (Langford and Bilissi [1969] 2011: 156–57).

mostly discussed in terms of being destined for visual expression, is a result of broader conventional structures imposed by its setting, for instance, in the operation of a camera.

A pixel always works in context. In a way, it is a virtual denominator that needs a certain set of numerical operations to fulfil its operational value. This abstract value (point) can be thought of as being virtual insofar as it gains importance according to the patterns of behaviour assigned to it within the grid formation. The long set of binary codes embeds particular behaviour patterns, alterations to which will impact on the image it might be used to construct.

Compared to a grain of exposed and fixed silver halide, the pixel has an attenuated physical existence in the digital image. For a start, it is only ever temporarily fixed. Its function is based on relational value sets assigned through the matrix of the corresponding elements around it. This enables designation and manipulation of point-by-point values in the image, which renders the image mutable and is what provoked the famous digital crisis of representation in photography. The formal ontology of the digital image, at single point element, is therefore relational, meaning that variations in the matrix of memory cells will potentially give rise to no image formation, which is one of the things that grounds the digital image's and the pixel's discussion as a virtual entity.

Noise is widely recognizable as that state of interference. During the process of a signal transmission, there is always a certain amount of unwanted distortion or error. 'Noise is both the material from which information (data) is constructed as well as the matter which information resists' (Ballard 2011: 62). In digital images, noise is considered an aberration at the level of the pixel. Its conventional visible register is a fleck of white appearing in the digital image, which is usually a product of low light. But noise is a broader category extending to effects caused by dust on the sensor or its malfunction. Noise is considered as a random factor that leads a pixel to behave inappropriately. Since pixels behave in context, solutions tend to deploy information from neighbouring pixels as a corrective that operates according to a set of supplementary codes or filters.

The possibilities contained within this tiny cell are what make the digital image fluid, porous and open to manipulation. One cost of this is that digital files are not as secure as an image captured on film. But, then, one of the effects of digital technology has been to put the assumptions underpinning this concern for permanence – and associated ideas of the value and meaning of photographs – to the test.

Ontologically, according to Francois Laruelle, the photograph is a site of becoming. In its immanent state, the photo is radically distinguished from its material support. 'The photo – not in its material support, but in its being-photo of the object – is none other than that which, through vision-force, is given immediately as the "in-itself" of the object' (Laruelle 2011: 21). Configured through the idea of a matrix (Laruelle 2012: 3–10, 33–36) what is of importance is not what the image represents but, rather, the sum of algebraic formulations that it opens up or fragments. Digital

acquisition quantifies the world as a palpable series of numbers (Rodowick 2007: 116). If it can be thought of as having an immanent state, this matrix of numerical coding propagates might be thought of in terms of its intensities, rhythmic aleatories of non-linear, folded time. The fundamental discontinuity of the digital image, encoded in the state of a singular picture element, suggests a way of thinking about photography in which the pixel is understood *as* an intensity rather than *for* its integrity.

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