DIGITAL IMAGE
數位影像

李天明 博士

何謂像素(Pixels)-1/3

◦ In order for any digital computer processing to be carried out on an image, it must first be stored within the computer in a suitable form that can be manipulated by a computer program. The most practical way of doing this is to divide the image up into a collection of discrete (and usually small) cells, which are known as pixels. Most commonly, the image is divided up into a rectangular grid of pixels, so that each pixel is itself a small rectangle. Once this has been done, each pixel is given a pixel value that represents the colour of that pixel.

◦ 要對影像進行任何數位計算機處理，首先必須將其以電腦程式可以處理的合適格式儲存在電腦中。最實用的方法是將影像分割成一系列離散的（通常很小的）單元，這些單元被稱為像素。最常見的做法是將影像分割成矩形像素網格，這樣每個像素本身就是一個小矩形。完成分割後，每個像素都會被賦予一個像素值，該值代表該像素的顏色。

何謂像素(Pixels)-2/3

○ It is assumed that the whole pixel is the same colour, and so any colour variation that did exist within the area of the pixel before the image was discretized is lost. However, if the area of each pixel is very small, then the discrete nature of the image is often not visible to the human eye.

○ 人們通常假設整個像素顏色相同，因此影像離散化之前像素區域內存在的任何顏色變化都會遺失。然而，如果每個像素的面積非常小，那麼影像的離散特性通常肉眼無法察覺。

何謂像素(Pixels)-3/3

◦ Other pixel shapes and formations can be used, most notably the hexagonal grid, in which each pixel is a small hexagon. This has some advantages in image processing, including the fact that pixel connectivity is less ambiguously defined than with a square grid, but hexagonal grids are not widely used. Part of the reason is that many image capture systems (e.g. most CCD cameras and scanners) intrinsically discretize the captured image into a rectangular grid in the first instance.

◦ 還可以使用其他像素形狀和排列方式，最值得注意的是六邊形網格，其中每個像素都是一個小的六邊形。這在影像處理方面有一些優勢，例如像素連通性比正方形網格更明確，但六邊形網格並不常用。部分原因是許多影像擷取系統（例如大多數CCD相機和掃描器）在初始階段就將擷取到的影像離散化為矩形網格。

Pixel Values(1/4)

◦ a computer has a pixel value which describes how bright Each of the pixels that represents an image stored inside simplest case of binary images, the pixel value is a 1-bit that pixel is, and/or what colour it should be. In the number indicating either foreground or background. For a greyscale images, the pixel value is a single number that represents the brightness of the pixel. Often this number is stored as an 8-bit integer giving a range of possible values from 0 to 255. Typically zero is taken to be black, and 255 is taken to be white. Values in between make up the different shades of grey.

◦ 電腦影像中每個像素的亮度都由一個像素值表示。在最簡單的二值影像中，像素值是一個 1 位元整數，表示該像素的顏色，即前景或背景。對於灰階影像，像素值是一個表示像素亮度的單一數值。通常，該數值儲存為 8 位元整數，取值範圍為 0 到 255。通常，0 代表黑色，255 代表白色。介於兩者之間的值構成不同的灰度。

Pixel Values(2/4)

- To represent colour images, separate red, green and blue components must be specified for each pixel (assuming an RGB colourspace), and so the pixel 'value' is actually a vector of three numbers. Often the three different components are stored as three separate `greyscale' images known as colour planes (one for each of red, green and blue), which have to be recombined when displaying or processing.

- 為了表示彩色影像，必須為每個像素分別指定紅色、綠色和藍色分量（假設採用 RGB 色彩空間），因此像素的「值」實際上是一個包含三個數字的向量。通常，這三個不同的分量被儲存為三個獨立的「灰階」影像，稱為顏色平面（分別對應紅色、綠色和藍色），在顯示或處理影像時需要將它們重新組合。

Pixel Values(3/4)

◦ Multi-spectral images can contain even more than three components for each pixel, and by extension these are stored in the same kind of way, as a vector pixel value, or as separate colour planes.

◦ The actual greyscale or colour component intensities for each pixel may not actually be stored explicitly. Often, all that is stored for each pixel is an index into a colourmap in which the actual intensity or colours can be looked up.

◦ 多光譜影像中每個像素可以包含三個以上的分量，因此這些分量的儲存方式也類似，可以是像素值的向量形式，也可以是單獨的顏色平面。

◦ 每個像素的實際灰階或顏色分量強度可能並沒有被明確儲存。通常情況下，每個像素只儲存一個指向顏色映射表的索引，可以透過該索引找到實際的強度或顏色值。

Pixel Values(4/4)

◦ Although simple 8-bit integers or vectors of 8-bit integers are the most common sorts of pixel values used, some image formats support different types of value, for instance 32-bit signed integers or floating point values. Such values are extremely useful in image processing as they allow processing to be carried out on the image where the resulting pixel values are not necessarily 8-bit integers. If this approach is used then it is usually necessary to set up a colourmap which relates particular ranges of pixel values to particular displayed colours.

◦ 儘管簡單的 8 位元整數或 8 位元整數向量是最常用的像素值類型，但某些影像格式支援不同類型的值，例如 32 位元有符號整數或浮點值。這些值在影像處理中非常有用，因為它們允許對影像進行處理，而最終得到的像素值不一定是 8 位元整數。如果採用這種方法，通常需要設定一個顏色映射表，將特定的像素值範圍與特定的顯示顏色關聯起來。

Primary Colours(1/2)

◦ that can be perceived by humans can all be It is a useful fact that the huge variety of colours produced simply by adding together appropriate amounts of red, blue and green colours. These colours are known as the primary colours. Thus in most image processing applications, colours are represented by specifying separate intensity values for red, green and blue components. This representation is commonly referred to as RGB.

◦ 人類可感知的顏色都可以是......。一個有用的事實是,只需將適量的紅色、藍色和綠色混合,就能產生種類繁多的顏色。這些顏色被稱為三原色。因此,在大多數影像處理應用中,顏色是透過分別指定紅色、綠色和藍色分量的強度值來表示的。這種表示法通常被稱為 RGB。

Primary Colours(2/2)

◦ The primary colour phenomenon results from the fact that humans have three different sorts of colour receptors in their retinas which are each most sensitive to different visible light wavelengths.

◦ The primary colours used in painting (red, yellow and blue) are different. When paints are mixed, the `addition' of a new colour paint actually subtracts wavelengths from the reflected visible light.

◦ 原色現像源自於人類視網膜中有三種不同的色彩感受器，它們分別對不同的可見光波長最為敏感。

◦ 繪畫中使用的原色（紅、黃、藍）各不相同。當顏料混合時，新顏料的「加入」實際上會使反射的可見光波長減少。