“Seeing is believing” and “A picture paints a thousand words” convey the wealth of information that we receive from images. Our brain is highly adapted to the processing of visual information. This ability to “get it” from an image without explicit processing is both a treasure and a trap. It fuels our ability to detect information, making computer analysis often look clumsy in comparison, but it also makes us sloppy where we are easily distracted or diverted by conflicting signals. Camouflage exploits this distraction by creating continuous colour distribution to obscure spatial structure. The army used to employ colour blind people exactly because they are more attuned to structure [1]. However, colour distracts us because we know that it normally conveys useful information and spectroscopy has been used since the 17th century to identify and analyse samples in almost every branch of science. The important point is to find the balance between information density and processing requirements. Within this Special Issue, in [2], the combination of a phasor representation of spectra and spatial information of readily available RGB images is shown to efficiently enhance the utility of these images.

The combination of the spectral and spatial information is called hyperspectral imaging. The data produced in hyperspectral imaging is necessarily multi-dimensional. In general, the images are taken as 2D images and the spectrum provides a third axis so that a 3D datacube is produced from which information can be extracted. Sometimes it is sufficient to use only a low resolution spectrum. After all, our eyes only have three spectral components which already produce a wealth of information. Sometimes the information is overwhelmed in the full spectrum but hidden in small peaks in which case a high spectral resolution (or targeted spectral bands) are required. Sometimes the relevant spectral information is not within the visible spectrum at all but rather in the Near-, Mid- or far-infrared or at wavelengths shorter than the visible. In [3] the mid-IR is used for histopathology. As technology allows for imaging at ever more extreme wavelength the interest in hyperspectral imaging at those wavelengths grows.

Spectral changes, caused by absorption shifts or reflection changes can reveal chemical changes such as polymerization, the oxygenation of haemoglobin or general cell health. The combination of the spectral and spatial information can reveal tissue activity or state in a way that could not be seen from imaging or spectroscopy separately. In [4] both the oxygenation and metabolic state can be gleaned from the hyperspectral data which would not have been possible from either the spatial or spectral information separately.

The analysis of hyperspectral datacubes requires advances in computational capacity and new strategies. Many algorithms are being developed and impressive results have emerged but it is easy to be lured into complexity where it is not required or simply get lost in a data-overload. To extract the useful information and only the useful information it is required to generate efficient and productive analysis tools for the lab or clinic. In [5] the algorithm adapts to the peculiarities of the image using an unmixing strategy rather than an absolute colour translation. New technology for the recording and the analysis of hyperspectral images is constantly being developed and generating a wealth of new possibilities. In [6] a scanning Fabry-Perot system is used to provide 2D imaging at a sequence of wavelengths. In this special issue we present a few of these achievements and developments in the conviction that images allow us to perceive life and hyperspectral images add colour to that life.

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Refs:

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