Spectral camera

Spectral imaging is imaging that uses multiple bands across the electromagnetic spectrum. While an ordinary camera captures light across three wavelength bands in the visible spectrum, red, green, and blue (RGB), spectral imaging encompasses a wide variety of techniques that go beyond RGB. Spectral imaging may use the infrared, the visible spectrum, the ultraviolet, x-rays, or some combination of the above. It may include the acquisition of image data in visible and non-visible bands simultaneously, illumination from outside the visible range, or the use of optical filters to capture a specific spectral range. It is also possible to capture hundreds of wavelength bands for each pixel in an image.

Hyperspectral and multispectral imaging (HMSI) in medical applications provides information about the physiology, morphology, and composition of tissues and organs. The use of these technologies enables the evaluation of biological objects and can potentially be applied as an objective assessment tool for medical professionals.

Aim: Our study investigates HMSI systems for their usability in medical applications.

Approach: Four HMSI systems (one hyperspectral pushbroom camera and three multispectral snapshot cameras) were examined and a spectrometer was used as a reference system, which was initially validated with a standardized color chart. The spectral accuracy of the cameras reproducing chemical properties of different biological objects (porcine blood, physiological porcine tissue, and pathological porcine tissue) was analyzed using the Pearson correlation coefficient.

Results: All the HMSI cameras examined were able to provide the characteristic spectral properties of blood and tissues. A pushbroom camera and two snapshot systems achieve Pearson coefficients of at least 0.97 compared to the ground truth, indicating a very high positive correlation. Only one snapshot camera performs moderately to high positive correlation (0.59 to 0.85).

Conclusion: The knowledge of the suitability of HMSI cameras for accurate measurement of chemical properties of biological objects offers a good opportunity for the selection of the optimal imaging tool for specific medical applications, such as organ transplantation [1].

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Mühle R, Markgraf W, Hilsmann A, Malberg H, Eisert P, Wisotzky EL. Comparison of different spectral cameras for image-guided organ transplantation. J Biomed Opt. 2021 Jul;26(7). doi: 10.1117/1.JBO.26.7.076007. PMID: 34304399.