H91 Quantification of Color Changes in Human Decomposition Using Image Processing Software

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After attending this presentation, attendees will understand how image processing software can quantify color changes in human decomposition. This presentation will show how the software can be used to construct a chromaticity diagram based on the RGB and CIELAB values generated from a set of images taken for a study on postmortem interval estimation by a total body score and accumulated degree-days method.

This presentation will impact the forensic science community by exploring the relationship between temporal changes in human decomposition and changes in chromaticity diagrams. It will also explain how RGB and CIELAB values taken from digital images might be used to validate current postmortem interval estimation.

Scientists can use a spectrophotometer to measure quantitatively the transmission or reflection properties of a material as a function of wavelength.[1] The spectral wavelengths are converted into three values, known as CIELAB tristimulus values, which numerically represent the sensitivity curves of three linear light detectors. Then, the values are used to calculate the two parameters humans use to process color: chromaticity, a quantitative property that is a combination of luminance, hue, and saturation; and brightness, a purely qualitative property. The parameters are plotted as x and y coordinates on what is known as a CIE 1931 color space chromaticity diagram.

Dermatologists have used spectrophotometry to monitor skin lesions and color changes in patients' skin.[2] While spectrophotometry is an accurate method of quantifying color change, it requires direct contact with the material being analyzed. Not all lesions or conditions allow for direct contact with this instrument of analysis, nor is it suitable for all types of investigation. Ophthalmologists, for example, cannot use a spectrophotometer inside the eye to diagnose diseases such as macular degeneration.[3] They instead use a method known as digital colorimetry. Image processing software analyzes an image or any specific region of an image and generates a set of values known as RGB values. These RGB values are another set of color additive values and can be converted into the same tristimulus values that can be plotted on a chromaticity diagram.

The stages of human decomposition can be quantitatively classified using a system like the Total Body Score method.[4] While the scoring system is a quantitative measure, this system and others like it rely on color as a criterion for classification. Large changes in color are easy to detect, but reporting the overall color of a limb or torso at only one point in time might be difficult. Investigators need a quantitative way of evaluating color, or at least a quantitative method of validating their estimation.

Spectrophotometry would be an accurate technique in analyzing color in human decomposition, but it can be problematic. The area of analysis is restricted by the need for direct contact with the body. Forensic scientists might need to analyze the colors on a large part of the body or even on the body as a whole before they classify the stage of decomposition. Digital colorimetry is a comparable alternative. It uses the digital images of the bodies at the crime scene or recovery scene, and immage processingsoftware can analyze specific or larger regions of the images.

Six digital images representing all stages of human decomposition will be selected from a larger group of images taken for a previous study.[5] ImageJ software will be used to select a region in each photo and will generate the respective RGB values; the images analyzed will not be corrected or altered. The RGB values will be converted into chromaticity coordinates and will then be plotted on a CIE 1931 color space chromaticity diagram so that a trend in the values can be evaluated.[6] This process will be repeated on the images after correcting them for brightness and contrast.

Preliminary results show RGB values generated from both uncorrected and corrected images can be converted into CIELAB values, which can then be plotted on a chromaticity diagram. The red, green, and blue color channels will be plotted against the time progression to establish how strong a relationship exists. Differences in the sets of values will expose the necessity of image correction. Patterns in the plotted points will reveal how digital colorimetry tracks color changes, and if it can validate postmortem interval estimation.

References:

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Human Decomposition, Chromaticity Diagram, Digital Colorometry

