

Analysis of Imaging Data through Structural Comparison

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Motivation

Imaging methods have become increasingly relevant in cultural heritage science. The data produced by these methods possess the advantage of having inherent internal spatial structure. However, this spatial structure is rarely leveraged during processing of the data.

This work explores different approaches to exploit spatial structure in different types of imaging data.

Structural Comparison

Two methods are tested:

Structural Similarity Index Measure (SSIM)

Calculate a similarity map using the structural component of SSIM:

$$SSIM(x, y) = l(x, y) \cdot c(x, y) \cdot s(x, y)$$

luminescence contrast structure

$$s(x, y) = \frac{\sigma_{xy} + C_3}{\sigma_x \sigma_y + C_3}$$

The similarity map highlight areas in which the two images are share similar structures.

Canny Edge detection

Compare edge maps derived using the Canny algorithm:

Photograph Isolate target color Define edges

Comparison of distribution maps

SSIM can provide insight into the structural relation between different MA-XRF elemental distribution maps.

Fe-K

Cr-K

SSIM s-map

Areas of structural difference show as dark areas

Brightness/Contrast shifted for clarity

Comparative Analysis of Woodblock Prints

As mass-produced art pieces, the authenticity of woodblock prints is a common question. Comparing different prints allows to determine authenticity as well as describing printing chronology, through the degradation and damage of the woodblocks. However, this analysis is time consuming and requires significant skill. Edge detection and false color images can help accelerate the process.

Comparison of prints from the same woodblocks allows study of the woodblock degradation process:

Comparison of cartouche of 4 different *Great Wave* prints:

Edge comparison False color image Edge comparison

Perspective

- Early results are promising and highlight the usefulness of such methods for varied problems across different imaging methods. However, selecting the correct method to address each specific problem is a complex issue.
- Accurate alignment of the data is crucial. Spectral imaging data has the benefit of being intrinsically aligned, but for the analysis of woodblock prints alignment is more complex, as they may not show the exact same spatial features for alignment.
- Edge comparison can highlight small deviations in line thickness in woodblock prints. However, study of woodblock degradation requires the analysis and comparison of many prints, due to the expected variations in the highly manual printing process.

Smart*Light (S*L) Inverse Compton Scattering X-ray source

Smart*Light is a novel inverse Compton scattering X-ray source with the potential to offer novel X-ray imaging capabilities for the study of cultural heritage objects, for which the structural comparison of imaging data would be very valuable. See poster "Smart*Light: First results from the Dutch inverse Compton source" for more information.

Preliminary experimental endstation.

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