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# On Spatial Metamerism in Computational Vision

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**Martin Lillholm**

## Abstract

This dissertation considers spatial *metamerism* in computational vision. Metamerism occurs when sensory input fail to completely determine the physical reality and a whole class of stimuli will produce the same measurements. The term metamerism is borrowed from colour science, where several distinct spectra may result in the same perceived 'colour'. In spatial vision metamerism arise as a result of e.g. sampling and front-end visual processing.

One of the main ideas in metamerism is to characterise metamery classes, not just as measurements, but via representatives; either as very simple or otherwise informative members. In the colour setting, we represent the spectra, not just as a measured triple, but as a 'colour'.

Building on the pioneering work of Koenderink, we present two frameworks for calculating representatives of spatial metamery classes. The first framework focuses on co-localised measurements of local image geometry and generates representatives that seek to characterise the local structure. The second framework, for global or multi-local metamerism, allows for measurements scattered over the entire irradiance field. Here, representatives are selected as the class member with lowest possible information contents relative to assumed models of natural image statistics.

The local framework is applied to natural image profiles scaled into canonical form and we conclude that the most likely natural image profile is a (blurred) step-edge.

Using the global framework, we investigate different models of natural image statistics and indirectly evaluate the notion of feature based analysis. Furthermore, we introduce points of maximal information as points that carry extremal information on an image relative to an underlying model. We show that they capture more image structure than corresponding classical feature detectors.

The final body of work in this dissertation considers simultaneous detection of several geometrical image feature types using a generic classification framework. Based on implicit models of edges and blobs and a generic model of image background, we get results comparable to that of classical feature detectors but in one unifying framework.