Keynote Lecture

Phase is an Important Low-Level Image Invariant

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Abstract. The performance of low-level image operators has always been less than satisfactory. The unreliability of the output, sensitivity to noise and the difficulty in setting thresholds has long frustrated those working in high-level vision. Much of the recent success of high-level image processing techniques have come about from the use of robust estimation techniques, such as RANSAC, and the use of effective optimization algorithms. These techniques have allowed the deficiencies of low level operators to be largely ignored. However, problems still remain.

Most of the existing low-level operators for feature detection and feature description are based in the use of local image derivatives. This is problematic because image gradients are affected by image contrast and scale. There is much we do not know about the low-level structure and statistics of images. This is especially so for the newer classes of images such as X-ray, MRI, and geological aeromagnetic images. It is too simplistic to think of image features as consisting of only step edges or lines. There is a continuum of feature types between these two. These hybrid feature types occur just as frequently as do lines and steps. Gradient based operators are unable to properly detect or localize these other feature types.

To overcome these problems I argue that local phase information should be the building block for low-level feature detectors and descriptors. Phase encodes the spatial structure of an image, and crucially, it is invariant to image contrast and scale. Intriguingly, while phase is important, phase values can be quantized quite heavily with little penalty. This offers interesting opportunities with regard to image compression and for devising compact feature descriptors. I will present some approaches that show how features can be detected, classified and described by phase information in a manner that is invariant to image contrast.