

Digital Image Processing 2019 20 - Homework 2

Instructor: José Delpiano - Teaching Assistant(s): To be defined

August 2019

1. Main goal

Study and apply the concepts of filtering.

2. Tasks and Questions

The variance filter (or standard deviation filter) is a simple filter with practical applications in image analysis. The result of applying this filter is a new ‘image’ where each pixel is the variance of a neighbourhood defined by a small window of the original (input) image. For instance, it may be useful to discriminate focused and out-of-focus areas in an image.

Use the two images that have been made available as part of this homework, ‘leaf’ and ‘bacteria’ (thanks to the bio-filtering lab at UANDES). The goal in the leaf image is to segment leaf (foreground) and background. The goal in the bacteria image is to discriminate bacteria pixels and background pixels. Most bacteria show some green blobs related to presence of a polymer.

1. Think about the difference of using variance or standard deviation. Is it relevant? What would you suggest?
2. Is the variance filter a linear filter? In other words: is there an equivalent kernel to get the same results using convolution?
3. Study the effect of window size on the results of applying the variance filter. Zoom-in and analyse parts of the images that are interesting to support your analysis.
4. Is it important to pay attention to biased/unbiased estimates of variance? Give a brief discussion of the topic. Add an experiment to support your answer.
5. Some students suggested edge detection may be useful for our goals. The simplest way to have edges detected is to estimate the partial derivatives of the image $\frac{\partial f}{\partial x} = f_x$, $\frac{\partial f}{\partial y} = f_y$ and use the gradient norm $\sqrt{f_x^2 + f_y^2}$ as an indicator for edges. A simple yet robust estimate of derivatives can be obtained via convolution with the Sobel filter.
6. Compare the results to another edge filter you can find (a well-known example is the canny filter for edge detection).

3. Submission

Submit before 8pm, 3 September, via SAF. Use pdf format, with no more than eight pages, in English, font size 12. Submit clearly commented code in English.