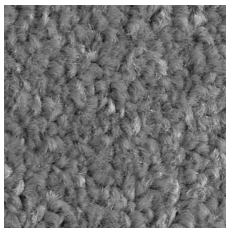


Determining Size and Classification of Textures in Images

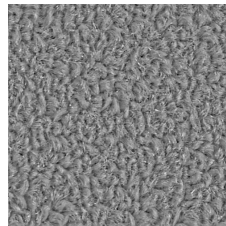
Purpose:

Classification of textures and the determination of their size are important first steps in texture-based segmentation and analysis. This understanding of texture, in turn, is essential to all aspects of general image understanding.

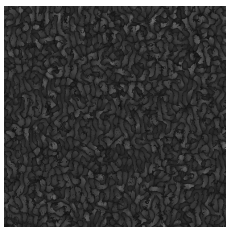
Textured images were examined by slowly expanding a window around a point in the image until the average intensity in the window stopped changing. The size at which this happened was taken as the size of the smallest unit of texture, or "texton."



First, digital images were taken of a texture at a number of different scales.

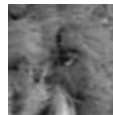


Images were then normalized with respect to brightness using variance. This ensured that region brightness did not affect texton size.



Finally, an expanding Gaussian differential method was used to determine size of a texton at every point. Bright areas in the image to the left represent larger textons.

To the right is an example of a texton found in the above image (keep in mind that this is a window of 4σ that would have been convolved with a Gaussian of the same σ).

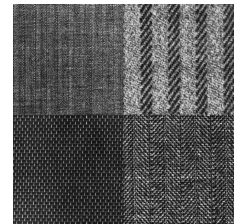


This method is used in the literature. However, it turned out to not be very discriminative; a magnification of several hundred times caused the detected size to change by only about 8%.

Texture analysis is applicable to every branch of computer vision from content-based image retrieval to photo-realistic movie scene rendering to autonomous robot navigation. Each of the two parts of our project can be much more easily accomplished given meaningful results from the other. One might therefore infer that the two tasks would best be accomplished in tandem. Combining these two processes into a single framework is the next logical step to be tried in future work.

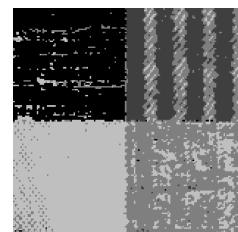
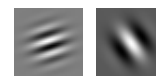
Textures were classified by two different methods, and images were segmented based on those classifications. The first method, co-occurrence matrices, is a statistical measure of the relative positions of gray levels within the texture. The second method, Gabor filters, is a frequency-based measure. It was hoped that the two methods would each have their strengths at identifying certain types of textures, and that by learning which types of textures each could identify, the methods could be combined into a versatile, general classifier.

An image composed of four different textures, all with recognizable repeating units (textons).



A segmentation of the above image by co-occurrence matrices. Each gray level corresponds to one "class" of pixels.

A segmentation of the same image by Gabor filters (sample filters below).



This segmentation using a median filter is used as a control to account for the effects of the different average intensities of the four textures.

The median filter probably does a worse job than the co-occurrence Matrix, but definitely performs better than the Gabor filters, suggesting that Gabor filters used in this way could not be compared to co-occurrence matrices as desired.