Texture Descriptors From Compressed Images

Rachel Westwood

Texture is an important factor in visual perception and discrimination of image content. On this basis, texture features are used within a range of applications, including identification of landmarks, such as mountains and lakes in ariel photography [1]. Texture descriptors are used to describe areas within an image where different textures occur.

Images can be compressed in multiple ways. The new JPEG2000 standard uses an algorithm called EBCOT and the Discrete Wavelet Transform, while the ordinary JPEG standard uses the Discrete Cosine Transform (DCT). Other compression methods use frequency-domain analysis with Gabon Filters, Radon Filters and other Wavelet Filters. Sim et al.[2] present an algorithm for obtaining texture descriptors of compressed images in the DCT domain. This site will explain how to obtain texture descriptors from an image compressed using wavelet filters and makes use of spatial-frequency domains. This method could also be used on images compressed using DWT.

When an image is compressed, it is split into subbands corresponding to different spatial-frequencies. An example of such an image and corresponding subbands is shown in Figure 1, in this case the QMF wavelet is used on the image.

![Figure 1. (a) Original image of Buffalos (b) QMF wavelet transformed image (c) Subbands yielding texture given by $t_k$. [1]](image)

Significance Maps

A significance map is a binary map of significant coefficients and is obtained as follows.

Let $m_0, m_1, \ldots, m_n$ be the magnitudes of the coefficients obtained from the wavelet transform.

It is possible to obtain a series of thresholds $\tau_0, \tau_1, \ldots, \tau_L$ such that

$$\tau_0 = \frac{1}{2} \max m_n \quad \text{and} \quad \tau_l = \frac{\tau_{l-1}}{2} \quad l = 1 \ldots L.$$
A coefficient $X$ is said to be significant if its magnitude is greater than $\tau_l$, that is $m_X > \tau_l$.

A significance map (Figure 2) for subband $k$ is defined as

$$b_k[x,y] = \begin{cases} 1, & \text{if the coefficients at coordinate } (x,y) \text{ are significant} \\ 0, & \text{otherwise} \end{cases}$$

**Texture Descriptor Vector**

The number of significant coefficients in a subband defines its significance, defined as $N_i$.

Hence, for the $i$th subband, $S_i$ and the magnitude of the $n$th coefficient, $m_n$

$$N_i(\tau_l) = |\{m_n \in S_i : m_n > \tau_l\}|$$

The texture vector can now be defined as

$$T = \{b_1, b_2, \ldots b_i\}, \text{ where } b_i = \frac{N_i}{\sum_i N_i}$$

Figure 3. Texture extraction from an image. (a) QMF wavelet transformed image. (b) After thresholding. (c) Labeled textures. (d) Outlined texture regions. [1]

**Further Information**

**Texture Descriptors from images**


Information relating to compression methods

  This site contains a good explanation of DCT, with formal definitions and comparison of DCT to the Discrete Fourier Transform.
- [http://www.stanford.edu/~esetton/wavelet.htm](http://www.stanford.edu/~esetton/wavelet.htm)
  This site contains an explanation of DWT. Relevant filterbanks are shown and examples of using DWT with images are presented.
- [http://www.wavelet.org](http://www.wavelet.org)
  This site contains general information on wavelets, with a forum and tutorials.
  This is the official website of the JPEG2000 standard. It contains links to the official standard and a FAQ section on the standard.

References

