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PARTIALLY SUPERVISED TEXTURE SEGMENTATION AND RETRIEVAL

by

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A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Computer Science, The University of Auckland, 2005

Supervisor: Associate Professor Georgy Gimel'farb
Co-supervisor: Professor Reinhard Klette
ABSTRACT

Partially supervised texture segmentation/retrieval aims to detect regions similar to a given texture in an arbitrary background. Such one-class texture detection has many important practical applications to identify regions of interest in remote sensing, medical diagnostics, industrial vision, or content-based image retrieval (CBIR). At the same time it differs from and cannot be performed with conventional supervised or unsupervised segmentation/retrieval techniques.

This thesis develops a novel partially supervised approach to segmentation and retrieval based on an original local-to-global texture descriptor. This latter exploits a distribution of distances between local and global frequencies of particular texture features. The empirical frequency distribution of the feature collected over the whole training texture globally characterises the texture. The similar distributions but collected within a moving window of a fixed size centred at each particular position in the image describe its local characteristics. The local-to-global distance distribution over a training texture provides a natural self-similarity threshold for separating the desired texture from each arbitrary background.

The thesis investigates capabilities of characteristic translation invariant pairwise interactions of pixel-wise colours as the texture features. The interactions are analysed using a generic Gibbs random field (GGRF) image model that produces a set of characteristic colour co-occurrence histograms (CCH) as generalised texture features. These latter are compared experimentally to other known features such as the marginal colour histogram (CH), the coordinated clusters representation (CCR), and the Tamura’s features popular in image retrieval.

Experimental investigation of the proposed approach was conducted with
large texture databases (e.g. the CUReT database containing more than 200 images for each of 61 natural textured surfaces, MIT VisTex database with more than 165 textured images, and Brodatz’s texture database with more than 100 images). These experiments confirm effectiveness of our approach for different types of textures. Moreover, the proposed local-to-global texture descriptor can be easily used with different features. This allows for selecting most appropriate pixel-wise features ensuring better performance in each particular application problem relating to single texture segmentation or retrieval.
To my wife, Yue Ding
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