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Automated classification of surface texture for photographic paper

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Abstract

Surface texture is a vital attribute defining the appearance of a photographic print. Texture impacts tonal range, rendering of detail, reflectance and conveys subtle qualitative information about the aesthetic intent of a photographer. During the 20th century, manufacturers created a huge diversity of specialized textures. Identification of these textures can yield important information about the origin of a photographic print, including the date and the region of origin.

Assembled over past decade, a texture library of photographic papers containing over 2,000 identified surfaces has been assembled using a simple system for capturing photomicrographs. Lacking a query and retrieval mechanism, this library has only the most basic application for the identification of unknown textures. Addressing this deficit, practical applications are being tested as part of the Museum of Modern Art's project to characterize photographs from its Thomas Walther collection (funded by the Andrew W. Mellon Foundation). As part of this project, texture is being documented by reflectance transformation imaging, raking light and differential interference contrast.

Using these tools, image data "training sets" were assembled from 65 reference samples of photographic paper. Within the 65 items in the training set about 30% have matches derived from the same package of photographic paper or from the same manufacturer's surface designation made during the same time period. As part of a "Photographic Paper Classification Challenge" these training sets have been distributed to teams with the objective of producing an automated classification system that matches an unknown texture to a short list of identified references gleaned from a library that may include thousands of samples. Accepting this challenge, five university teams from Worcester Polytechnic Institute (USA), University of Wisconsin (USA), University of Arizona (USA), Tilburg University (the Netherlands), and Ecole Normale Supérieure de Lyon (France) are developing separate approaches to solving this classification problem.

Such classification procedures typically divide into two parts: feature vector extraction from the images and similarity evaluation of the feature vectors. For these tasks many algorithms are plausible

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with strengths and weaknesses dependent on the peculiarities of materials being analyzed. For example Fourier, wavelet, and multi-fractal analysis may have greater or lesser success on certain types of surfaces based on physical characteristics including isotropy or roughness. The success of these and other strategies from the Photographic Paper Classification Challenge will be assessed just prior to the 3D Digital Documentation Summit and will be summarized in the presentation. The techniques developed through the challenge may have applications for rapidly and inexpensively assembling texture libraries of other materials such as textiles, painted surfaces as well as accessing and identifying these texture collections through database query and retrieval methods.