Nonparametric Statistics of Image Neighborhoods for Unsupervised Texture Segmentation

Suyash P. Awate
Tolga Tasdizen
Ross T. Whitaker

UUCS-05-008

School of Computing
University of Utah
Salt Lake City, UT 84112, USA

Abstract

In this paper, we present a novel approach to unsupervised texture segmentation that is based on a very general statistical model of image neighborhoods. We treat image neighborhoods as samples from an underlying, high-dimensional probability density function (PDF). We obtain an optimal segmentation via the minimization of an entropy-based metric on the neighborhood PDFs conditioned on the classification. Unlike previous work in this area, we model image neighborhoods directly without preprocessing or the construction of intermediate features. We represent the underlying PDFs nonparametrically, using Parzen windowing, thus enabling the method to model a wide variety of textures. The entropy minimization drives a level-set evolution that provides a degree of spatial homogeneity. We show that the proposed approach easily generalizes, from the two-class case, to an arbitrary number of regions by incorporating an efficient multi-phase level-set framework. This paper presents results on synthetic and real images from the literature, including segmentations of electron microscopy images of cellular structures.