Public Abstract

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For many years, topic models (e.g., pLSA, LDA, SLDA) have been widely used for segmenting and recognizing objects in imagery simultaneously. However, these models are confined to the analysis of categorical data, forcing a visual word to belong to one and only one topic. There are many images in which some regions cannot be assigned a crisp categorical label (e.g., transition regions between a foggy sky and the ground or between sand and water at a beach). In these cases, a visual word is best represented with partial memberships across multiple topics. To address this, a partial membership latent Dirichlet allocation (PM-LDA) model and associated parameter estimation algorithm are present.

PM-LDA defines a novel partial membership model for word and document generation. Different from the standard LDA model which assumes that each word belongs to one and only one topic, PM-LDA model allows words to have partial membership in multiple topics. This model can be useful for image/video documents where a visual word (an image patch) may be a mixture of multiple topics. For example, in a SONAR imagery where the gradually vanishing sand ripples blur the boundary between sand ripple region and flat sand region, it is impossible to tell where the sand ripple ends and the flat sand starts. In the proposed PM-LDA model, the visual words are represented with partial memberships in both "sand ripple" and "flat sand" topics, which is more reasonable than assigning them to one and only one topic as in the standard LDA model. A Gibbs sampling is employed for parameter estimation. Experimental results on simulated data, SONAR image dataset and natural image datasets show that PM-LDA can produce both crisp and soft semantic image segmentations; a capability existing methods do not have.