Color Segmentation

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Abbreviation:	color-seg
Number of instances:	3
Number of variables:	21000, 424720
Number of labels:	3, 4
Number of factors:	
Order:	2
Function type:	potts

Description The `color-seg` instances describe the segmentation of 2D color images. A discrete random variable with k labels is introduced for each pixel and their configuration is interpreted as the segmentation of the image into k disjoint sets. The quality of the segmentation is characterized by an energy function that trades off boundary against region terms given some sparse external labels of the desired segments.

Objective / Learning The energy to be minimized takes the following form:

$$E(\mathbf{x}) = \sum_{i \in \mathcal{V}} \phi_i(x_i) + \sum_{\{i,j\} \in \mathcal{N}} \phi_{ij}(x_i, x_j) \tag{1}$$

The unary region terms $\phi_i(x_i)$ are defined in term of the RGB distributions $\mathcal{H}_a, a = l_1, \ldots, l_k$ for the k segments as

$$\phi_i(x_i) = -\log p(x_i = a | \mathcal{H}_a) \tag{2}$$

The distributions are estimated from the externally provided labels.

The pairwise boundary terms $\phi_{ij}(x_i, x_j)$ operate on a 8-pixel neighborhood $\mathcal{N}$. They take the form of a Generalized Potts model:

$$\phi_{ij}(x_i, x_j) = \begin{cases} \lambda_1 + \lambda_2 \exp\left(\frac{-g^2(i,j)}{2\sigma^2}\right) \frac{1}{\mathrm{dist}(i,j)} & \text{if } x_i \neq x_j \\ 0 \quad \text{if } x_i = x_j \end{cases} \tag{3}$$

The terms $g(i,j)$ and $\mathrm{dist}(i,j)$ represent the distance in the RGB values and the spatial distance respectively. The following parameter settings are used: $\lambda_1 = 5$, $\lambda_2 = 100$, and $\sigma = 5$.

References