Multiclass color-based segmentation

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Abbreviation:	color-seg-n4/color-seg-n8
Number of instances:	9
Number of variables:	$\sim 10^5$ (360 × 240)
Number of labels:	4–12
Number of factors:	$\sim 2.5 \times 10^5$ (n4), $\sim 4.3 \times 10^4$ (n8)
Order:	2
Function type:	Potts

Description Segmentation of various images into 4–12 classes. The unary potentials are computed as the ℓ_1-distance to prototypical class color vectors that were found using hierarchical clustering. The `snail` example uses statistics over user-selected regions and a weighted distance in HSV space. The synthetic `fourcolors` example contains a mix of round structures to test isotropy as well as straight lines in various angles with sharp junctions.

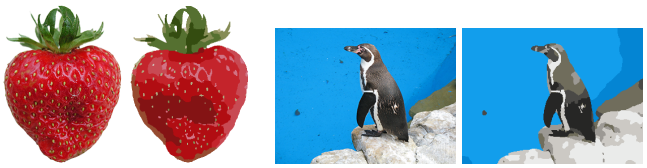

Figure 1: Multi-class color-based segmentation: Input (left), exemplary segmentation into classes corresponding to 12 different colors (right). The colors for the individual classes were pre-selected using a hierarchical clustering method.

Objective / Learning The objective function is

$$J(x) = \sum_{v \in V} \varphi_i(x_i) + \sum_{ij \in E} \varphi_{ij}(x_i, x_j). \tag{1}$$

which discretizes the continuous functional

$$J(u) = \int_D \|c_{u(x)} - I(x)\| dx + \lambda \mathcal{L}(u), \tag{2}$$

where $u : \Omega \to \{0, \ldots, n\}$ is the label function and $\mathcal{L}(u)$ is the total boundary length. The employed norm $\|\cdot\|$ varies between instances (see above). The regularization weights λ were set manually.

The Potts regularizer has been implemented using pairwise potentials with 4-neighborhoods (-n4) and 8-neighborhoods (-n8) with the pairwise factor weight chosen optimally according to [1].

References

[1] Y. Boykov. Computing geodesics and minimal surfaces via graph cuts. In *ICCV*, 2003.