Harmony Potentials for Joint Classification and Segmentation

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Outline

Local Information

- Superpixel-based labeling
- Small region information
- Ambiguity for small regions
- Ground truth expensive

Global information

- Image-based labeling
- Full image information
- Sophisticated learning
- Ground truth cheaper

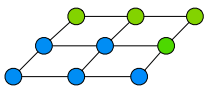
- How to efficiently fuse this information?

$$\sum_{i\in\mathcal{V}}\phi(x_i)+\sum_{(i,j)\in\mathcal{E}_L}\psi_L(x_i,x_j)+\sum_{(i,g)\in\mathcal{E}_G}\psi_G(x_i,x_g)$$

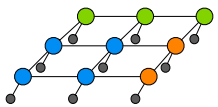
- Ability to learn semantic co-occurrence
- Allows foreground-background learning
- Enforce ***harmony*** in label configurations

Consistency Potentials

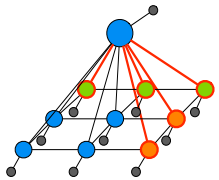
Previous approaches



Ground truth

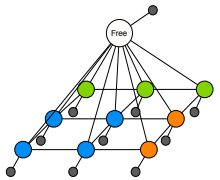


No global potential



Potts

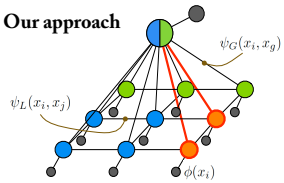
$\psi_G(x_i,x_g)=\gamma_i^l\mathrm{T}[x_i\neq x_g]$



Robust P^N-based

$\psi_G(x_i,x_g)=\begin{cases}0 & \text{if } x_g=l_P \text{ or } x_g=x_i\\ \gamma_i^l & \text{otherwise, where } l=x_i\end{cases}$

Our approach



Harmony Potential

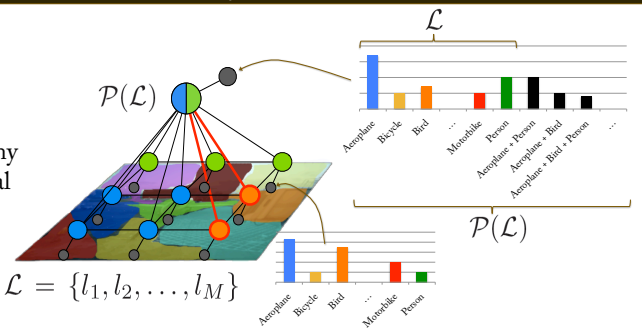
$\psi_G(x_i,x_g)=\gamma_i^l\mathrm{T}[x_i\notin x_g]$

Harmony Potential

Classification

Harmony Potential

Segmentation

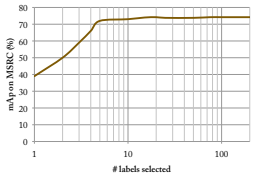


Ranked Subsampling

- All possible label combinations is unfeasible.

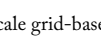
$2^{|\mathcal{L}|}$ combinations of labels.

- Rank the most plausible combination of labels, based on a branch and bound technique.

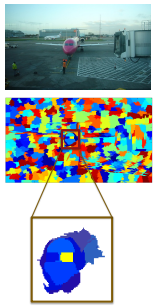


Implementation Details

- Oversegmentation based on superpixels
  - ≈500 segments *[Vedaldi et al. ECCV'08]*
- Local Features:
  - SIFT multiscale grid-based
  - Color Histograms
- Local unary potentials based on BoW
  - Local + Context

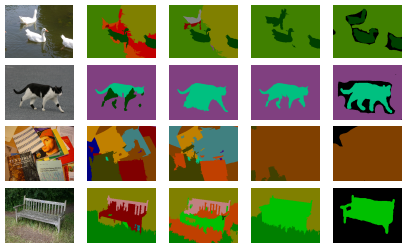


- Global unary potentials
  - State of the art classification Method *[Khan et al. ICCV'09]*



Experimental Results

MSRC v2



Segmentation Methods	MSRCv2 (mAP)	Pascal VOC 2009
Shotton et al. (2008)	67%	-
Lim et al. (2009)	67%	-
Zhu et al. (2008)	74%	-
Fulkerson et al. (2009)	-	13.8%
Yang et al. (2010)	-	23.7%
Ladicky et al. (2009)	75%	24.8%
Li et al. (2010)	-	37.2%
Ours	75%	34.1%

Pascal VOC 2009