Detection Bank: An Object Detection Based Video Representation for Multimedia Event Recognition

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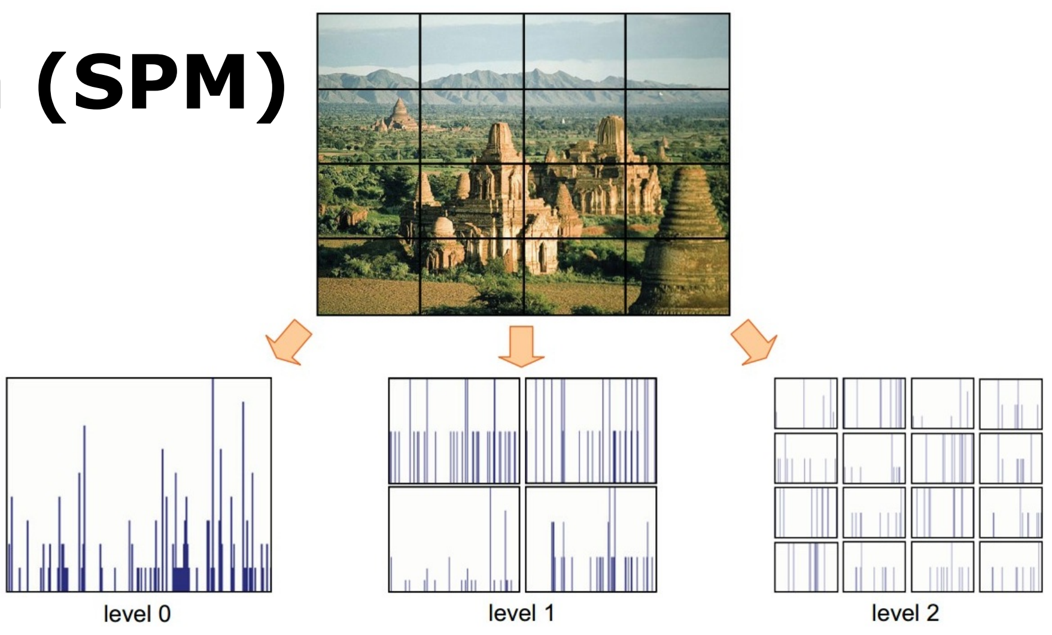
Multimedia Event Detection

Birthday Party vs **Wedding Ceremony**

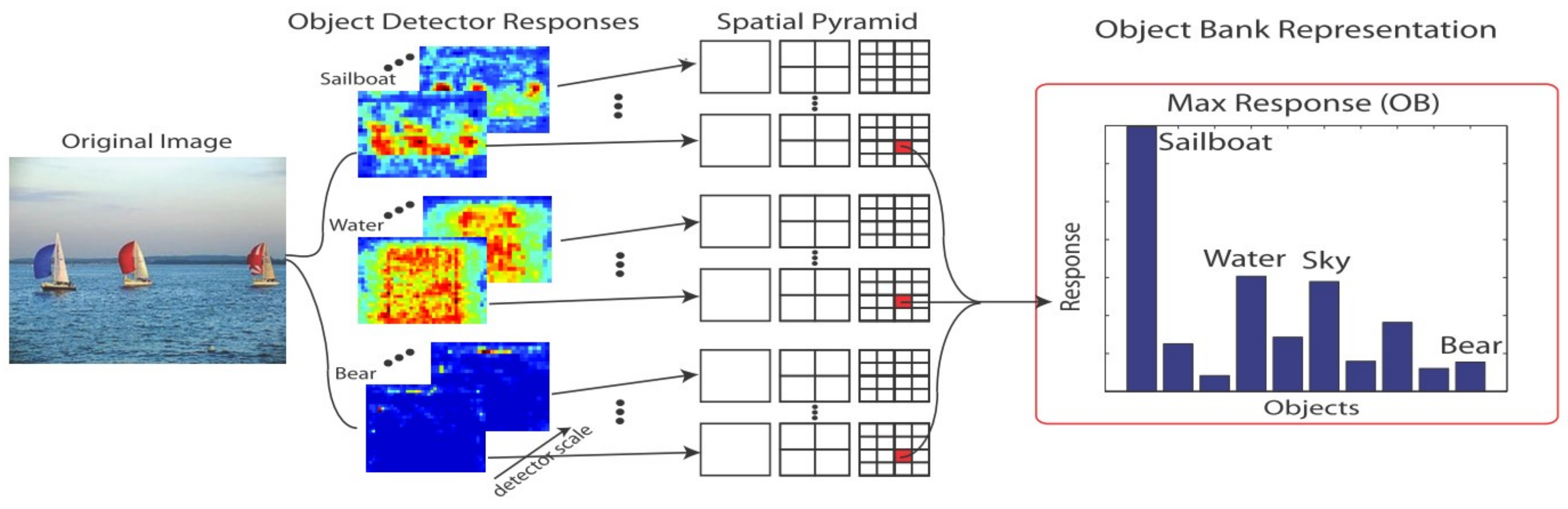
Look for: Balloon, Candle, Birthday Cake vs. Bride, Groom, Wedding Gown, Wedding Cake

Previous Work

Spatial Pyramid Match (SPM)



Object Bank (OB)



Problem

Scene-level descriptors cannot capture *fine-grained phenoma* that discriminate between events. **Object Bank** lacks immediate sense of whether or not there are *objects present in the image* and if so how many.

Idea

- ObjectBank omits the following steps that are standard in a detection pipeline:
  - *Thresholding of score maps*
  - *Non-maximum suppression*
  - *Pooling across all scales*
- We compute different *detection count statistics* to capture e.g. max number of detections, sum of detection scores, probablity of detection based on the detection images from a large number of windowed object detectors.

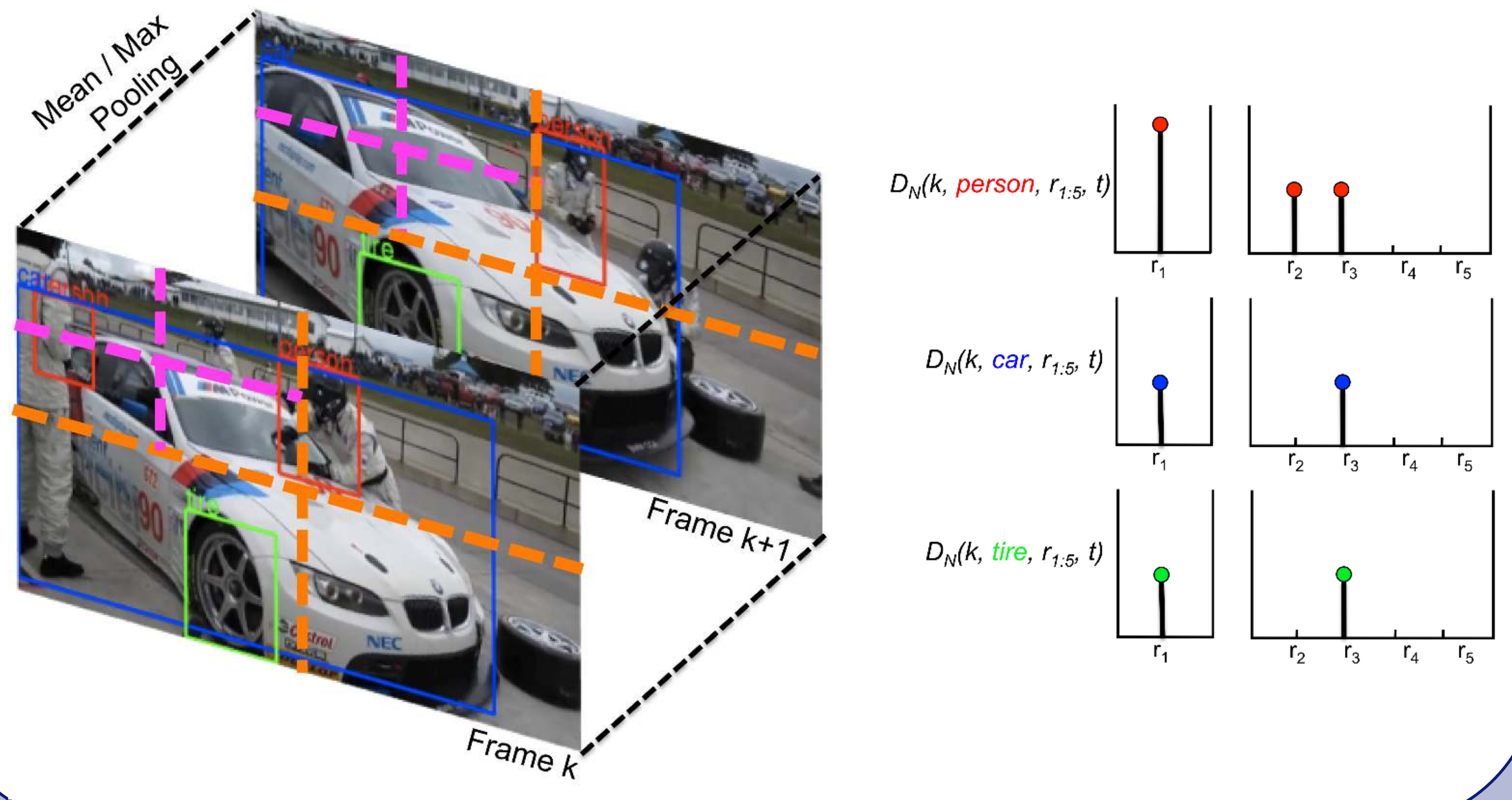
Detection Count Statistics

$$D_S\left(k,c,r,t\right)=\sum_{i=1}^{P}\mathbb{I}\left[\ \overline{\mathbf{b}_{c,i}}\in\mathcal{I}\left(r\right)\ \right]\mathbb{I}\left[s\left(\mathbf{b}_{c,i}\right)\geq t\right]s\left(\mathbf{b}_{c,i}\right)$$

$$D_N\left(k,c,r,t\right)=\sum_{i=1}^{P}\mathbb{I}\left[\ \overline{\mathbf{b}_{c,i}}\in\mathcal{I}\left(r\right)\ \right]\mathbb{I}\left[s\left(\mathbf{b}_{c,i}\right)\geq t\right]$$

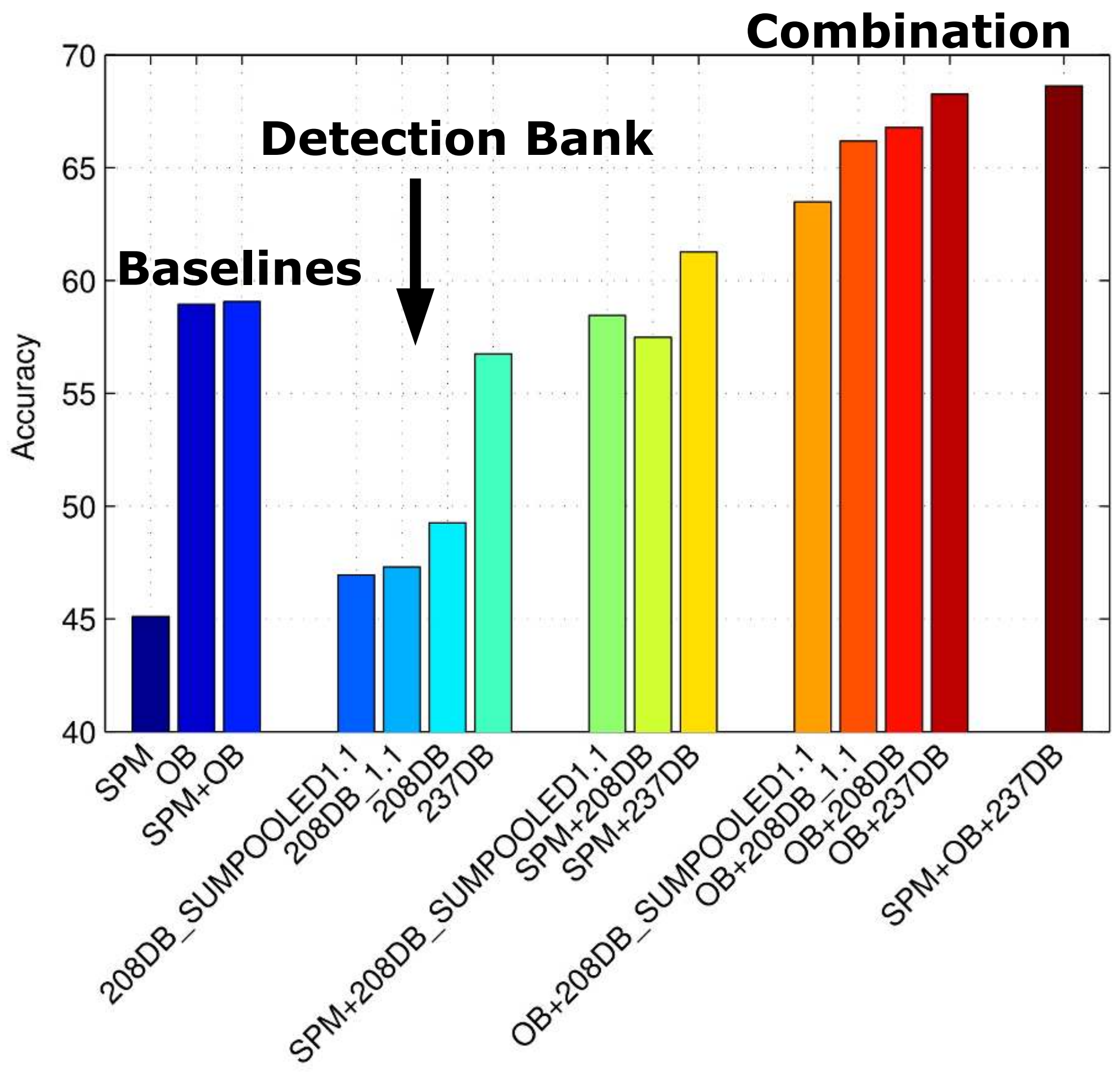
$$D_0\left(k,c,r,t\right)=\mathbb{I}\left[\sum_{i=1}^{P}\left(\mathbb{I}\left[\ \overline{\mathbf{b}_{c,i}}\in\mathcal{I}\left(r\right)\ \right]\mathbb{I}\left[s\left(\mathbf{b}_{c,i}\right)\geq t\right]\right)>0\right]$$

Illustration

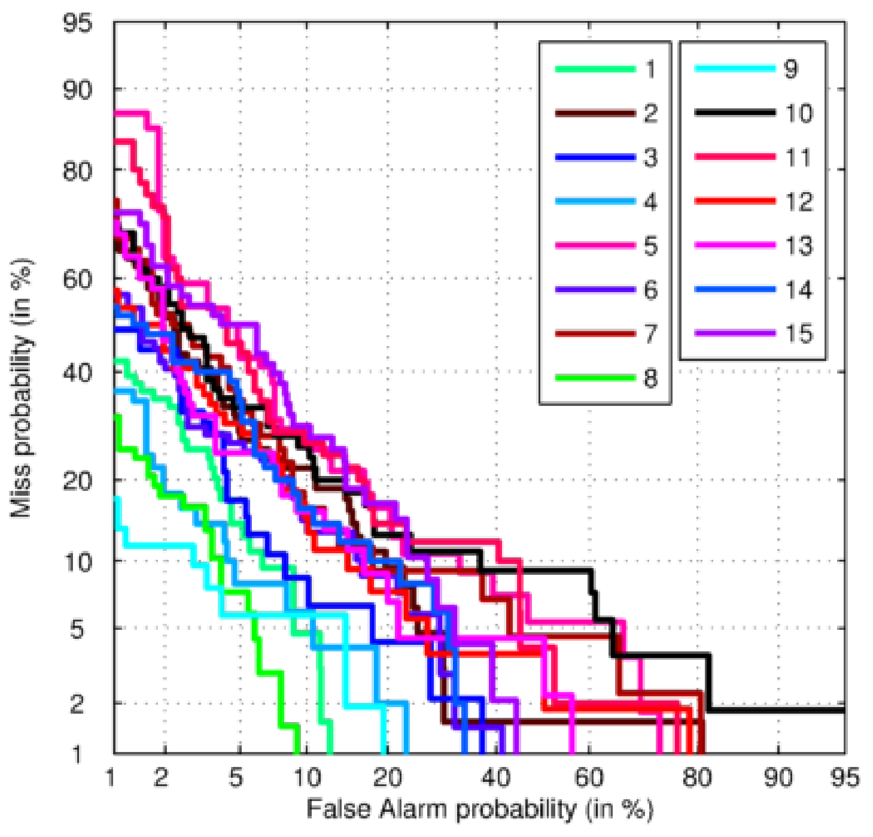

Mean / Max Pooling
Frame k+1
Frame k
$D_N(k, person, r_{1:5}, t)$
$D_N(k, car, r_{1:5}, t)$
$D_N(k, tire, r_{1:5}, t)$
r_1
r_2
r_3
r_4
r_5

Experiments

Classification Accuracy on TRECVID MED



DET Curves for all 15 Events



Conclusion

- Significant performance increase in Multimedia Event Classification Task
- Provides complementary discriminative information to current state-of-the-art image representations such as Spatial Pyramid Matching and Object Bank

References

S. Lazebnik, C. Schmid, and J. Ponce. Beyond bags of features: Spatial pyramid matching for recognizing natural scene categories. CVPR, 2006.

L.-J. Li, H. Su, E. P. Xing, and L. Fei-Fei. Object bank: A high-level image representation for scene classification & semantic feature sparsification. NIPS, 2010.

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