Semantic Video Classification by Fusing Multimodal High-Level Features

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1. Objective of Our Work

Semantic Video Classification

Automatic Video Classification by Combining High-level Features

2. Related Work

① Bank Representation

➢ Object Bank

[L. Li, 10], Object Bank models an imaged based on the objects that appear in it

➢ Action Bank

[S. Sadanand & J. Corso, 12], Action Bank uses action detectors to form the video representation

② Improved Densed Trajectories

[H. Wang, 13], Dense Trajectories samples dense points & tracks them from optical flow

③ Two-Stream Convolutional Networks for Action Recognition

[K. Simonyan, 14], Deep learning method that combines still-frames and motion

3. Overview

Main Steps of Our Method:

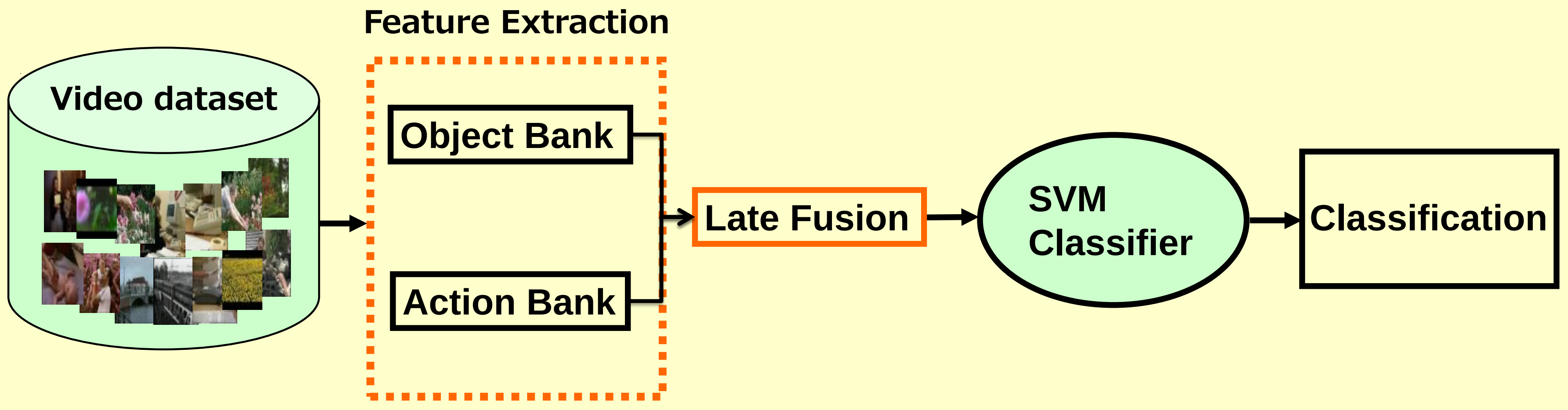
① Object Bank & Action Bank feature extraction

Feature vectors are mean-pooled across each detector to represent presence or absence of objects/actions

② Fusion of features

Using late fusion method of weighted averaging

③ Train an SVM classifier



Feature Extraction

Video dataset

Object Bank

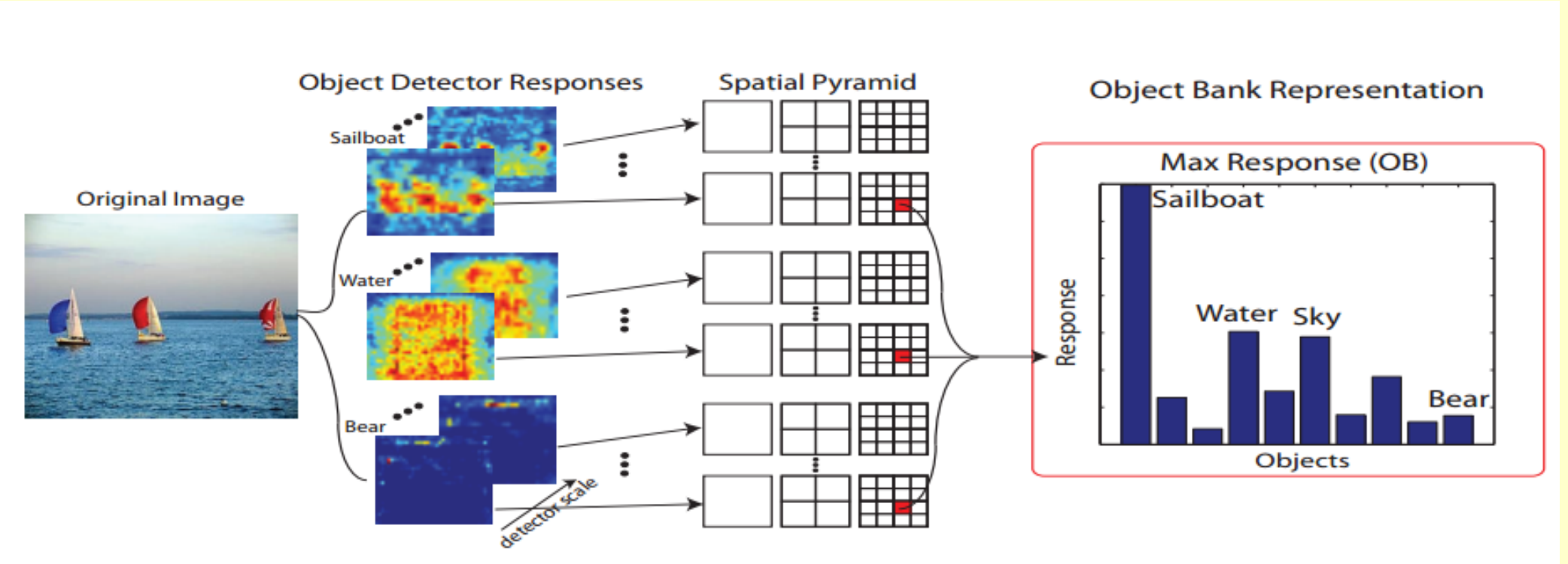
Action Bank

Late Fusion

SVM Classifier

Classification

Example: Images with similar low-level image information

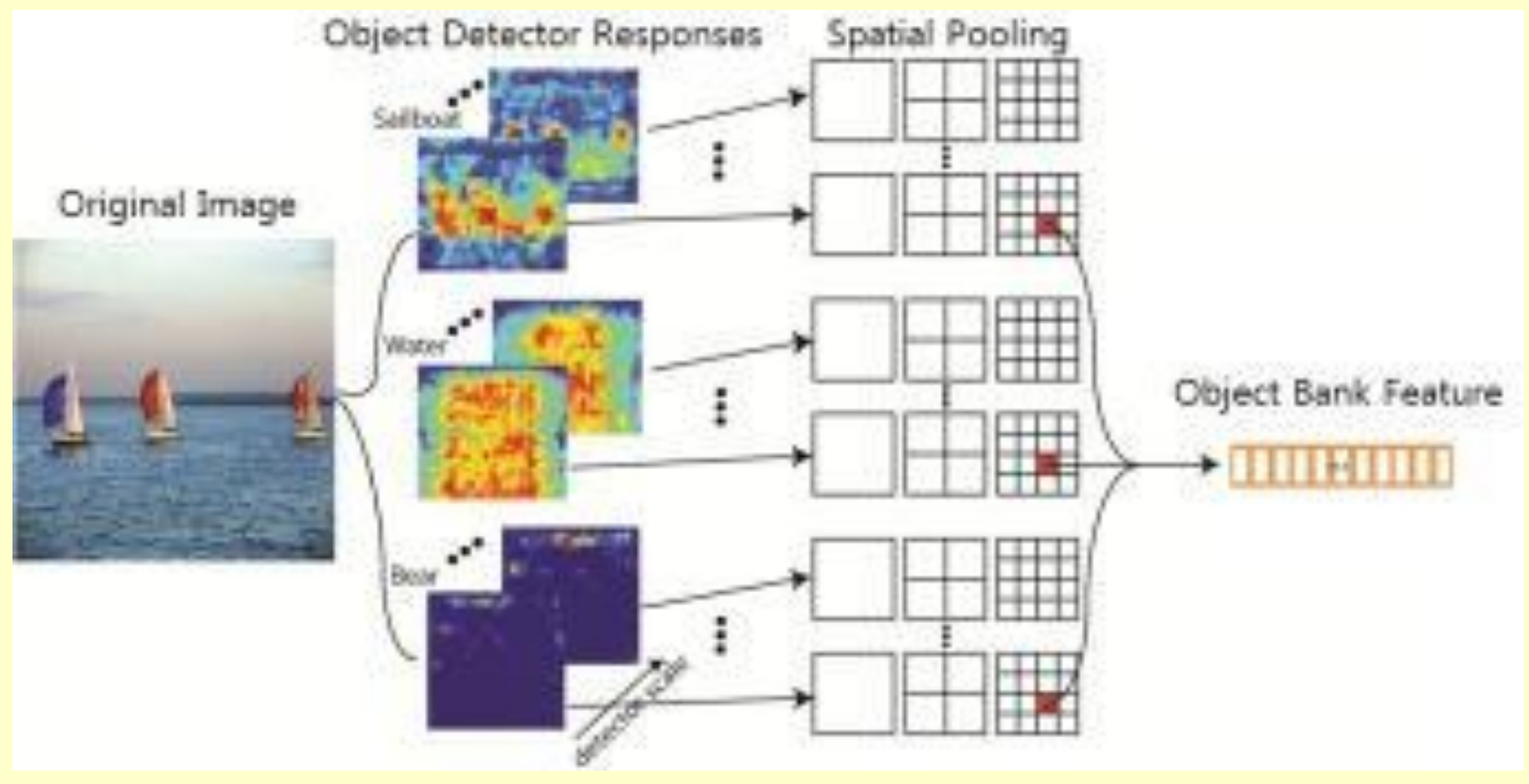


4. Details of Our Method

① Feature Extraction & Preprocessing

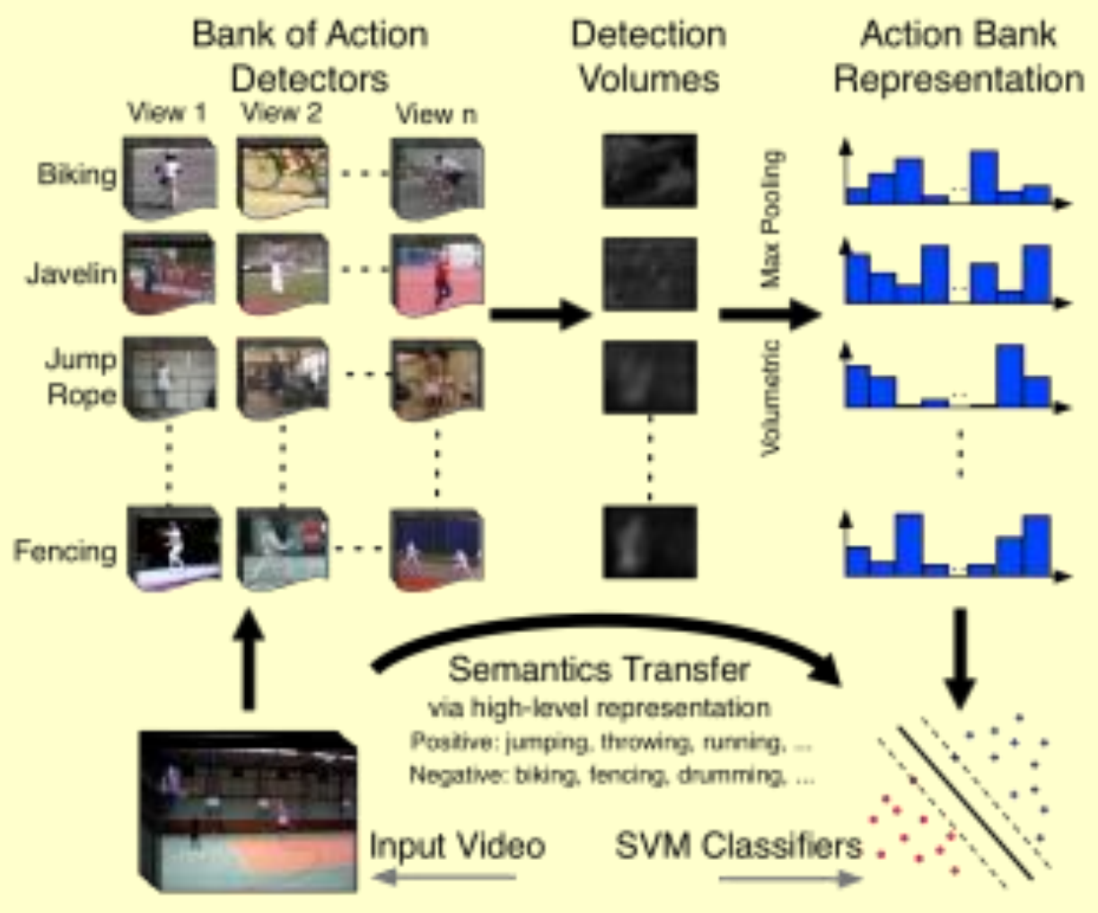
①.1: Object Bank

- ◆ **Key-frame are extracted from the raw input videos**
- ◆ **Images constituting the video are max-pooled on all dimensions**



①.2 : Action Bank

- ◆ **Features are extracted directly from the input videos**
- ◆ **Each detector is mean-pooled**



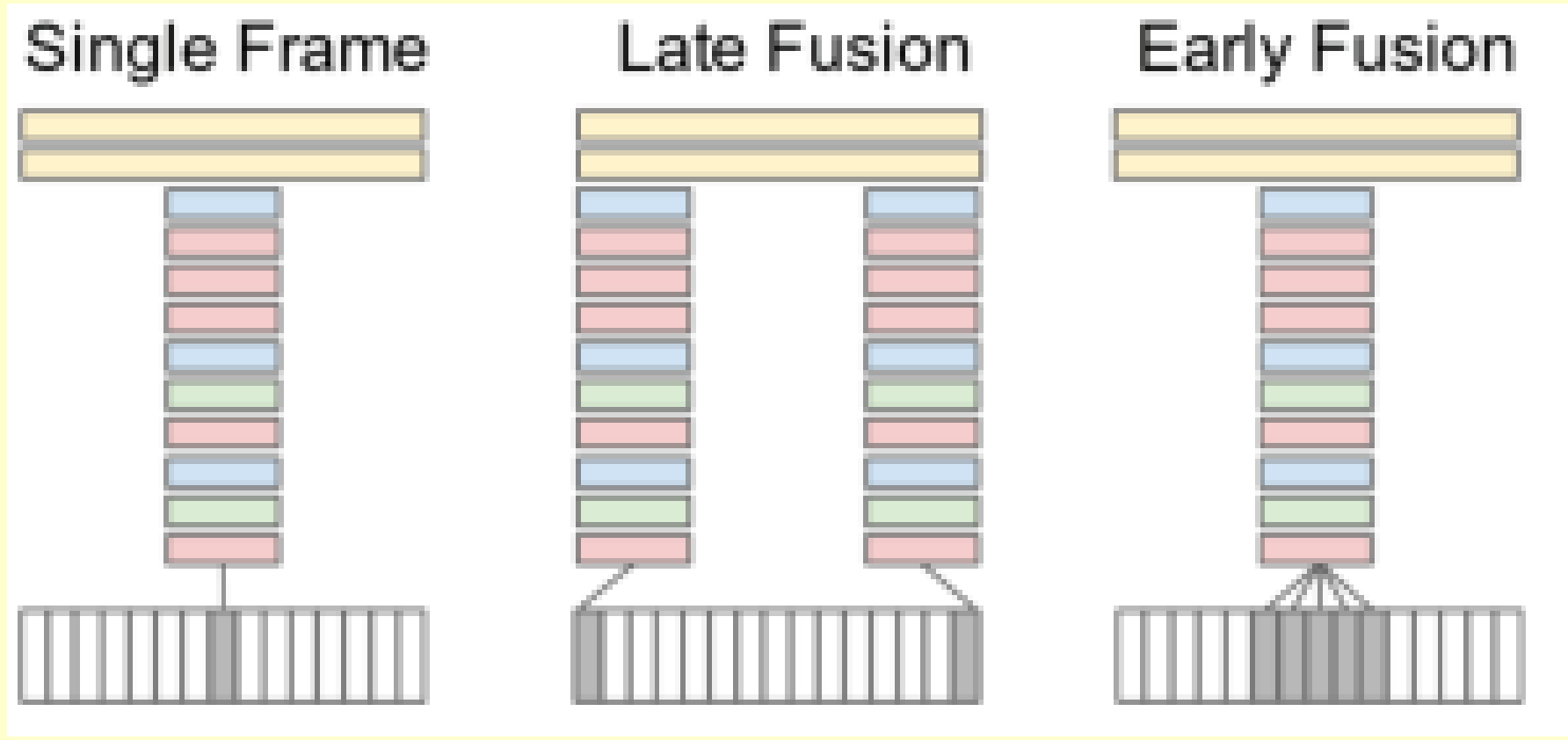
② Feature Fusion Methods

◆ **Weight Averaging (WA) as late fusion method to combine both Features**

$$p(c \mid x_1, \ldots, x_M) = \sum_{i=1}^{M} p(c \mid x_i)\alpha_i$$

c: video class, xi: individual feature, M: number of features, α: weight value

◆ **Weights α selected by exhaustive grid search**



③ Training of Classifiers

◆**SVM was used for classification with kernels and hyper-parameters selected through grid-search and cross-validation**

5. Experiment

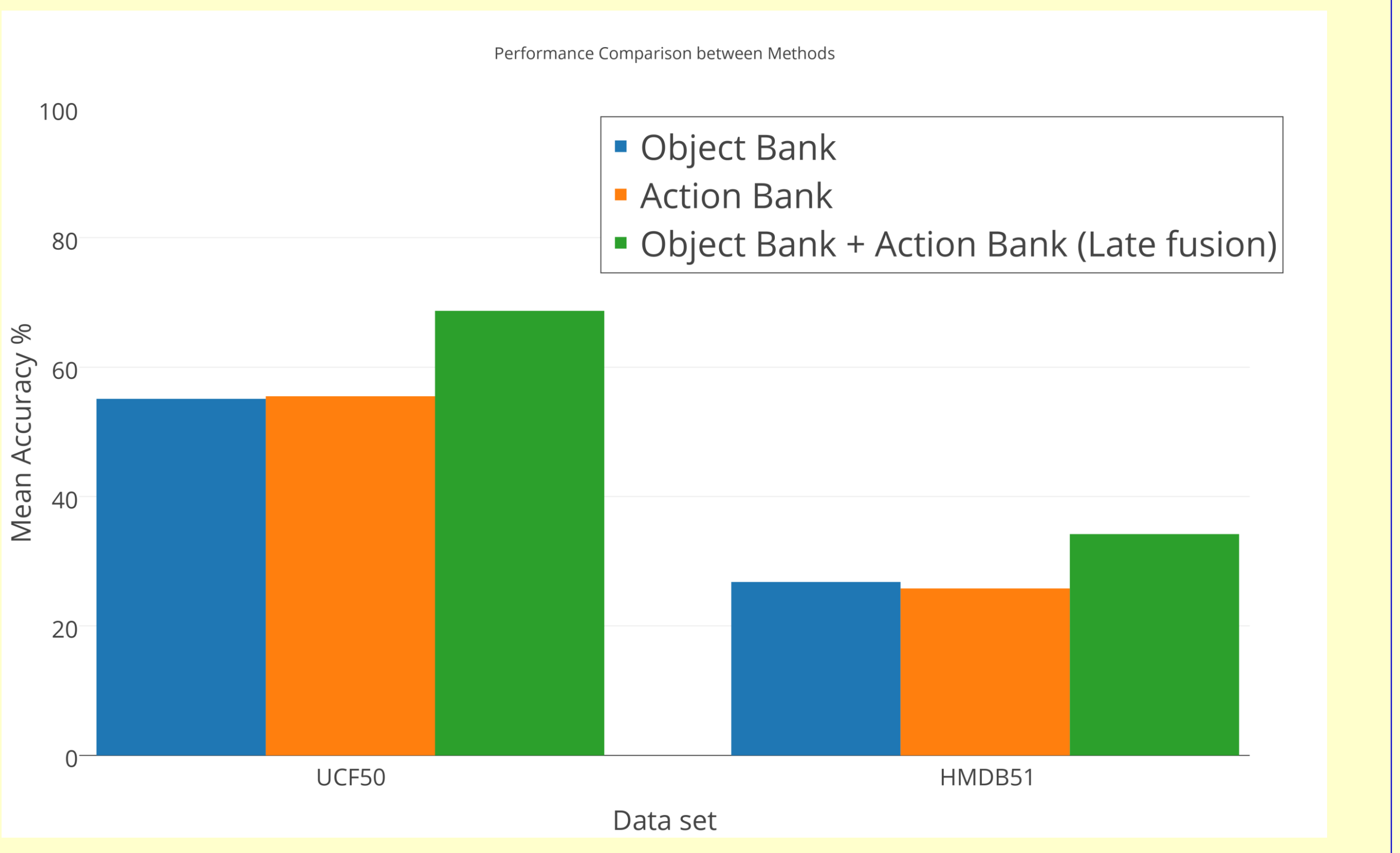
◆UCF50 & HMDB51 Data set:
Over 6000 videos which more than 50 categories in each datasets

◆Cross-validation: Leave-one group out & Three train splits

◆Evaluation Method: Macc.
Mean Accuracy

Example: Key frames from the UCF50 video data set

Classification results



Comparison with each method individually, And with late fusion of OB and AB

6. Conclusion

- Object Bank & Action Bank are complementary when performing fusion on these features
- Promising potential with improvements in the quality and number of action and object detectors
- Future work including detailed investigation on deep learning methods