

Developing Open Source code for Pyramidal Histogram Feature Sets

Classifying an image by the object category that it contains has been the subject of many recent papers in the field of Computer Vision.

Here I introduce the trainable descriptors that can learn the degree of spatial correspondence between image instances of a class for discriminative classification.

IMPORTANCE OF PYRAMIDAL HISTOGRAM FEATURE SETS

Bosch and Zissermann technique scores over other Image classification algorithms (existent today) in terms of accuracy which is evident from the experiments I have done for different algorithms. This technique has the accuracy of about 80%(A. Bosch, A. Zisserman, and X. Munoz. Image classification using random forests and ferns. 2007.) which is much higher than those of other algorithms.

Bosch and Zissermann algorithm uses Pyramidal Histogram Feature Sets for representation of spatial layout of images.

Hence these descriptors are frequently used nowadays in image classification algorithms but are not yet been implemented in OpenCV library. So it will be a great contribution to OpenCV library as developers can directly use the feature generation code and concentrate more on developing applications.

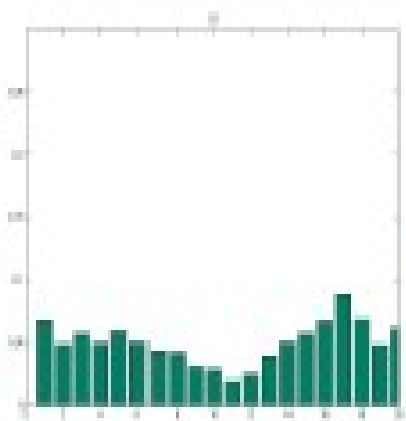
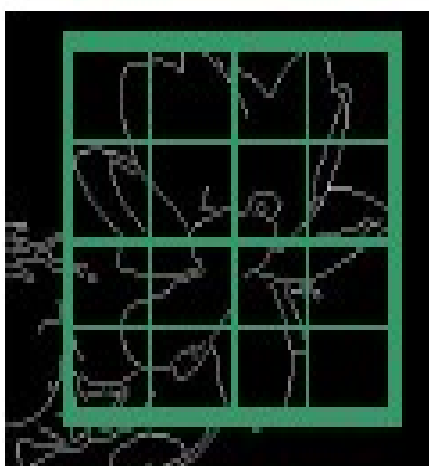
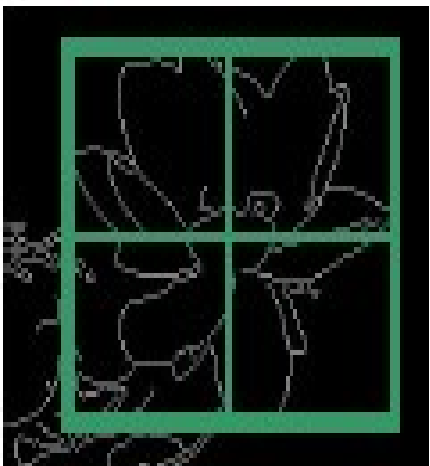
AIM

Considering the utmost importance of utility of these Pyramidal Histogram Feature Sets for image classification and lack of functions in OpenCV library for ready-made use by developers, our purpose is to write a C++ implementation for these feature sets.

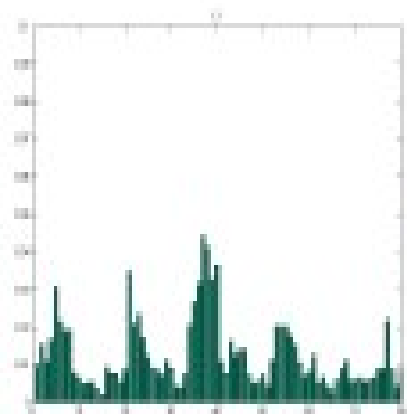
Work Done

Characteristics and importance of feature sets like PHOG and PHOW were studied thoroughly.
C++ implementation of the feature sets PHOG and PHOW has been done successfully.

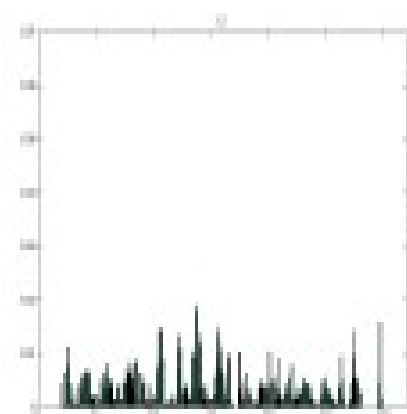
Part 1: Pyramid Histogram of Oriented Gradients



+



+



||
PHOG

Edge detection is done through Canny Edge Detector

Gradients are calculated in the resultant matrix and are subsequently inserted in a bin according to the angle of the gradient

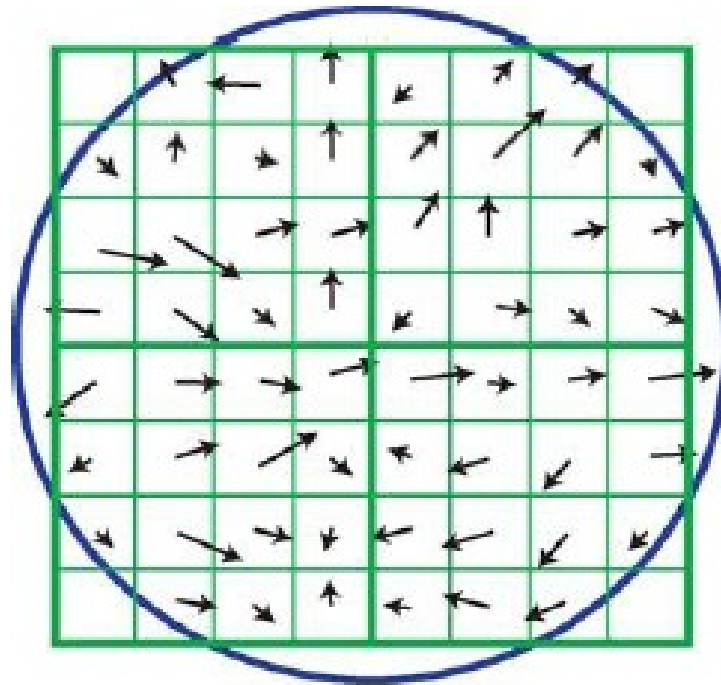


Image gradients



Part 2: Pyramid Histogram of Visual Words

Object

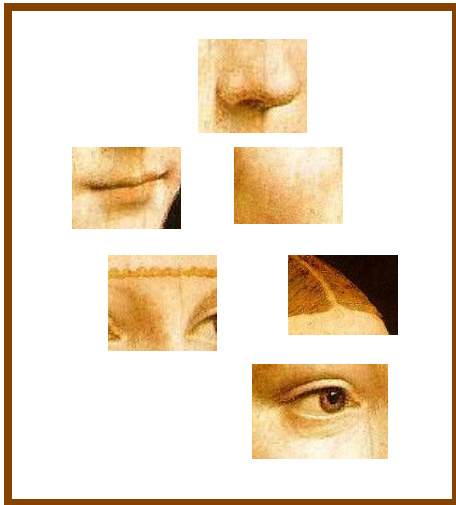


Bag of 'words'

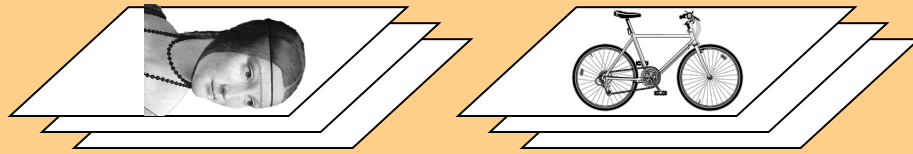


A clarification: definition of “BoW”

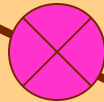
- Looser definition
 - Independent features



learning



feature detection
& representation



codewords dictionary

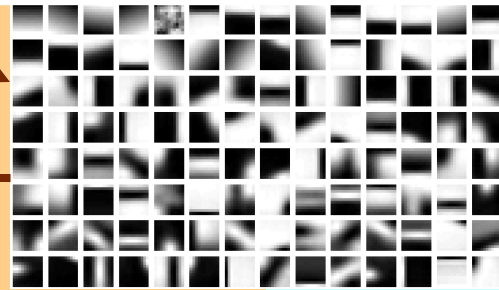
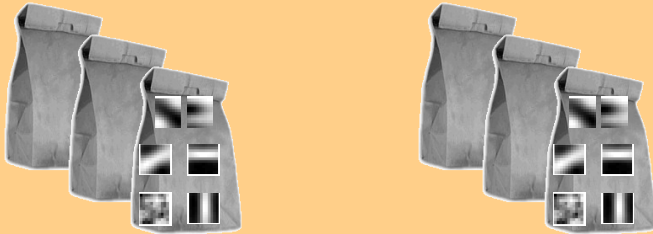
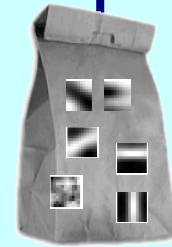
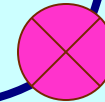


image representation



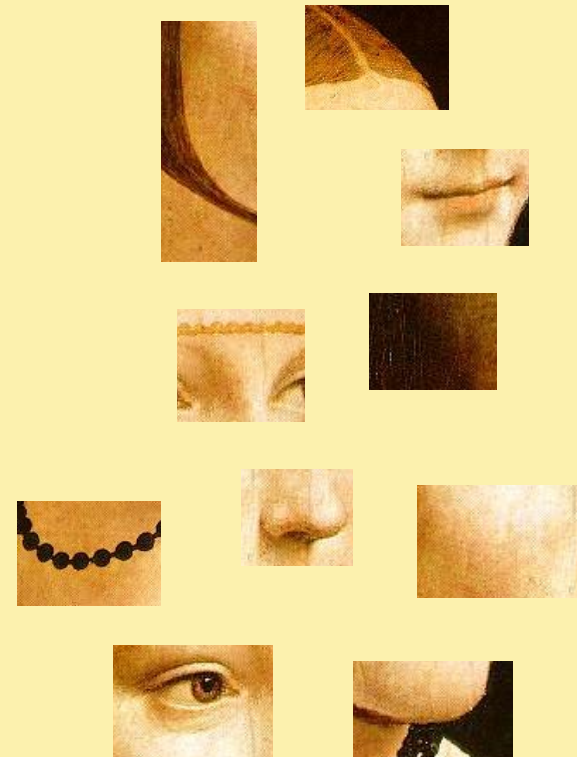
**category models
(and/or) classifiers**

recognition



**category
decision**

1. Feature detection and representation

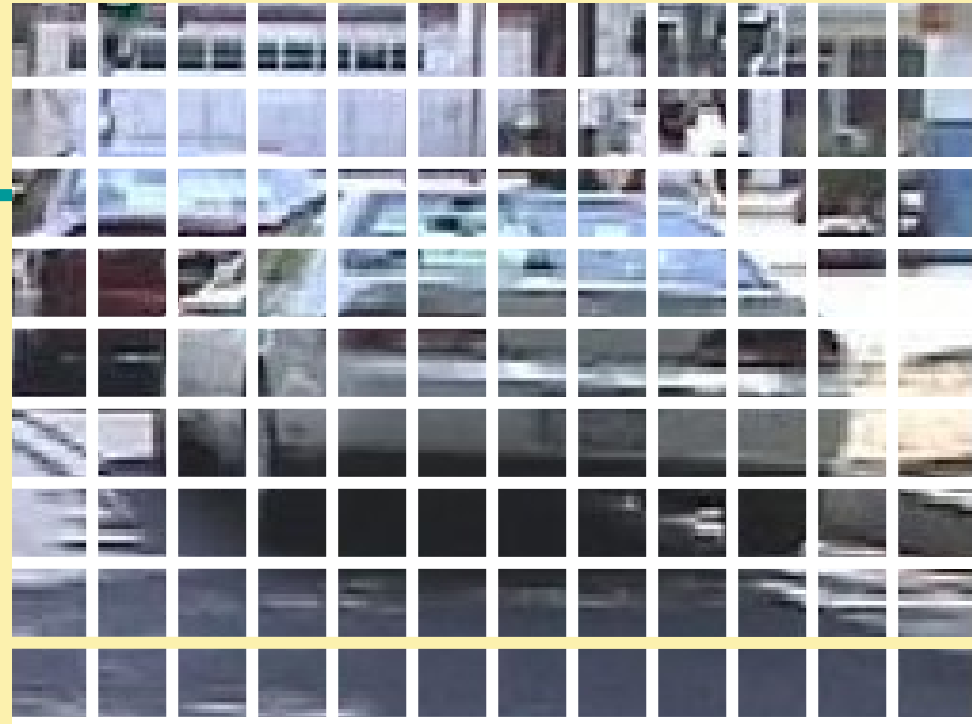
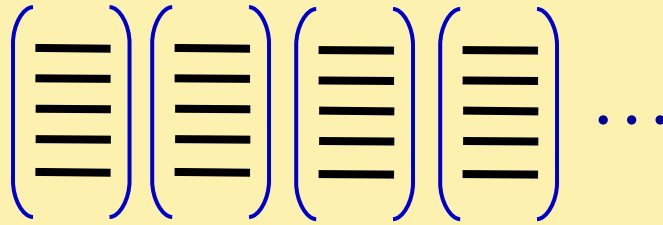


1. Feature detection and representation

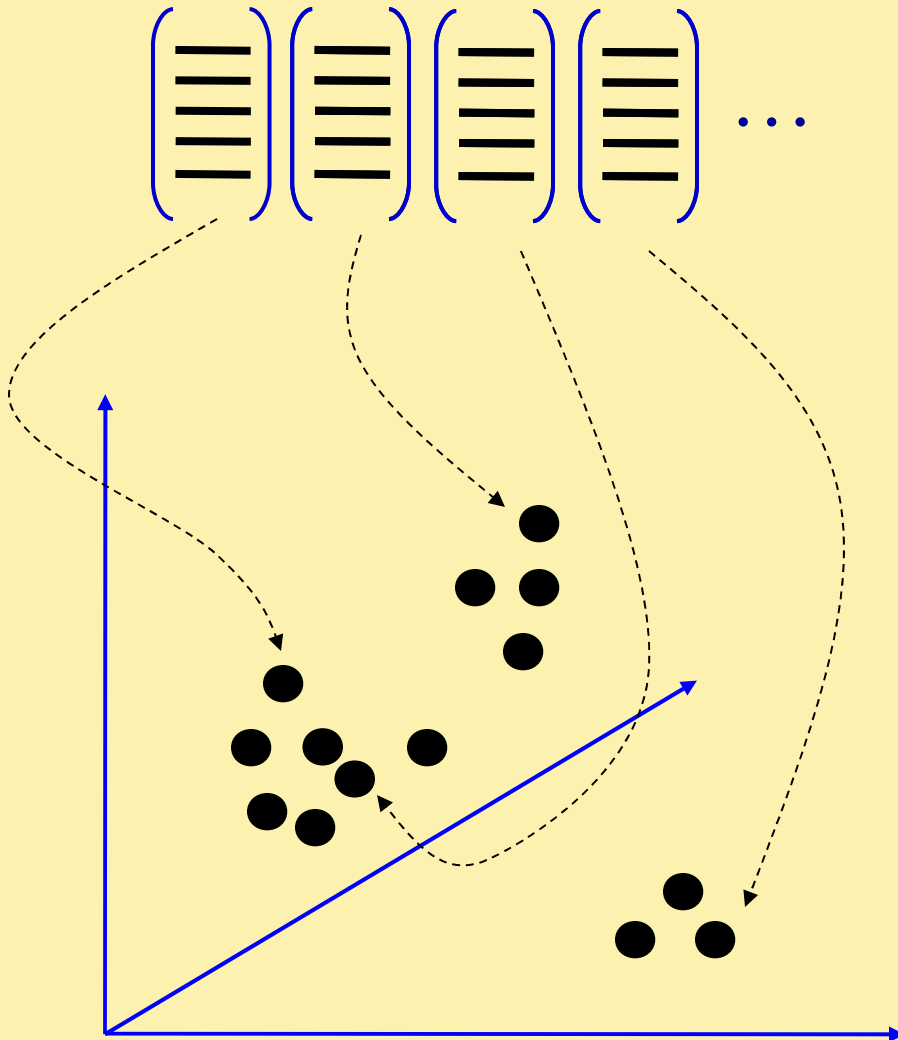
- Regular grid
 - Vogel & Schiele, 2003
 - Fei-Fei & Perona, 2005



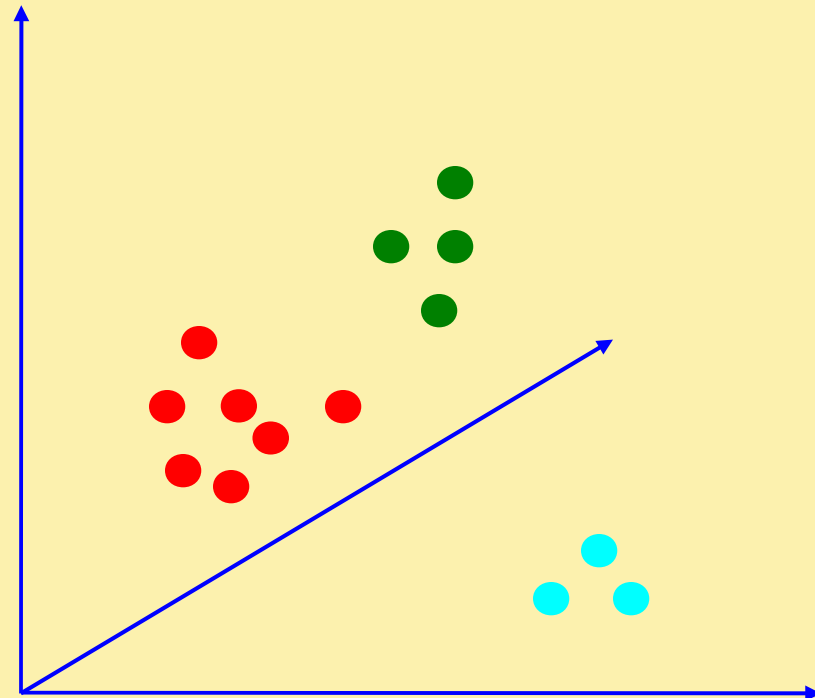
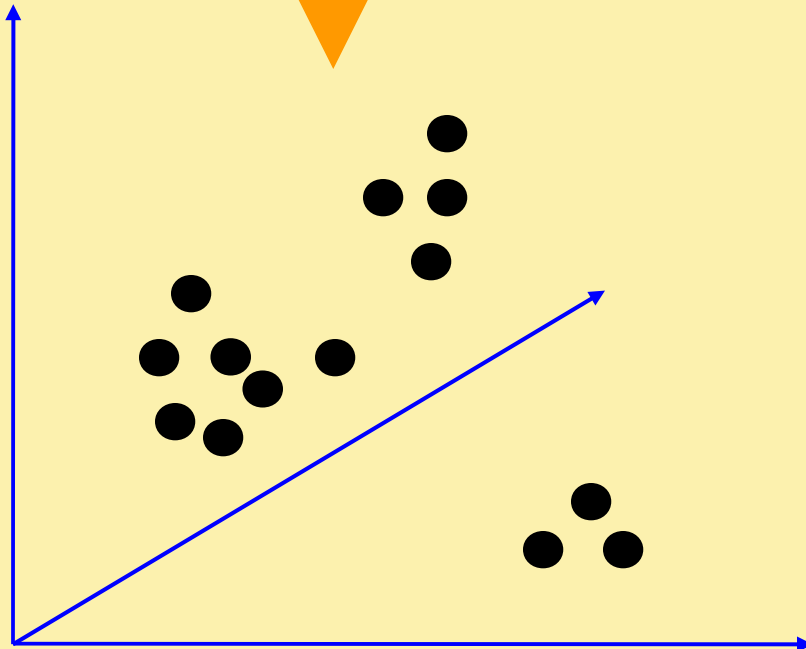
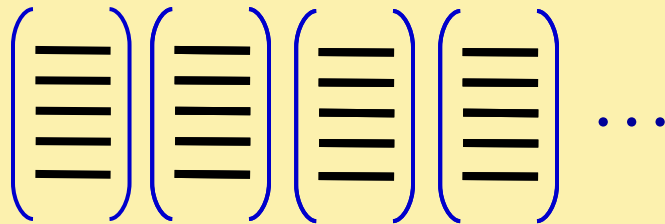
1. Feature detection and representation



2. Codewords dictionary formation

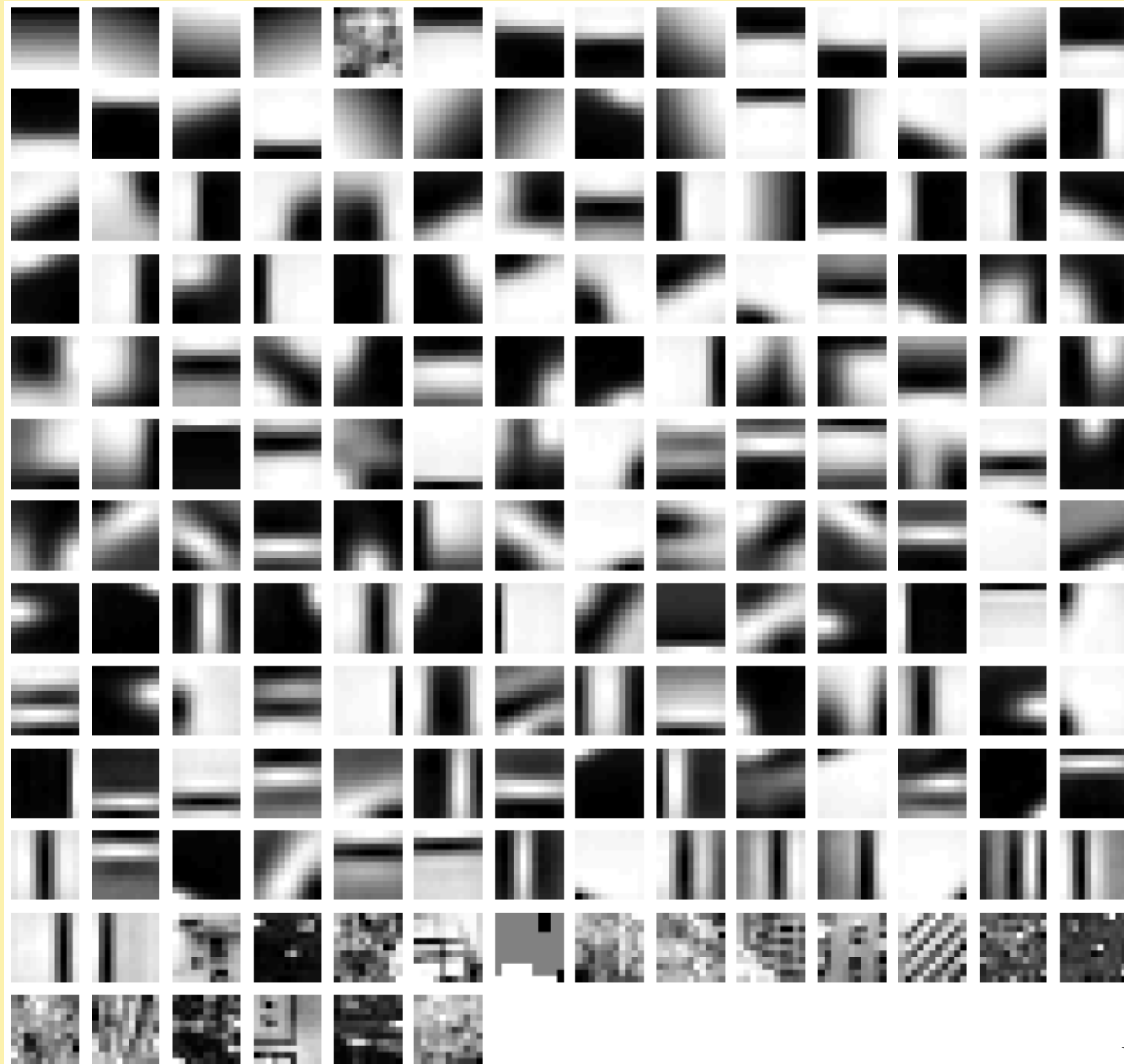


2. Codewords dictionary formation

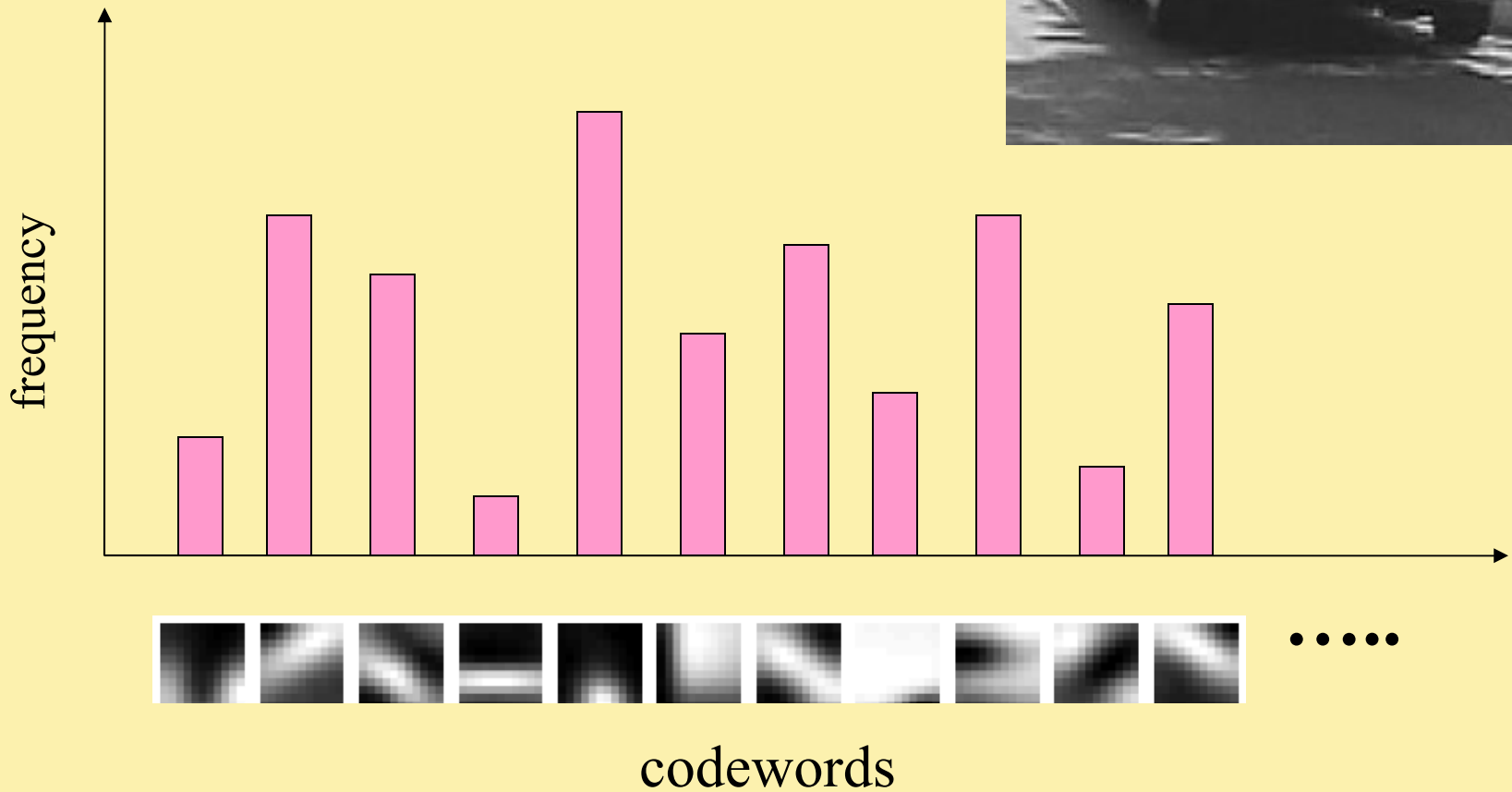


Vector quantization

2. Codewords dictionary formation



3. Image representation



Work Done

C++ implementation of the feature sets PHOG and PHOW has been done successfully.

Authors of Bosch and Zesseemann algorithms had written a MATLAB code for these features. I tested the result of my implementation with their code and it was comparable.

PHOG code have been mailed to OpenCV community for further considerations.

References

- [1] A. Bosch, A. Zisserman, and X. Munoz. Image classification using random forests and ferns. 2007.
- [2] "Saurabh Daptartdar". "*Explorations on a neurologically plausible model of image object classification*". PhD thesis, 2009.
- [3] Christoph Lampert. Detecting objects in large image collection and videos by efficient subimage retrieval. 2009.
- [4] Jim Mutch and David Lowe. Object recognition with sparse, localized features. 2006.
- [5] H. Jhuang T. Serre L. Wolf T. Poggio. Biologically inspired system for action recognition. 2007.
- [6] Poggio" "Riesenhuber. "hierarchical model of object recognition in cortex". 1999.
- [7] T. Serre, L. Wolf, S. Bileschi, M. Riesenhuber, and T. Poggio. Robust object recognition with cortex-like mechanisms. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, pages 411–426, 2007.
- [8] <http://cbcl.mit.edu/software-datasets/>
- [9] <http://www.robots.ox.ac.uk/~vgg/index.html>