

## ABSTRACT

Under the “highly-emotional” atmosphere of object retrieval applications, the author selected an interesting and challenging algorithm, multi-path sparse coding via hierarchical matching pursuit (M-HMP), as his last undergraduate research topic, the core of his bachelor’s graduation thesis. The algorithm mentioned above was first published at IEEE Conference on Computer Vision and Pattern Recognition (CVPR’2013), authored by Dr. Liefeng Bo, Dr. Xiaofeng Ren and Dr. Dieter Fox. The author of this thesis first re-implement the multi-path sparse coding algorithm presented in Liefeng Bo’s work, and then test the obtained sparse codes (matrix) by using them in retrieval experiment, on three different 3-D databases. A simple-but-novel nonlinear mapping approach, row pooling & deleting on sorted rows of the matrix, is proposed and tested to reduce dimensionality of the sparse codes.

Experiment results shows that 1) multi-angle models achieves much superior retrieval performance than the single-angle model, and meanwhile, little difference in performance is detected among the cases when the number of angles per model are larger than 90; 2) combinations of independently-superior (sparse codes of) paths can achieve better retrieval results than those of their working alone; 3) row pooling & deleting on sorted rows (by variance of each row), a nonlinear mapping approach, effectively reduces row dimensionality of the sparse codes matrix, achieving comparable retrieval performance with that of before reduction, and also reduces average retrieving time cost significantly (from  $10^1$  s to less than  $10^{-1}$  s).

The highly-motivated author call for further research/exploration upon this interesting and gorgeous multi-path image sparse coding architecture, mainly focusing on the reduction (or “distillation”, more appropriately) of the high-dimensionality sparse codes matrix. To achieve this, fundamental principles of the dictionary learning phase should be observed more calculatingly, along with a comprehensive analysis of the images in 3-D databases. Our final goal, building a system that promotes the retrieval speed (“fast algorithm”) meanwhile maintaining a comparative retrieval performance (by referring to Precision-Recall curve) at the same or even superior level with that of before dimensionality reduction, will be intriguing continuously.

**Keywords:** object retrieval, multi-path sparse coding, hierarchical matching pursuit,