HAND SHAPE RECOGNITION USING SHIFT-INVARIANCE FEATURE FROM THE MULTI-VIEWPOINT IMAGES

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Abstract

We propose a method of recognizing a hand shape using multi-viewpoint images[1]. The recognition of a hand is a difficult problem, as its appearance changes largely depending on view point. To overcome this problem, we apply the Kernel Orthogonal Mutual Subspace Method(KOMSM)[2] to shift-invariance features from multiple view images of a hand. The validity of the proposed method is demonstrated through the evaluation experiments using the multiple view images of 16 kinds of hand shapes.

Goal and Problems

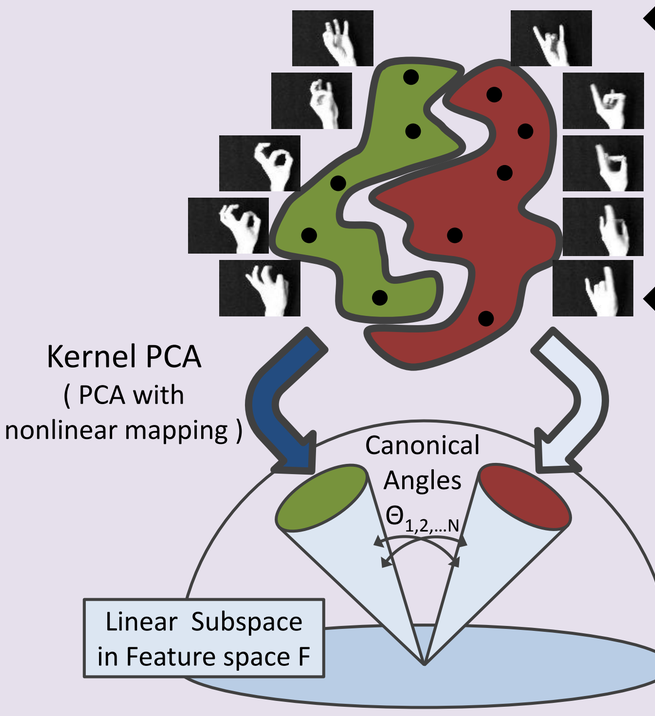
To realize a method of recognizing hand shape, which is robust to the influence of various changes.

Prob. 1: The influence of changes in the appearance of a hand : due to view points, illumination conditions, individual characteristics.
◆ We use the multi-viewpoint image set for recognition based on KOMSM[2].

Prob.2: Difficulty of segmentation of a hand from an image:
◆We avoid the explicit segmentation of a hand by introducing shift-invariant feature (HLAC: Higher-order Local Auto-Correlation Feature[3], 2D-DFT, etc.).

Effectiveness of Multi-Viewpoint image

How is similarity between two multi-viewpoint images set measured ?

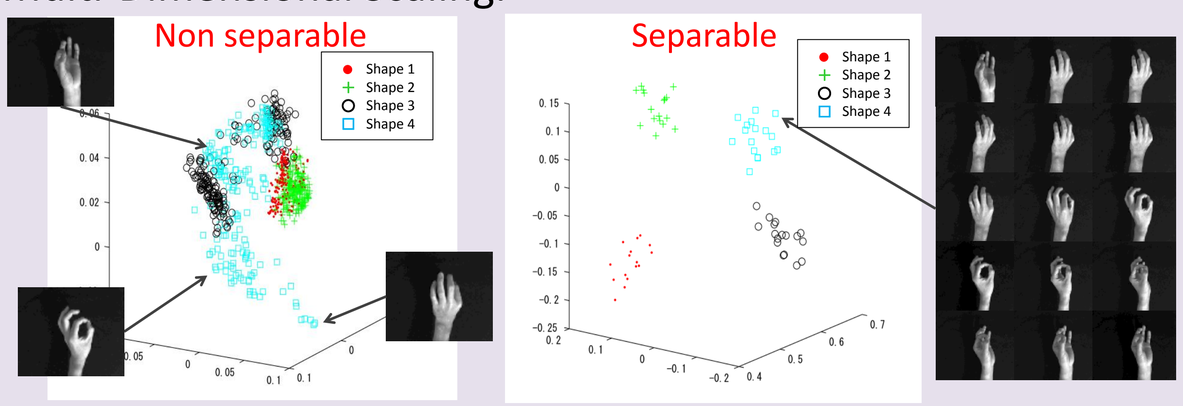


◆ The distributions of hand-shapes are represented by linear subspace in high-dimensional Feature space F, using Kernel PCA.
◆ The similarity is measured by canonical angles, θ, between them.

Similarity between tow Subspaces

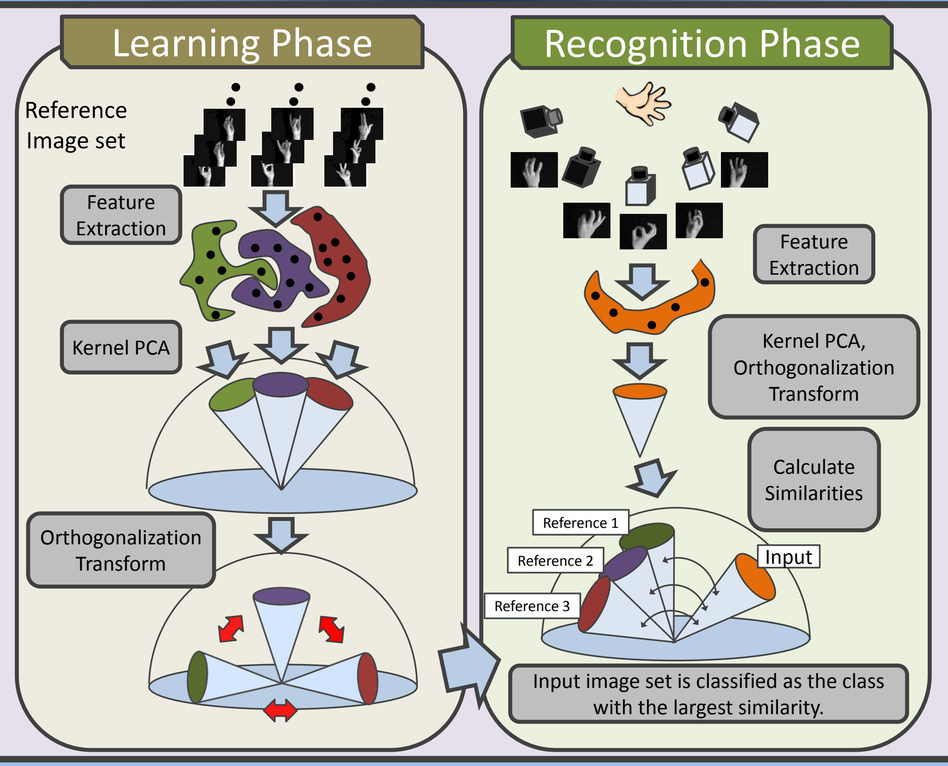
$$Sim = \frac{1}{N}\sum_{n=1}^{N}\cos^2\theta_n$$

◆ Visualization of the relation of 4 kinds of hand shapes by Multi-Dimensional Scaling.



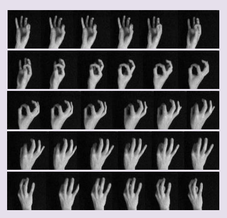
Left: The relation among single view images. Each marker indicates an image of a hand-shape from different viewpoint.
Right: The relation among subspaces based on canonical angles, where each subspace represents the set of multiple view images of a hand-shape.

The flow of hand shape recognition based on KOMSM

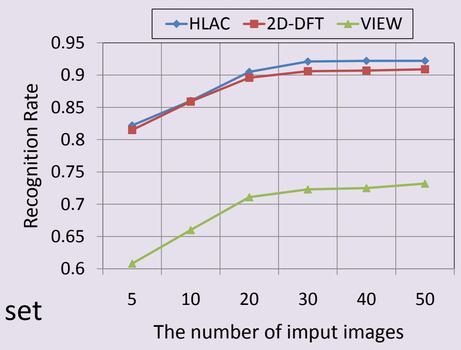


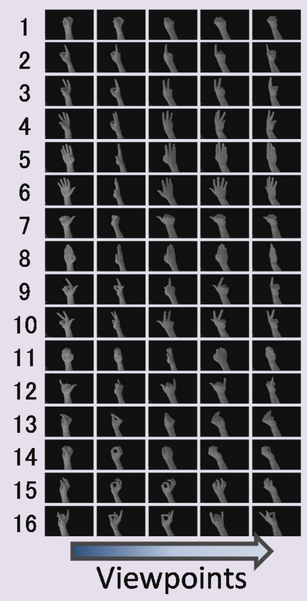
Experimental results

◆ Sixteen kinds of hand shapes with various view-pints, from 20 subjects.
◆ Evaluation with Leave one-out cross validation for 20 subjects.



Example of input image set





◆ The performance was more improved as the number of input patterns increased.
◆ Using the shift-invariance features (HLAC, 2D-DFT) obtained from multiple view images are essential to achieve high performance hand shape recognition.

Conclusion

We have proposed a robust and precise hand recognition based on KOMSM using shift-invariance features from the multi-viewpoint images.

[1]Y. Ohkawa, K. Fukui, "Hand Shape Recognition based on Kernel Orthogonal Mutual Subspace Method", IAPR International Conference on Machine Vision and Applications (MVA2009), pp.122-125, 2009.
[2] Kazuhiro Fukui, Osamu Yamaguchi, “The Kernel Orthogonal Mutual Subspace Method and its Application to 3D Object Recognition”, ACCV2007,Part-II, pp.467-476, 2007.
[3] N. Otsu and T. Kurita. “A new scheme for practical flexible and intelligent vision systems “, IAPR Workshop on Computer Vision, pp.431–435, 1988.