

Successive Refinement Strategies for Complex Pattern Recognition

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A major problem in pattern recognition is to find tractable, statistical models that characterize the observed patterns to the extent that recognition becomes feasible? Since the observed patterns are very high dimensional (e.g. images), most pattern recognition techniques utilize a dimension reduction technique followed by a density estimation and a computation of divergence between the estimated densities. ICA, PCA, wavelet decompositions, landmarks, active contours, 3D templates, and many others, accompanied with their probability models, have been proposed as representations.

We argue that in case of complex patterns, such as images of human faces, a better strategy is to use a sequence of representations of increasing complexity, starting from simple pixel based features to more advanced 3D templates, each contributing to inferences on the same hypothesis set. Proper choices of probability models, at each level of representation, enables successive refinement of the hypothesis set. One such probability model, called the *Bessel K form*, has shown remarkable efficiency and success in modeling spectral representations of images and in pruning hypothesis for object recognition. Successive inference is very useful in intelligent data collection, e.g. the problem of object recognition using active multi-sensor (video, IR, range) imaging: Conditioned on the current level of inference, what next observation(s) maximally refines the hypothesis set?