Pattern Recognition without Features

Pattern recognition is usually implemented through the use of a selected set of plausible features that characterise the data being studied. In addition it is also necessary to identify a set of data that represents the problem area and is used to train and adjust parameters to maximise recognition performance. However, in practice it is never possible to be certain that the features chosen and the data selected will anticipate and encompass all future situations in the real world. Indeed when facial images, for example, are distorted by illumination, pose, occlusion, hair, expression and other factors, some features become inappropriate and contribute noise to the discrimination on unseen data. Of course, where it is possible to obtain theoretically representative sets of training data and recognition features, optimal performance can be attained.

A new approach is proposed which extracts structural 'commonality' to determine similarity rather than employ distances in feature space [1]. Structure that is common between pairs of images is detected and uses the extent of such structure to measure similarity. In all cases the commonality will be different and will be dependent on the content of each image pair. In this case the size of the largest structure found to match both patterns is the number of nodes in the corresponding fully connected maximal graph or clique. Nodes correspond to pixels and match if the brightness gradient vector directions match within a certain threshold angle. In addition all pairs of matching nodes in the clique possess the same relative orientation within a second threshold angle. Patterns are automatically co-located in the process. This similarity measure is independent of scale and brightness, and to a certain extent, of image orientation.

The method has been applied to the Yale database A [2] in which a single reference face from each individual is compared with all other data to obtain a 100% result for the first time. There may be connections with neuroscience as it has been shown that certain visual neurons are sensitive to brightness gradient vector orientation [3]. This approach is also being applied to speech and text data.

[1] F W M Stentiford, "Face recognition by detection of matching cliques of points," Image Processing Machine Vision Applications VII Conf., IS&T/SPIE Electronic Imaging 2014, San Francisco, 2 - 6 Feb. 2014.

[2] Yale Face Database, http://cvc.yale.edu/projects/yalefaces/yalefaces.html.

[3] Podvigin, N. F., Poeppel, E., Kiseleva, N.B., Kozlov, I.V., Vershinina, E.A., and Granstrem, M.P., "The sensitivity of neurons in the lateral geniculate body of the cat to the orientation vectors of brightness gradients," Neuroscience and Behavioral Physiology, vol. 31, no. 6, pp. 657-668, 2001.