

Hand Gesture Recognition for Sign Language: A New Higher Order Fuzzy HMM Approach

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Abstract : Sign Languages (SL) are the most accomplished forms of gestural communication. Therefore, their automatic analysis is a real challenge, which is interestingly implied to their lexical and syntactic organization levels. Hidden Markov models (HMM's) have been used prominently and successfully in speech recognition and, more recently, in handwriting recognition. Consequently, they seem ideal for visual recognition of complex, structured hand gestures such as are found in sign language. In this paper, several results concerning static hand gesture recognition using an algorithm based on Type-2 Fuzzy HMM (T2FHMM) are presented. The features used as observables in the training as well as in the recognition phases are based on Singular Value Decomposition (SVD). SVD is an extension of Eigen decomposition to suit non-square matrices to reduce multi attribute hand gesture data to feature vectors. SVD optimally exposes the geometric structure of a matrix. In our approach, we replace the basic HMM arithmetic operators by some adequate Type-2 fuzzy operators that permits us to relax the additive constraint of probability measures. Therefore, T2FHMMs are able to handle both random and fuzzy uncertainties existing universally in the sequential data. Experimental results show that T2FHMMs can effectively handle noise and dialect uncertainties in hand signals besides a better classification performance than the classical HMMs. The recognition rate of the proposed system is 100% for uniform hand images and 86.21% for cluttered hand images.

Keywords : hand gesture recognition, hand detection, type-2 fuzzy logic, hidden Markov Model

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