Abstract

A covariate in face recognition can be defined as an effect that independently increases the intra-class variability or decreases the inter-class variability or both. Covariates such as pose, illumination, expression, aging, and disguise are established and extensively studied in literature and are categorized as existing covariates of face recognition. However, ever increasing applications of face recognition have instigated many new and exciting scenarios such as matching forensic sketches to mug-shot photos, faces altered due to plastic surgery, low resolution surveillance images, and individual from videos. These covariates are categorized as emerging covariates of face recognition, which is the primary emphasis of this dissertation. One of the important cues in solving crimes and apprehending criminals is matching forensic sketches with digital face images. The first contribution of this dissertation is a memetically optimized multi-scale circular Weber’s local descriptor (MCWLD) for matching forensic sketches with digital face images. This dissertation presents an automated algorithm to extract discriminative information from local regions of both sketches and digital images using MCWLD. An evolutionary memetic optimization is proposed to assign optimal weights to every local facial region to boost the identification performance. Since, forensic sketches and digital images can be of poor quality, a pre-processing technique is also used to enhance the quality of images. Results on different sketch databases, including forensic sketch database, illustrate the efficacy of the proposed algorithm. Widespread acceptability and use of biometrics for person authentication has instigated several techniques for evading identification such as altering facial appearance using surgical procedures. These procedures modify both the shape and texture of facial features to varying degrees and thus degrade the performance of face recognition when matching pre- and post-surgery images. The second contribution of this dissertation is a multi-objective evolutionary granular algorithm for matching face images altered due to plastic surgery procedures.
The algorithm first generates non-disjoint face granules at multiple levels of granularity. The granular information is assimilated using a multi-objective genetic algorithm that simultaneously optimizes the selection of feature extractor for each face granule along with the weights of individual granules. On IIIT-D plastic surgery database, the proposed algorithm yields the state-of-the-art performance. Face recognition performance degrades when a low resolution face image captured in unconstrained settings, such as surveillance, is matched with high resolution gallery images. The primary challenge is to extract discriminative features from the limited biometric content in low resolution images and match it with information-rich high resolution face images. The problem of cross-resolution face matching is further alleviated when there is limited labeled low resolution training data. The third contribution of this dissertation is co-transfer learning framework, a cross pollination of transfer learning and co-training paradigms, for enhancing the performance of cross-resolution face recognition. The transfer learning component transfers the knowledge that is learned while matching high resolution face images during training for matching low resolution probe images with high resolution gallery during testing. On the other hand, co-training component facilitates this knowledge transfer by assigning pseudo labels to unlabeled probe instances in the target domain. Experiments on a synthetic, three low resolution surveillance quality face databases, and real world examples show the efficacy of the proposed co-transfer learning algorithm as compared to other approaches. Due to prevalent applications and availability of large intra-personal variations, videos have gained significant attention for face recognition. Unlike still face images, videos provide abundant information that can be leveraged to compensate for variations in intra-personal variations and enhance face recognition performance. The fourth contribution of this dissertation is a video based face recognition algorithm which computes a discriminative video signature as an ordered (ranked) list of still face images from a large dictionary. A three stage approach is developed for optimizing ranked lists across multiple video frames and fusing them into a single composite ordered list to compute the video signature. The signature embeds diverse intra-personal variations and facilitates in matching two videos across large variations. Results obtained on Youtube and MBGC v2 video databases show the effectiveness of the proposed algorithm.