

RECOGNIZING PARTIALLY-OCCLUDED FACES BY RECOVERING NORMALIZED FACIAL APPEARANCE

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ABSTRACT. *This paper proposes a novel approach to recognize partially-occluded and -damaged face images. Two novel technical contributions of the proposed approach include an iterative face recovery method and a face recognition method called the recognition-by-input-approximation (RBIA) method. The iterative face recovery method can nicely recover the lost face textures of occluded or damaged areas, while well preserving the original input illumination on the recovered faces. With the RBIA method, our experiments on testing the public AR face database show that the achieved recognition rate in recognizing faces with occlusions from sunglasses, gauze masks and scarves, under different illumination conditions, is 92.5%.*

Keywords: Biometrics, Face recognition, Principal component analysis, Illumination adjustment, Face texture recovery, Partial occlusions, Facial appearance

1. **Introduction.** Since the 911 terrorist attacks, people start to pay great attention to the issues of public and personal safety. The research and development of various kinds of biometric systems for person identification became attractive for many researchers and companies. Among the many kinds of developed systems, face recognition systems are particularly appealing on the market due to the widespread use of video cameras in our daily lives. Many developed face recognition systems have exhibited good recognition performance under restricted operating environments [1, 2, 3, 4, 5, 6]. However, whenever partial occlusions and illumination changes occur on input faces, these systems may become no longer effective. One way to remedy the degraded effectiveness of recognition is to restore the lost or damaged face appearances before the recognition. Simultaneously, the commonly-used recognition approach which matches the dynamically varied input faces with fixed face templates should be also improved.

In regard to the recovery of occluded face appearances, some researchers have proposed a few methods [7, 8, 9, 10, 11]. In the prior arts, most deal with only small areas of occlusions. For large areas of occlusions, some methods require the manual labeling of the occluded areas to yield better recovery results. What is more, little attention was paid to handle the face recovery under varying illumination conditions. The original illumination appeared on input faces cannot be well preserved on the recovered faces. The face recovery can even fail under odd illumination.

As to the face recognition, the commonly-used eigenface method [12] bases the recognition upon the linear subspace representation of face images. Each input face is matched to some pre-built template models statistically acquired from a set of face samples. The system's tolerance to dynamic variations of face appearances highly relies upon the diversity of the collected face samples. Generally, the large appearance variations caused by