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Orthogonal Filter Banks with Region Log-TiedRank Covariance Matrices for Face Recognition

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ABSTRACT

With the capability of fusing varying features from a specific image region, the Region Covariance Matrices (RCM) image descriptor has been evidenced plausible in face recognition. However, a systematic study for RCM, regarding which features to be fused in particular, remains absent. This paper therefore explores several features derived from the orthogonal filter ensembles, i.e., Identity Transform, Discrete Haar Transform, Discrete Cosine Transform, and Karhunen-Loève Transform, for feature encoding in RCM. Aside from that, we also outline a RCM variant, dubbed Region Log-TiedRank Covariance Matrices (RLTCM) in this paper. The RLTCM descriptor, on average, exhibits dramatic performance gain over RCM as well as state-of-the-art descriptors, especially when probe sets far deviated from the face gallery. Furthermore, we discern that the RLTCM descriptor defined based on Identity Transform, i.e., the simplest form of orthogonal filters, and other learning-free orthogonal filters yield impressive performance on par with the learning-based counterparts.

Keywords—Orthogonal Filters, Region Covariance Matrices, Log-TiedRank, Face Recognition.

1. INTRODUCTION

For face representation, the holistic and the local structural appearance emerge as two prominent approaches in literature. The longstanding holistic approaches, including the principal component analysis (PCA) [1], the linear discriminant analysis (LDA) [2], and other relevant variants [72-74], projects the entire face image, or a sub-block, into a feature subspace for a compact and discriminative representation. In comparison to PCA and LDA, the local appearance approaches that capture the local structures is often shown to be relatively superior. A prevalent local appearance instance is the Local Binary Pattern (LBP) [3], originally proposed by Ojala et al. [4]

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