International Journal of Innovative
Computing, Information and Control
Volume **7**, Number **10**, October **2011**

 ISSN 1349-4198
pp. 5645–5667

INNOVATIVE SPARSE REPRESENTATION ALGORITHMS FOR ROBUST FACE RECOGNITION

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Received May 2010; revised September 2010

Abstract. *In this paper, we propose two innovative and computationally efficient algorithms for robust face recognition, which extend the previous Sparse Representation-based Classification (SRC) algorithm proposed by Wright et al. (2009). The two new algorithms, which are designed for both batch and online modes, operate on matrix representation of images, as opposed to vector representation in SRC, to achieve efficiency whilst maintaining the recognition performance. We first show that, by introducing a matrix representation of images, the size of the ℓ_1-norm problem in SRC is reduced from $O(whN)$ to $O(rN)$, where $r \ll wh$ and thus higher computational efficiency can be obtained. We then show that the computational efficiency can be even enhanced with an online setting where the training images arrive incrementally by exploiting the interlacing property of eigenvalues in the inner product matrix. Finally, we demonstrate the superior computational efficiency and robust performance of the proposed algorithms in both batch and online modes, as compared with the original SRC algorithm through numerous experimental studies.*

Keywords: Sparse representation, Incremental learning, Robust face recognition

1. **Introduction.** In recent years, face recognition has been substantially studied both in the academic community and industry with many significant results achieved [1, 2, 3, 4]. The target of face recognition is to build systems which can perform automatic person identification or verification, when a digital image or a video frame sequence of that person is provided. During the past two decades, a number of face recognition algorithms, as well as their modifications, have been developed. These algorithms can be typically categorized into two classes: appearance-based and model-based approaches.

In appearance-based methods, the features are the pixel intensities in a digital face image. These pixel intensities are the quantized measurements of light radiance emitted from a person along certain rays in space, and contain abundant information which can be used to determine identity from appearance. These methods include: subspace-based methods [5, 6, 7], Hidden Markov Model (HMM) methods [8], Bayesian methods [9], Support Vector Machine (SVM) methods [10], Kernel methods [11, 12, 13, 14] and multi-resolution method [15].