The refining estimates of invariant subspaces through projected nonsymmetric algebraic Riccati equations in high dimensionality reduction and image compression

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In the era of big data, real-world data like digital photographs, MRI scans, or speech signals usually has a high dimensionality, we need to reduce the dimensionality adequated in order to save data in the limited storage space and to transmit efficiently. Some common methods of dimensionality reduction such as singular value decomposition, principal component analysis, independent component analysis and autoencoders. However, for high dimensionality data, these methods suffer from heavily computational complexity and memory requirement in practice. Therefore, we provide an efficient and accurate method, which is the numerical solution of the projected nonsymmetric algebaric Riccati equations (pNAREs) arisen in the refinement of estimates of invariant subspaces (REIS). The theoretical contribution of our paper is threefold. Firstly, we introduce how to apply SVD to do image compression and provide some mathematics measurement tools. Secondly, the core of this paper is to adapt REIS and find the first singular values to do image compression, especially for high resolution images. The main idea of REIS is applied to large-scale and real matrices via pNAREs or their associated Sylvester equations through Newton's method. Thirdly, we describe some measurement tools like compression ratio, mean square error, peak signal to noise ratio and structural similarity index to evaluate the performance of the compression factors and the quality of the compressed images. Furthermore, the operation counts and computational complexity are also provided. Finally, we present some numerical experiments about some real world image dataset to show the feasibility of our proposed algorithm.