ISSN: 2321-7782 (Online)
Volume 2, Issue 11, November 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Higher Order Singular Value Decomposition for Image Fusion

Pooja Kohok[1]
Department of Computer Engineering,
G. H. Raisoni College of Engineering and Management, Ahmednagar.
University of Pune, India

Sachin Patil [2]
Asst.Professor, Department of Computer Engineering,
G. H. Raisoni College of Engineering and Management, Pune.
University of Pune, India

Abstract: ***The Important points are as follows:1) Since fusion of image mainly depends on local information of source images, the proposed algorithm picks out informative image patches of source images to constitute the fused image by processing the divided sub tensors rather than the whole tensor; 2)To evaluate the quality of the related image patch the sum of absolute values of the coefficients (SAVC) from HOSVD of sub tensors is employed for activity-level measurement; and 3)a novel sigmoid-function-like coefficient-combining scheme is applied to construct the fused result. Hence, a novel higher order singular value decomposition (HOSVD) based image fusion algorithm is proposed.***

Keywords: Tensor, Higher Order Singular Value Decomposition, sigmoid

I. INTRODUCTION

The process of combining information from two or more images of the same scene in order to obtain the resulting image more suitable for human and machine perception or further image processing tasks like segmentation, feature extraction, and target recognition is known as Image Fusion [1].It is widely applied in various fields like medical, remote sensing, computer vision.

The recent availability of multi-sensor system in key image application areas, such as remote and air bone sensing, motivated researchers to work on image fusion in general and pixel level image fusion in particular. thus a plethora of pixel level fusion algorithms have been developed with different performance and complexity characteristics.

Fusion performance is mainly assessed using informal subjective preference tests and ,so far, little if any effort has been directed towards the development of objective image fusion performance metrics. In this work we associate important visual information with the “edge” information that is present in each pixel of an image. Notice that this visual to edge information association is supported by Human Visual System studies and is extensively used in image analysis and compression systems. Furthermore, by evaluating the amount of edge information that is transferred from input images to the fused image, a measure of fusion performance can be obtained.

Multiway arrays like tensors are the generalizations of scalars, vectors and matrices to an arbitrary number of indices. As tensor based information processing methods are more suitable for representing high-dimensional data and extracting relevant information than vector and matrix based methods they receive lots of attention [5]-[7].

II. LITERATURE SURVEY

A number of previous researchers have proposed techniques for image fusion one of them is Discrete Wavelet Transform(DWT),In the case of wavelet transform fusion, all respective wavelet coefficients from the input images are combined using the fusion rule. Since wavelet coefficients having large absolute values contain the information about the salient features of the images such as edge and lines, a good fusion rule plays an important role in fusion process.DWT uses method

named Principal Component analysis(PCA).This fusion method has the effect of blurring textures as well image information loss occurs in edge.

a) Objective Image Fusion Performance Measure by C.S.Xydeas and V.Petrovic

A measure for objectively assessing pixel level fusion performance is defined. The proposed metric reflects the quality information obtained from the fusion of input images and can be used to compare the performance of different image fusion algorithms. Experimental results clearly indicate that this metric is perceptually meaningful.

b) Adaptive Multi-way Analysis Of Images by Damien Letexier and Salah Bourennane

This paper presents a new multiway filtering method for multidimensional images corrupted by white Gaussian noise. Images are considered as multi-way arrays instead of matrics or vectors, which enable to keep relations between each index. The presented filtering method is based on multilinear algebra principles and it improves the multi-way Wiener filtering. The originality of the method relies on the flattening of images. Experiments on color images and hyper spectral images have been computed to illustrate the improvement of MWF by the analysis of image characteristics.

c) A Method for Compact Image Representation using Sparse Matrix and Tensor projections onto Exemplar Orthonormal bases by K. S. Gurumoorthy, A. Rajwade, A. Baneriee, and A. Rangaraian

This paper presents a new method for compact representation of large image datasets. This method is based on treating small patches from a 2D image as matrices as opposed to the conventional vectorial representation, and encoding these patches as sparse projections onto a set of exemplar orthonormal bases, which are learned a priori from a training set. The end result is a low-error, highly compact image/patch representation that has significant theoretical merits and compares favorably with existing techniques (including JPEG) on experiments involving the compression of ORL and Yale face databases, as well as two databases of miscellaneous natural images. In the context of learning multiple orthonormal bases, this paper show the easy tunability of our method to efficiently represent patches of different complexities.

d) Multi-Sensor Image Fusion usinf the Wavelet Transformation by H. Li, S. Manjunath, and S. Mitra

In the image fusion scheme presented in this paper, wavelet transformation of the input images are appropriate combined, and the image is obtained by taking the inverse wavelet transform of the fused wavelet coefficients. An area-based maximum selection rule and a consistency verification step are used for feature selection. A performance using specially generated is also suggested.

e) A Contrast based image fusion technique in the DCT domain by Jinshan Tang

This paper studies image fusion technique in the discrete cosine transform domain. A new image fusion technique based on a contrast measure defined in the DCT domain is presented. The performance of our contrast measure based technique is analyzed and compared with image fusion techniques. Experimentsl results show that there is no difference in visual quality between the fused image obtained by our algorithm and that obtained by a wavelet transform based image fusion technique.

f) The Higher-Order Singular Value Decomposition: Theory and an Application by G. Bergqvist and E. G. Larsso

Tensor modeling and algorithms for computing various tensor decompositions constitute a very active research area in mathematics. Most of this research has been driven by applications. There is also much software available, including MATLAB toolboxes [4].

g) Higher Order SVD Analysis for Dynamic Texture Synthesis by R.Costantini,L.Sbaiz and S.Susstrunk

Videos representing flames, water, smoke, etc., are often defined as dynamic textures: "textures" because they are characterized by the redundant repetition of a pattern and "dynamic" because this repetition is also in time and not only in

space. Dynamic textures have been modeled as linear dynamic systems by unfolding the video frames into column vectors and describing their trajectory as time evolves. After the projection of the vectors onto a lower dimensional space by singular value decomposition (SVD), the trajectory is modeled using system identification techniques. Synthesis is obtained by driving the system with random noise. In this paper, we show that the standard SVD can be replaced by a higher order SVD (HOSVD), originally known as Tucker decomposition. HOSVD decomposes the dynamic texture as a multidimensional signal (tensor) without unfolding the video frames on column vectors. This is a more natural and flexible decomposition, since it permits us to perform dimension reduction in the spatial, temporal, and chromatic domain, while standard SVD allows for temporal reduction only. We show that for a comparable synthesis quality, the HOSVD approach requires, on average, five times less parameters than the standard SVD approach.

h) A Universal image quality index by Z.Wang and A.Bovik

In this paper a new universal objective image quality index is proposed, which is easy to calculate and applicable to various image processing applications. Intead of using tradional error summation methods,the proposed index is designed by modeling any image distortion as a combination of three factors: loss of correlation, luminance distortion and contrast distortion. Although the new index is mathematically defined and no human visual system model is explicitly employed.

i) Adaptive Flattening for Multidimensional Image Restoration by D. Letexier and S. Bourennane

Whereas most previous works treating color or hyper- spectral image restoration use hybrid filters or data splitting, some new approaches consider multidimensional or tensor signal processing techniques. Tensor processing methods are based on multilinear algebra and are more efficient than 2-D filtering. This paper proposes a method to adapt the flattening depending on the data set. Proposed method is based on the estimation of main directions in multidimensional data. For this purpose, they extend the straight line detection algorithm. Multidimensional filtering method HOSVD - (K1,..., K_N) is applied along the estimated directions. They also adapt a quad tree partitioning in order to split tensors into homogeneous sub-tensors to keep local characteristics. Considering some examples of color and hyper spectral images, they present some promising results Fig 7.D2AMA

III. Proposed System

A novel Higher Order Single Value Decomposition based image fusion algorithm is proposed

1. HOSVD,a fully data-driven technique,is an efficient tool for high-diamensional data decomposition and feature extraction.
2. The SAVC is a feasible activity-level measurement for evaluating the quality of image patches.
3. The sigmoid-function-based coefficient-combining strategy incorporates the conventional choose-max strategy and the weighted average strategy and thus adapts to different activity levels flexibly.

This technique evaluates six quality parameters. It doesn't produce the blurring effect.

IV. Conclusion

A novel HOSVD-based image fusion algorithm has been proposed.It constructed multiple input images as a tensor and can evaluate the quality of image patches using HOSVD of sub tensors.then,it employed a novel sigmoid-function-like coefficient-combining scheme to obtain the fused reult. Finally experimental result show that the proposed transform domain algorithm is an alternative image fusion approach.

References

1. E. H. Adelson, C. H. Anderson, J. R. Bergen, P. J. Burt, and J. Qgden, "Pyramid methods in signal processing," RCA Eng., vol. 29, no. 6, pp. 33–41, Nov./Dec. 1984.

2. H. Yesou, Y. Besnus, and J. Rolet, “Extraction of spectral information from Landsat TM data and merger with SPOT panchromatic imagery— A contribution to the study of geological structures,” ISPRS J. Photogramm. Remote Sens., vol. 48, no. 5, pp. 23–36, Oct. 1993.
3. H. Li, S. Manjunath, and S. Mitra, “Multi sensor image fusion using the wavelet transform,” Graph. Models Image Process., vol. 57, no. 3, pp. 235–245, May 1995.
4. J. Tang, “A contrast based image fusion technique in the DCT domain,” Digit. Signal Process., vol. 14, no. 3, pp. 218–226, May 2004.
5. G. Bergqvist and E. G. Larsson, “The higher-order singular value decomposition Theory and application,” IEEE Signal Process. Mag., vol. 27, no. 3, pp. 151–154, May 2010.
6. T. G. Kolda and B. W. Bader, “Tensor decompositions and applications,” SIAM Rev., vol. 51, no. 3, pp. 455–500, Sep. 2009.
7. L. De Lathauwer, B. De Moor, and J. Vandewalle, “A multilinear singular value decomposition,” SIAM J. Matrix Anal. Appl., vol. 21, no. 4, pp. 1253–1278, Mar.–May 2000.
8. M. Haardt, F. Roemer, and G. Del Galdo, “Higher-order SVD-based subspace estimation to improve the parameter estimation accuracy in multidimensional harmonic retrieval problems,” IEEE Trans. Signal Process., vol. 56, no. 7, pt. 2, pp. 3198–3213, Jul. 2008.
9. K. S. Gurumoorthy, A. Rajwade, A. Banerjee, and A. Rangarajan, “A method for compact image representation using sparse matrix and tensor projections onto exemplar orthonormal bases,” IEEE Trans. Image Process., vol. 19, no. 2, pp. 322–334, Feb. 2010.
10. B. Savas and L. Elden, “Handwritten digit classification using higher order singular value decomposition,” Pattern Recognit., vol. 40, no. 3, pp. 993–1003, Mar. 2007.
11. D. Letexier and S. Bourennane, “Adaptive flattening for multidimensional image restoration,” IEEE Signal Process. Lett., vol. 15, pp. 229–232, 2008.
12. R. Costantini, L. Sbaiz, and S. Susstrunk, “Higher order SVD analysis for dynamic texture synthesis,” IEEE Trans. Image Process., vol. 17, no. 1, pp. 42–52, Jan. 2008.
13. C. S. Xydeas and V. Petrovic, “Objective image fusion performance measure,” Electron. Lett., vol. 36, no. 4, pp. 308–309, Feb. 2000.
14. Z.Wang and A. Bovik, “A universal image quality index,” IEEE Signal Process. Lett., vol. 9, no. 3, pp. 81–84, Mar. 2002.
15. B. Savas, Analyses and tests of handwritten digit recognition algorithms, Master's thesis, LinkÄoping University, http://www.mai.liu.se/»besav/ (2003).
16. M. A. O. Vasilescu and D. Terzopoulos, “Multilinear analysis of image ensembles: Tensorfaces,” in Proc. Int. Conf. Pattern Recognition (ICPR), 2002, pp. 511–514.
17. M. Vasilescu and D. Terzopoulos, “Multilinear (tensor) image synthesis, analysis and recognition,” IEEE Signal Processing Mag., vol. 24, no. 6, pp. 118–123, 2007.
18. Y. Chen and R. S. Blum, "Experimental Tests of Image Fusion for Night Vision", Eighth International Conference on Information Fusion, Philadelphia, PA, July 2005.
19. The Online Resource for Research in Image Fusion, www.imagefusion.org, 2008.
20. Toet, A., “Detection of dim point targets in cluttered maritime backgrounds through multi-sensor image fusion,” In: W.R. Watkins, D. Clement & W.R. Reynolds (Ed.), Targets and Backgrounds: Characterization and Representation VIII, The International Society for OpticalEngineering, pp. 118-129, Bellingham, WA, 2002.

AUTHOR(S) PROFILE

Miss. Pooja T.Kohok Research Scholar, G. H. Raisoni College of Engineering and Management Ahmednagar, University of Pune, India. She received B.Tech in Computer Science from MIT College of Engg. Aurangabad,India.

Prof. Sachin Patil received the B.E. and ME degrees in Computer Science and Engineering. Currently he is working as Assistant Professor at Computer Engineering Department in G. H. Raisoni College of Engineering and Management, Pune, India**.**

