Article

Multi-modality medical image fusion based on separable dictionary learning and Gabor filtering

April 2020 · Signal Processing Image Communication 83(4):115758
DOI:10.1016/j.image.2019.115758

Authors:

Qiu Hu
NingboTech university

Shaohai Hu

Fengzhen Zhang

Citations (53) References (34)

Abstract

Sparse representation (SR) has been widely used in image fusion in recent years. However, source image, segmented into vectors, reduces correlation and structural information of texture with conventional SR methods, and extracting texture with the sliding window technology is more likely to cause spatial inconsistency in flat regions of multi-modality medical fusion image. To solve these problems, a novel fusion method that combines separable dictionary optimization with Gabor filter in non-subsampled contourlet transform (NSCT) domain is proposed. Firstly, source images are decomposed into high frequency (HF) and low frequency (LF) components by NSCT. Then the HF components are reconstructed sparsely by separable dictionaries with iterative updating sparse coding and dictionary training. In the process, sparse coefficients and separable dictionaries are updated by orthogonal matching pursuit (OMP) and manifold-based conjugate gradient method, respectively. Meanwhile, the Gabor energy as weighting factor is utilized to guide the LF components fusion, and this further improves the fusion degree of low-significant feature in the flat regions. Finally, the fusion components are transformed to obtain fusion image by inverse NSCT. Experimental results demonstrate the more competitive results of the proposal, leading to the state-of-art performance on both visual quality and objective assessment.

No full-text available

Citations (53) References (34)

... Representation CSC [114],CSR-DPC [167],MWSR [91], and content loss. 2. Captures stable intrinsic real-time applications due to SDL [63] ,SML-SR [92],SR [88],SUnSAL [139] representation of images. ...

... Higher [30,34, 63, 89,114,118,130,134,145,168,171,174,180] to the fused image from source image. [20,59,67,71,103,106,141,152,160,175,193] [42,43,47,70,123,137,148,156,164] signal power to noise power. ...

... Higher Table 8 Image quality evaluation metrics in selected studies Table 8 continued Reference Metric [29,30,32,44,51,54,71,94,98,130,141,144,145,147,152,154,160,168,171,174,175,178,180,192,193] Normalized Weighted Performance Metric/Xydeas [4,15,18,26,88,101,137,139,140,151,162,166,194] Edge Index /Gradient-based Index/Edge Retention/Xydeas [25,31,42,43,64,92,99,108,146,165,182,189,191] and Petrovic Edge Index/Edge-based Similarity Measure [4, 6, 7, 29-32, 56, 57, 68, 93, 97, 110, 111, 114, 122, 129, 144-147, 162, 180] Feature Mutual Information [13,17,27,28,40,44,46,49,51,55,56,74,85,87,88,90,96,102,115,123,125,155,158,169,170,174,183] Average Gradient [42,43,48,76,105,107,138,161,179,184,185,190] [30,33,74,103,106,135,136,148] Mean Value [2,14,95,139,153,157,165,182] Normalized Mutual Information [3, 5, 28, 34, 46, 56, 71, 83, 89, 103, 106, 110, 117-119, 130, 141, 148, 154, 160, 172, 176, 180, 187] Structural Similarity Index Measure [25,26,36,37,47,60,68,70,97,101,123,125,127,156,162,[184][185][186]188] [7, 57,66,116,149,165,179] [51,54,62,65,79,83,87,107,113,185,187,188,190] Information Entropy [14,54,75,82,95,192] Phase Congruency-based Metric [3,10,44,46,67,70,123,134,141,148,156,160,164,176] Peak Signal to Noise Ratio [7,9,36,42,43,47,66,79,128,137,179,190] [8,16,55,87,125,156,160,161,170,176,179] Correlation Coefficient [1,2,6,8,12,15,22,50, 63, 64,75,90,91,94,98,100,101,116,118,122,147,157,172,181,194] Peilla Metric/Salient Quality Index/Edge-dependent Fusion Quality Index [22,27,28,75,94,95,178,180,192,193] Non-linear Correlation Information Entropy Table 8 continued Reference Metric [2,22,60,94,101,178] Chen and Blum Metric [6,8,29,30,32,51,56,59,86,88,111,114,129,130,142,153,157,167,168,172,175,176,181,187,192,193] Visual Information Fidelity Fusion [26,31,48,57,112,166,182,191] [8,16,27,62,93,133,134,142,152] Mean Structural Similarity Index Measure [34,36,38,46,47,90,103,106,112,170] Tone Mapped image Quality Index [1, 8, 10, 16, 78, 80, 110, 116-119, 124, 127, 131, 133, 150] Fusion Factor [7,9,56,79,89,112,128,138,141,142,164] Root Mean Square Error [17,33,56,75,135,136,142,192] Edge Information [5,8,34,49,67,90,170] Natural Image Quality Evaluator [6, 13, 26-28, 42, 44, 66, 90, 102, 112, 170, 183, 184] Edge Intensity [10, 21, 78, 80, 110, 113, 115-119, 129, 131, 149, 186] Edge Strength [5, 16, 78, 85, 116-119, 124, 131, 133, 161, 163] Fusion Symmetry [34,47,110,139,182,193] Feature Similarity Index [12,40,52,85,97,125] Petrovik Metric Parameter Index ...

A Systematic Literature Review on Multimodal Medical Image Fusion

Article Full-text available

Jul 2023 · MULTIMED TOOLS APPL

Shatabdi Basu · Sunita Singhal · Dilbag Singh

View Show abstract

... The steps of the separable dictionary-learning algorithm include sparse coding and dictionary update. The dictionary optimization problems were found using the extensional two-dimensional OMP (2D-OMP) greedy algorithm and the ASeDiL (analytic separable dictionary learning) algorithm to obtain the sparse coefficients and the pre-trained subdictionaries {D A , D B }, respectively, using the method described by [40] . The dictionary pre-training model is shown in Figure 1. ...

... The steps of the separable dictionary-learning algorithm include sparse coding and dictionary update. The dictionary optimization problems were found using the extensional two-dimensional OMP (2D-OMP) greedy algorithm and the ASeDiL (analytic separable dictionary learning) algorithm to obtain the sparse coefficients and the pre-trained sub-dictionaries { , } AB DD , respectively, using the method described by [40] . The dictionary pre-training model is shown in Figure 1. ...

... Furthermore, the training patches were normalized with a zero mean and unit l 2 -norm, and the initial sub-dictionaries were obtained by the MATLAB function randn with normalized columns. Following the experimental setup detailed in [40] , the spatial size of the sliding window was set to 8 × 8, the patch-wise step size was set to 1 to keep the shift invariant of SR, the two Kronecker-criterion-based separable dictionaries were set to the same size of 8 × 16, and the tolerance of the reconstruction error ε was set to 0.01. ...

MRI Image Fusion Based on Sparse Representation with Measurement of Patch-Based Multiple Salient Features

Article Full-text available

Jul 2023

Qiu Hu · Weiming Cai · Shuwen Xu · Shaohai Hu

View Show abstract

... A few techniques are also discussed, including the principle of feature measurement [15] and graph filter and sparse representation (GFSR) [16]. Dual-branch CNN (DB-CNN) [17] as well as separable dictionary learning based on Gabor filtering [18] and local difference in the non-subsampled domain (LDNSD) [19] are also considered. Edge-based artifacts are instances of blocking objects in these methods [7]. ...

... For all quality measures, it can be seen from Table 6 that the proposed approach produced superior quantitative analysis than the conventional approaches, as shown in Figure 8. MR-PET Fusion approach: the efficiency of the designed approach for fusing MR and PET medical images is shown in this section, both subjectively and objectively. Additionally, the performance of many standard techniques was compared, including MCA-CS [14], LTEM [15], DB-CNN [17], GF-SDL [18], and LDNSD [19], respectively. Figure 9a,b show the original MR and PET images, and Figure 9c-h show the results of various fusion techniques. ...

... MR-PET image fusion techniques for all metrics are shown in Figure 10. , (d) LTEM [15], (e) DB-CNN [17], (f) GF-SDL [18], (g) LDNSD [19], (h) designed fused results. Figure 11 illustrates how the suggested HFCMIK segmentation strategy enhanced the localization of the tumor tissue in MR, CT, and fused images analyzed with current methodologies. ...

A Feature Extraction Using Probabilistic Neural Network and BTFSC-Net Model with Deep Learning for Brain Tumor Classification

Article Full-text available

Dec 2022

Arun Singh Yadav · Surendra Kumar · Girija Rani Karetla · Nisha Tatkar

View Show abstract

... Several methods are used to do the preprocessing operation. These include laws of texture energy measures (LTEM) [15], graph filter and sparse representation (GFSR) [16], dual-branch CNN (DB-CNN) [17], Gabor filtering based separable dictionary learning (GF-SDL) [18], and local difference in non-subsampled domain LDNSD [19,20]. ...

... The performance is compared by using entropy, structural similarity index metric (SSIM), mutual information (MI), standard deviation (STD), and peak signal to noise ratio (PSNR) metrics. Fig. 7 presents the visual performance comparison of the proposed MRI-CT fusion outcome with conventional approaches like MCA-CS [14], LTEM [15], DB-CNN [17], GF-SDL [18], and LDNSD [19]. Further, the proposed method resulted in higher contrast and brightness with an accurate tumor highlight as compared to other fusion algorithms. ...

... Furthermore, Table V presents the objective comparison of the proposed method with the existing methods. Finally, for all performance metrics, the proposed approach outperformed conventional approaches in terms of quantitative performance, as shown in Fig. 8. Fig.9 compares the proposed MRI-PET fusion result with the visual performance of standard methods such as MCA-CS [14], LTEM [15], DB-CNN [17], GF-SDL [18], and LDNSD [19]. In addition, the suggested approach produced a stronger contrast and brightness, together with an accurate highlight of the tumor, in comparison to the methods that were already in use. ...

A Deep Probabilistic Sensing and Learning Model for Brain Tumor Classification with Fusion-Net and HFCMIK Segmentation

Article Full-text available

Oct 2022

M.V.S. Ramprasad · Zia Ur Rahman Mohammad · Masreshaw Demelash Bayleyegn

View Show abstract

... Recently, several fusion methods based on sparse representation (SR) [24][25][26][27], convolutional neural networks (CNN) [28][29] and deep learning [30][31] [32] [33][34] have emerged and shown success in visual contrast and clarity. Among them, Maqsood et al. [25] proposed a multi-modal medical image fusion method in the MSD domain based on SR, while Liu et al. [28] introduced CNNs to medical image fusion by obtaining a map containing pixel activity information from the original image. ...

... Similarly, the SR-based fusion approach [24][25][26][27] relies on over-complete dictionary image training, which suffers from extremely time-consuming and computationally intensive problems. In the same vein, the implementation of deep learning-based fusion methods [28][29][30] [31] [32] [33][34] demands robust computer hardware support, extensive time investment, and a complicated sparse reconstruction process that typically involves a precise setting of multiple parameters, putting significant pressure during experimental operations. ...

A novel medical image fusion method based on multi-scale shearing rolling weighted guided image filter

Article Full-text available

Jul 2023

Fang Zhu · Wei Liu

View Show abstract

... As cross product of the over-complete dictionary D, the subdictionaries m n A D R and m n B D R are obtained by the Kronecher product criterion, and for simplicity, we set the both sub-dictionaries with same size. The steps of separable dictionary learning algorithm include sparse coding and dictionary update, and the dictionary optimization problems will be carried out by the extensional 2-dimension OMP (2D-OMP) greedy algorithm and the ASeDiL (Analytic Separable Dictionary Learning) algorithm to get the sparse coefficients and the pre-trained sub-dictionaries{ , } A B D D , respectively through [35], and the dictionary pre-training model is shown in Figure 1. The process of sparse coding consists of a four-step iterative loop, including the determination of most relevant dictionary atom, updates of the support set, updates of the sparse matrix S, and refactoring residual updates. ...

... For the proposed method, to obtain the pre-trained sub-dictionaries, we choose 10 4 patches of size 8×8 from different uncorrupted images as training dataset, and the training patches are normalized with zero mean and unit L2-norm, and the initial sub-dictionaries are obtained by the MATLAB function randn with normalized columns. Following the experimental setup of the previous work in [35], the spatial size of sliding window is set to 8×8, the patch-wise step size is set to 1 to keep shift invariant of SR, the two Kronecker-criterion-based separable dictionaries are set to the same size of 8×16，the tolerance of reconstruction error is set to 0.01. ...

MRı Image Fusion Based on Sparse Representation with Patch-based Multiple Salient Features Measurement

Preprint Full-text available

Jun 2023

Weiming Cai · Shuwen Xu · Qiu Hu · Shaohai Hu

View Show abstract

... The dictionary learning algorithm is consisted of the loop iterations of sparse coding and dictionary update. Suppose the separable dictionariesD A andD B are learned as a whole by the manifold-based conjugate gradient algorithm [10]. Different from the OMP method for sparse coding [10], the FISTA [1] is used as a substitute to get the updated sparse coefficient matrices S j È É Q j¼1 , and Q means the number of image patches that participates in the process of sparse coding. ...

... Suppose the separable dictionariesD A andD B are learned as a whole by the manifold-based conjugate gradient algorithm [10]. Different from the OMP method for sparse coding [10], the FISTA [1] is used as a substitute to get the updated sparse coefficient matrices S j È É Q j¼1 , and Q means the number of image patches that participates in the process of sparse coding. To obtain the sparsest representation with current separable dictionariesD A andD B , the definition of sparse coding objective function is expressed as ...

MRı Image Fusion Based on Optimized Dictionary Learning and Binary Map Refining in Gradient Domain

Article Full-text available

Jun 2022 · MULTIMED TOOLS APPL

Qiu Hu · Shaohai Hu · Xiaole Ma · Jing Fang

View Show abstract

... In a research publication (Zhang et al. 2018;Li et al. 2012;Bhatnagar et al. 2013;Yin et al. 2014;Kumar 2014, 2016;Kong and Liu 2013;Singh et al. 2012), several image fusion substructures were proposed, as well as an outline of multimodal medical image fusion (Xiao-Bo et al. 2008;Du et al. 2016;Zhou et al. 2019;Ramlal et al. 2019;Liu et al. 2017Liu et al. , 2018Ullah et al. 2020;Wang et al. 2014;Mehta and Budhiraja 2018;Maqsood and Javed 2020; Hu et al. 2020; Zhu et al. 2016) was provided. There are three general divisions into which these substructures can be classified: depending on when the integration process takes place, based on their size, and based on their function. ...

... NSCT does not require any shift invariant qualities, but it does perform something efficient and cost-effective with those shift invariant properties: it effectively compresses pseudo-Gibbs phenomena. Thus, using image fusion approaches, some researchers have proposed an image fusion substructure, which they refer to as NSCT Mehta and Budhiraja 2018;Maqsood and Javed 2020; Hu et al. 2020; Zhu et al. 2016). The new fusion approaches that are being proposed in this study are designed to address these concerns and provide a solution. ...

Directive clustering contrast-based multi-modality medical image fusion for smart healthcare system

Article Full-text available

Mar 2022

Dilip Sisodia · Manoj Diwakar · Prabhishek Singh · Achyut Shankar

View Show abstract

... The Gabor filter has been widely utilized for a variety of applications in image processing and computer vision, such as image segmentation [37], cell segmentation [48,49], and medical image fusion [19]. Figure 4 illustrates six Gabor filters. ...

... Stage 3: This stage occurs in one-third of the remaining iteration when predators moves faster than preys. This stage is calculated according to Eqs. (19) and (20). Stepsizeðm; nÞ ¼R L ðm; nÞ ðR L ðm; nÞ Eðm; nÞ À Preyðm; nÞÞ ð19Þ Preyðm; nÞ ¼Eðm; nÞ þ K:CF Stepsizeðm; nÞ ð 20Þ ...

An improved medical image synthesis approach based on marine predators algorithm and maximum Gabor energy

Article Full-text available

Mar 2022 · NEURAL COMPUT APPL

Phu-Hung Dinh

View Show abstract

... This method produces clear and clean fused images free of noise and artefacts while maintaining key details from multiple images. Hu et al. [28] propose an algorithm related to separable dictionary learning and the Gabor filter, and Polinati et al. [29] present a fusion algorithm based on local energy maxima with empirical wavelet decomposition. Li et al. [30] present a robust method based on segment graph filtering with sparse representation. ...

Effective image fusion strategies in scientific signal processing disciplines: Application to cancer and carcinoma treatment planning

Article Full-text available

Jul 2024 · PLOS ONE

Ayush Dogra · Bhawna Goyal · Dawa Chyophel Lepcha · Vinay Kukreja

View Show abstract

... To resolve the abovementioned drawback, automated image registration for motion correlation using multiple sets of SV-OCT data was utilized. This computerized image registration procedure consists of six operational steps, namely, image segmentation [82], motion detection, and image sub-division [83], Gabor filtering [84], global image registration or global placement of each strip relative to a starting reference image, local deformation of the image of the vasculature, and finally, generation of a composite image [85]. The above-processed image was further mosaiced in a wide field to obtain a visualization with a wide field of view [86]. ...

Growing Trend to Adopt Speckle Variance Optical Coherence Tomography for Biological Tissue Assessments in Pre-Clinical Applications

Article Full-text available

Apr 2024

Ruchire Eranga Wijesinghe · Nipun Shantha Kahatapitiya · Changho Lee · Jeehyun Kim

View Show abstract

... Since the EEG signal is characterized by non-stationary behavior and a diverse range of time-frequency components, using Gabor filters can be an advantage for discovering the signal's descriptive features. In recent years, researchers have prominently used Gabor filters in image processing (Hu et al., 2020), and computer vision-based applications (Oppong et al., 2022). In addition, Gabor filter-based features have been found to be effective in signal classification tasks (Kumar et al., 2015) and even integrated into deep learning models (Barshooi and Amirkhani, 2022;Hammouche et al., 2022;Khalifa et al., 2022;Oppong et al., 2022). ...

Gabor filter-based statistical features for ADHD detection

Article Full-text available

Apr 2024 · FRONT HUM NEUROSCI

Sathiya .E · T. D. Rao · T. Sunil Kumar

View Show abstract

... Medical image fusion is to synthesize multiple medical images from single or different imaging devices. The main purpose of the medical image fusion is to improve imaging quality while preserving the specific features for accurate diagnosis and treatment, which plays an important role in surgical navigation, routine staging, and radio-therapy planning of malignant disease [9][10][11] [12][13] [14] . ...

Medical image fusion with deep neural networks

Article Full-text available

Apr 2024

Nannan Liang

View Show abstract

... In view of this, Gabor filter banks are selected as the feature extraction filter template of LR images. Many scholars have used Gabor filter banks to extract local image features [35] [36]. Generally, Gabor feature image r(x, y) is obtained by convolving input image I(x, y) with 2-D Gabor function g(a, b): ...

Image super resolution by double dictionary learning and its application to tool wear monitoring in micro milling

Article

Jan 2024 · MECH SYST SIGNAL PR

Si Li · Zhihao Ling · Kunpeng Zhu

View

... During the feature extraction process, the DPNN learns to assign a probability value to each class based on their features. When presented with a new image, the DPNN uses these probabilities to classify each pixel as either tumor or non-tumor [3] The DPNN performs these classification operations once, learning to train with the input's local characteristics at a higher level. The network also provides information on each layer, such as its size, parameters, and filters. ...

Efficient Clustering of Brain Tumor Segments using Level-set Hybrid Machine Learning Algorithms

Article

Nov 2023

He Lvliang · Wu Hua

View Show abstract

... This SR-based fusion technology is only successful if the dictionary is overflowing with components and the best-in-class fusion algorithm is constructed. DCT, DWT, Gabor, and Ridgelet are some of the sparse fusion methods often used [20] [21][22]. Another image that is frequently used is that of dictionary learning. ...

Multimodality Medical Image Fusion Using Clustered Dictionary Learning in Non-Subsampled Shearlet Transform

Article Full-text available

Apr 2023

Ravinder Singh · Lukáš Ševčík · Manoj Diwakar · Prabhishek Singh

View Show abstract

... Polinati et al. [18] introduced a method of fusing the information of the various image modalities such as speculation (SPEC), positron emission tomography (PET) and MRI using fusion rule of local energy maxima and empirical wavelet transform representation. Hu et al. [19] presented a fusing method of combining dictionary optimization and the filter Gabor in contourlet transform domain. Chen et al. [20] proposed a method of medical image fusion that is based on Rolling Guidance Filtering. ...

Combining Entropy Optimization and Sobel Operator for Medical Image Fusion

Article Full-text available

Jan 2023 · COMPUT SYST SCI ENG

Nguyen Tu Trung · Trần Thị Ngân · Tran Manh Tuan · To Huu Nguyen

View

... Hu et al. [19] proposed anew fusion method that integrates separable dictionary optimization with a Gabor filter in the non-subsampled contourlet transform (NSCT) domain. The proposed method was tested on 127 groups of brain anatomical images from the Whole Brain Atlas medical image database with modalities such as MRI and CT images. ...

Artificial Intelligence-Based Multimodal Medical Image Fusion Using Hybrid S Optimal CNN

Article Full-text available

Jul 2022

Marwah Almasri · Abrar Alajlan

View Show abstract

... Lastly, the contrast enhancement technique is used to enhance the fused image quality. Q. Hu et al. [93] proposed a dictionary learning and Gabor filter based MMIF. The frequency bands are fused by Gabor energy weights, and sparse representations, which are updated by dictionary-based algorithm (OMP) with manifold-based conjugate gradient method. ...

Recent Advancements in Multimodal Medical Image Fusion Techniques for Better Diagnosis: An Overview

Article

Jun 2022

Haribabu Maruturi · Velmathi Guruviah · Pratheepan Yogarajah

View Show abstract

... In the sparse domain, the sparse representation(SR) [15] and dictionary learning [16] are widely used in image fusion. For instance, Li et al. [17] proposed a novel multimodal fusion method via three-layer decomposition and SR. ...

Infrared and Visible Image Fusion in a Multilevel Low-Rank Decomposition Framework Based on Guided Filtering and Feature Extraction

Article Full-text available

Apr 2022

Chao Fang · Xin Feng · Haifeng Gong · Xicheng Lou

View Show abstract

... In this technique, multiscale fusion scheme is used in the wavelet domain. Hu et al. (2020) proposed an image fusion technique, i.e., GDNSCT by using Gabor filter, separable dictionary, and non-subsampled contourlet transform (NSCT). Maqsood and Javed (2020) introduced image fusion using sparse representation and twoscale image decomposition (STD). ...

Fusion of multi-modality biomedical images using deep neural networks

Article Full-text available

Aug 2022 · SOFT COMPUT

Manish Gupta · Naresh Kumar · Neha Gupta · Atef Zaguia

View Show abstract

... In this technique, multiscale fusion scheme is used in the wavelet domain. Hu et al. [9] proposed an image fusion technique i.e., GDNSCT by using Gabor filter, separable dictionary, and non-subsampled contourlet transform (NSCT). Maqsood and Javed [10] introduced image fusion using sparse representation and two-scale image decomposition (STD). ...

Fusion of Multi-Modality Biomedical Images Using Deep Neural Networks

Preprint Full-text available

Oct 2021

Manish Gupta · Naresh Kumar · Neha Gupta · Atef Zaguia

View Show abstract

... However, only one dictionary is employed in the SR-based methods. To address this limitation, dictionary learning has been introduced in SR-based methods [24] [25] [26]. ...

Medical image fusion based on DTNP systems and Laplacian pyramid

Article Full-text available

Nov 2021

Siheng Mi · Li Zhang · Hong Peng · Jun Wang

View Show abstract

... A Gabor filter is a linear filter widely utilized for many applications in image processing. Some of the applications can be mentioned as Cell segmentation [55,56], multi-modality medical image [57] , medical image coloring [58], and image segmentation [59]. Gabor filters are illustrated as Eq. ...

Combining Gabor energy with equilibrium optimizer algorithm for multi-modality medical image fusion

Article

May 2021 · BIOMED SIGNAL PROCES

Phu-Hung Dinh

View Show abstract

... Gabor is a direction-sensitive linear filter, mainly used for edge detection and texture analysis [21] . A 2-dimensional Gabor filter is the product of a sine plane wave and a Gaussian kernel function [22]. ...

Multimodal Medical Image Fusion Based on Gabor Representation Combination of Multi-CNN and Fuzzy Neural Network

Article Full-text available

Apr 2021

Lifang Wang · Jin Zhang · Yang Liu · Jiong Zhang

View Show abstract

... However, only one dictionary is employed in the SR-based methods. To address this limitation, dictionary learning has been introduced in SR-based methods [33] [34] [35] . ...

A novel fusion method based on dynamic threshold neural P systems and nonsubsampled contourlet transform for multi-modality medical images

Article

Jan 2021 · SIGNAL PROCESS

Bo Li · Hong Peng · Jun Wang

View Show abstract

An Iteration Method for Astronomical Image Deconvolution and Reconstruction

Article

Apr 2025 · RES ASTRON ASTROPHYS

F Sine · Li Zhang · Mei Lu

View Show abstract

Deep evidential fusion with uncertainty quantification and reliability learning for multimodal medical image segmentation

Article

Jan 2025 · INFORM FUSION

Ling Huang · Su Ruan · Pierre Decazes · Thierry Denœux

View Show abstract

A novel framework of multimodal medical image fusion using adaptive NSST and optimized deep learning approach

Article

Aug 2023

Kondi Vanitha · D. Satyanarayana · M. N. Giriprasad

View

Enhancing Medical Diagnosis Through Multimodal Medical Image Fusion

Chapter

Apr 2024

Kashi Sai Prasad · Meghana Kolli · Bhargavi Linga · Tiruneswar Veeranki

View Show abstract

Multi-Objective Differential Development Using DNN for Multimodality Medical Image Fusion

Chapter

Feb 2024

M. Ranjith Kumar · Abhishek Dondapati · Dilip Kumar Sharma · S. Shalini

View

Medical Image Fusion with Deep Neural Networks

Preprint Full-text available

Dec 2023

Nannan Liang

View Show abstract

Multimodal medical image fusion towards future research: A review

Article Full-text available

Aug 2023

Sajid Khan · Mir Ahmad Khan · Muhammad Azhar · Muhammad Javed

View

A Hybrid Guided Filtering and Transform-Based Sparse Representation Framework for Fusion of Multimodal Medical Images

Chapter

Jun 2023

Sandhya Sathyanarayanan · Senthil Kumar Murugesan · B. Chidhambararajan

View Show abstract

Multimodality medical image fusion in shearlet domain

Chapter

Jan 2023

Pardeep Kumar · Manoj Diwakar · Prabhishek Singh

View

Medical image denoising using convolutional neural networks

Chapter

Jan 2023

Rini Smita Thakur · Shubhojeet Chatterjee · R.N. Yadav · Lalita Gupta

View

MRI and CT Image Fusion using Synchronized Anisotropic Diffusion Equation with DT-CWT Decomposition

Conference Paper

Dec 2022

Vijayalakshmi Aakaaram · Srinvas Bachu

View

Non Sub-Sampled Contourlet with Joint Sparse Representation Based Medical Image Fusion

Article Full-text available

Jan 2023 · COMPUT SYST SCI ENG

Kandasamy Kittusamy · Latha Shanmuga Vadivu Sampath Kumar

View

Medical image fusion based on sparse representation and neighbor energy activity

Article

Feb 2023 · BIOMED SIGNAL PROCES

Xiaosong Li · Weijun Wan · Fuqiang Zhou · Haishu Tan

View Show abstract

Deep Learning-Based Medical Image Fusion Using Integrated Joint Slope Analysis with Probabilistic Parametric Steered Image Filter

Article

Apr 2022

E. Srinivasa Rao · Ch. Raghava Prasad

View Show abstract

A review on multimodal medical image fusion: Compendious analysis of medical modalities, multimodal databases, fusion techniques and quality metrics

Article

May 2022 · COMPUT BIOL MED

Muhammad Adeel Azam · Dr KB Khattak · Sana Salahuddin · Amir H Gandomi

View Show abstract

A novel multi-focus image fusion method based on joint regularization optimization layering and sparse representation

Article

Nov 2021 · SIGNAL PROCESS-IMAGE

Yanxiang hu · Bo Zhang · Ya Zhang · Zhijie Chen

View Show abstract

Recent advances in image fusion technology in agriculture

Article

Dec 2021 · COMPUT ELECTRON AGR

Daoliang Li · Zhaoyang Song · Chaoqun Quan · Chang Liu

View Show abstract

Research on pixel-level image fusion based on multi-scale transformation: progress application and challenges

Article Full-text available

Sep 2021

Tao Zhou · Shan Liu · Yali Dong · Zongjun Ma

View Show abstract

Bone SPECT/CT image fusion based on the discrete Hermite transform and sparse representation

Article

Jan 2022 · BIOMED SIGNAL PROCES

Leiner Barba J. · Lorena Vargas · Jose A. Calderón-Agudelo

View Show abstract

A unified framework for damaged image fusion and completion based on low-rank and sparse decomposition

Article

Aug 2021 · SIGNAL PROCESS-IMAGE

Minghong Xie · Jiaxin Wang · Yafei Zhang

View Show abstract

Multiple channels local binary pattern for color texture representation and classification

Article

Jul 2021 · SIGNAL PROCESS-IMAGE

Xin Shu · Zhigang Song · Jinlong Shi · Xiao-Jun Wu

View Show abstract

Multi-modal medical image fusion framework using co-occurrence filter and local extrema in NSST domain

Article

Jul 2021 · BIOMED SIGNAL PROCES

Manoj Diwakar · Prabhishek Singh · Achyut Shankar

View Show abstract

Wavelet Filtering for Limited-Angle and Low-Dose Computed Tomographic Reconstruction

Chapter

Apr 2021

Thavavel Vaiyapuri

View Show abstract

A novel multiscale transform decomposition based multi-focus image fusion framework

Article Full-text available

Jan 2021 · MULTIMED TOOLS APPL

Liangliang Li · Hongbing Ma · Zhenhong Jia · Yujuan Si

View Show abstract

Show more