(1)

Pose Invariant Approach for Face Recognition at Distance

Eslam Mostafa, Asem M Ali, Aly A. Farag

Abstract:

We propose an automatic pose invariant approach for Face Recognition At a Distance (FRAD). Since face alignment is a crucial step in face recognition systems, we propose a novel facial features extraction model, which guides extended ASM to accurately align the face. Our main concern is to recognize human faces under uncontrolled environment at far distances accurately and fast. To achieve this goal, we perform an offline stage where 3D faces are reconstructed from stereo pair images. These 3D shapes are used to synthesize virtual 2D views in novel poses. To obtain good synthesized images from the 3D shape, we propose an accurate 3D reconstruction framework, which carefully handles illumination variance, occlusion, and the disparity discontinuity. The online phase is fast where a 2D image with unknown pose is matched with the closest virtual images in sampled poses. Experiments show that our approach outperforms the-state-of-the-art approaches.

Keywords:

Face Recognition, 3D Reconstruction,

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Springer Berlin Heidelberg , Lecture Notes in Computer Science: Proceedings of 12th European Conference on Computer Vision, Florence, Italy , 7574 , 15-28

(2)

Multimodal imaging: modelling and segmentation with biomedical applications

Asem M. Ali, Amal A. Farag, N. Alajlan, Aly A. Farag

Abstract:

The maximum a posteriori (MAP) technique, combining intensity and spatial interactions, has been a standard statistical approach for image segmentation. Crucial steps for the MAP technique are the model identification, incorporation of priors, and the optimization approach. This paper describes an unsupervised MAP segmentation framework of N-dimensional multimodal images. The input image and its desired labelling are described by a joint Markov-Gibbs random field (MGRF) model of independent image signals and interdependent region labels. A kernel approach is used to model the joint and marginal probability densities of objects from the gray level histogram, incorporating a generalized linear combination of Gaussians (LCG). A novel maximum likelihood estimate (MLE) for the number of classes in the LCG model is introduced. An approach is devised for MGRF model identification based on region characteristics. The segmentation process employs LCG to provide an initial segmentation, and then alpha-expansion move algorithm iteratively refines the labelled image using MGRF. The resulting MAP algorithm is studied in terms of convergence and sensitivity to initialization, improper estimation of the number of classes, and discontinuities in the objects. The framework is modular, allowing incorporation of intensity and spatial interactions with varying complexity, and can be extended to incorporate shape priors.

Keywords:

Graph Cut, MGRF, LCG

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(3)

New Approach for Classification of Autistic vs. Typically Developing Brain Using White Matter Volumes

Mostafa Abdelrahman, Asem M. Ali, Ahmed A. Farag, Manuel Casanova, Aly A. Farag

Abstract:

Autism is a complex developmental disability, characterized by deficits in social interaction, communication skills, range of interests, and occasionally the presence of stereotyped behaviors. Several studies show that changes in brain weight and volume over aging follow a unique trajectory in those affected by the condition (Redcay E, Courchesne E. When is the brain enlarged in autism? A meta-analysis of all brain size reports. Biol Psychiatry 58(1):1-9, 2005). In this work, we develop a robust technique for evaluating the volume of white matter (WM), and use it as the main classification criteria. We perform MRI-based analysis on the brains of 14 autistic and 28 control subjects, male and female between aged 7 to 38 years. The proposed framework consists of several stages. First the entire T1-weighted MRI scans are filtered out from noise using anisotropic diffusion filter. Then, the white matter (WM) is segmented from the skull. The segmentation framework is the search for maximum-a-posterior configurations in a Markov Gibbs Random Field (MGRF) model. After that, a 3D mesh is generated from the segmented WM. Finally, the volume of the 3D mesh is computed using a new algorithm. The experiments show accurate classification results of the proposed framework.

Keywords:

Autism, white matter, MGRF-based segmentation

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IEEE Computer Society: Proceedings of the Ninth Conference on Computer and Robot Vision , , 284-289

(4)

A passive stereo system for 3D human face reconstruction and recognition at a distance

Mostafa Abdelrahman, Asem M. Ali, Shireen Y. Elhabian, Ham Rara, Aly A. Farag

Abstract:

In this paper, we propose a front-end framework for 3D human face reconstruction and recognition at a distance. A stereo acquisition system is built and deployed to capture stereo pairs of subjects at different distances. Three main issues are addressed to achieve accurate face reconstruction, which leads to good recognition; Different illumination conditions between the stereo pair due to larger baseline and further distances, where a fast similarity measure based on normalized cross correlation is shown to tackle such problem. Due to the non-convexity nature of a human face, concave regions introduce occluded regions where cubic Splines are used to estimate the disparity. Disparity discontinuities are introduced due to the sparse nature of stereo reconstruction, where surface fitting is performed at prominent facial points. We present our database of 99 subjects at different ranges where reconstruction and recognition results are presented.

Keywords:

Face recognition, 3d reconstruction

Published In:

IEEE Computer Society: Procedings of Computer Vision and Pattern Recognition Workshops (CVPRW) , , 17-22

(5)

Solving geometric co-registration problem of multi-spectral remote sensing imagery using SIFT-based features toward precise change detection

Mostafa Abdelrahman, Asem M. Ali, Shireen Elhabian, Aly A. Farag

Abstract:

This paper proposes a robust fully automated method for geometric co-registration, and an accurate statistical based change detection technique for multi-temporal high-resolution satellite imagery. The proposed algorithm is based on four main steps: First, multi-spectral scale-invariant feature transform (M-SIFT) is used to extract a set of correspondence points in a pair, or multiple pairs, of images that are taken at different times and under different circumstances, then Random Sample Consensus (RANSAC) is used to remove the outlier set. To insure an accurate matching, uniqueness constrain in the correspondence is assumed. Second, the resulting inliers matched points is used to register the given images. Third, changes in registered images are identified using statistical analysis of image differences. Finally, Markov-Gibbs Random Field (MGRF) is used to model the spatial-contextual information contained in the resulting change mask. Experiments with generated synthetic multiband images, and LANDSAT5 Images, confirm the validity of the proposed algorithm.

Keywords:

registration, SIFT, RANSAC, MGRF

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Springer-Verlag: Proceedings of the 7th international conference on Advances in visual computing , 2 , 607-616

(6)

A new segmentation and registration approach for vertebral body analysis

Melih S. Aslan, Asem M. Ali, Aly A. Farag, Hossam Abdelmumin, Ben Arnold, Ping Xiang

Abstract:

To diagnose the osteoporosis accurately, the bone mineral density (BMD) measurements of the vertebral bodies (VBs) are required. In this paper, we propose a new segmentation and registration method in order to assist the BMD measurements and fracture analysis (FA) accurately. In this experiment, image appearance and shape information of VBs are used. Our shape model is required to be registered to the testing image to avoid user interaction(s). Our proposed framework has four phases: i) the detection of vertebral body (VB) using the Matched filter, ii) initial segmentation using the intensity and spatial interaction models, iii) the registration of the shape prior and initially segmented image by matching a vector distance function (VDF), and iv) final segmentation using graph cuts which integrates intensity, spatial interaction and shape prior. Preliminary results show that our new algorithm is very promising and can solve many segmentation and registration problems.

Keywords:

Vertebral Body (VB), shape based segmentation and registration, BMD measurements.

Published In:

IEEE Computer Society: Proceedings of the 8th IEEE International Symposium on Biomedical Imaging , , 2006-2009

(7)

Simultaneous Identification and Tracking of Moving Targets

Ahmed Shalaby Asem M. Ali Amal A. Farag

Abstract:

This paper describes a framework for simultaneous identification and tracking of moving targets in random media. Video and IR thermal sensors are used to obtain the target signature. Classical Kalman filtering methods are implemented on targets with unknown trajectories. Computer vision methodologies are proposed to design a smart interceptor which identifies the targets based on shape and thermal signatures. The paper also describes a platform for basic studies in tracking of targets using vision-guided robotics. The system enables multiple object tracking and recognition.

Keywords:

Kalman filters , image motion analysis , infrared imaging , object tracking

Published In:

IEEE Computer Society Conference on Computer Vision and Pattern Recognition Workshops , , 49 - 54

(8)

Feature Descriptors For Nodule Type Classification

Amal Farag, Aly A Farag, Hossam Abdelmunim, Asem M. Ali, James Graham, Salwa Elshazly, Ahmed Farag, Sabry Al Mogy, Mohamed Al Mogy , Sahar Al Jafary, Hani Mahdi, Robert Falk, Rebecca Milam

Abstract:

This paper examines feature-based nodule description for the purpose of nodule categorization (i.e., associating detected nodules into types) in low-dose CT scanning (LDCT). The multi-resolution Local Binary Pattern (LBP) and Distance Transform of the edge maps were used to generate the features that describe the texture and shape of common nodules and non-nodules. The LBP of the Distance Transform output were merged together to obtain shape and texture based feature descriptors of the nodules and non-nodules. These features were optimized using PCA and LDA, and the resultant sets were used for classifying/categorization into five categories: juxta-pleural, vascularized, pleural-tail, well-circumscribed and non-nodule. In the categorization process, the combinational shape and texture based feature descriptor resulted in an overall 12% enhancement in results when compared to using shape and texture features separately. These results are encouraging and good indicators for progress towards fully automated detection, segmentation, categorization (into types) and classification (into pathologies) of lung nodules from LDCT scans.

Keywords:

lung nodule classification, Distance Transform, Geometric Descriptors

Published In:

Proceedings of 25th International Congress and Exhibition, Computer Assisted Radiology and Surgery , ,

(9)

Probability density estimation by linear combinations of Gaussian kernels- generalizations and algorithmic evaluation

Amal A. Farag, Asem M. Ali, Shireen Elhabian, Aly A. Farag

Abstract:

This paper examines parametric density estimation using a variable weighted sum of Gaussian kernels, where the weights may take positive and negative values. Various statistical properties of the estimator are studied as well as its extensions to multidimensional probability density estimation. Identification of the estimator parameters are computed by a modified EM algorithm and the number of kernels are estimated by information theoretic approach, using the Akiake Information Criterion (AIC). This paper provides empirical evaluation of the estimator with respect to window-based estimators and the classical linear combinations of Gaussian estimator that uses only positive weights, showing its robustness (in terms of accuracy and speed) for various applications in image and signal analysis and machine learning.

Keywords:

Gaussian processes , expectation-maximisation algorithm , probability , statistical analysis

Published In:

IEEE Computer Society: Proceedings of International Conference on Multimedia Technology , , 6491-6494

(10)
Face recognition in low resolution thermal images

Eslam Mostafaa Riad Hammoud Asem M. Ali Aly Farag

Abstract:

This paper proposes an accurate, rotation invariant, and fast approach for detection of facial features from thermal images. The proposed approach combines both appearance and geometric information to detect the facial features. A texture based detector is performed using Haar features and AdaBoost algorithm. Then the relation between these facial features is modeled using a complex Gaussian distribution, which is invariant to rotation. Experiments show that our proposed approach outperforms existing algorithms for facial features detection in thermal images. The proposed approach's performance is illustrated in a face recognition framework, which is based on extracting a local signature around facial features. Also, the paper presents a comparative study for different signature techniques with different facial image resolutions. The results of this comparative study suggest the minimum facial image resolution in thermal images, which can be used in face recognition. The study also gives a guideline for choosing a good signature, which leads to the best recognition rate.

Keywords:

Thermal imaging; MAP; Probabilistic model; Features detection

Published In:

Journal of Computer Vision and Image Understanding , 117 , 1689–1694

(11)

Vertebral Body Segmentation with Prior Shape Constraints for Accurate BMD Measurements

Asem M. Ali Melih S. Aslan Aly A. Farag

Abstract:

We propose a novel vertebral body segmentation approach, which is based on the graph cuts technique with shape constraints. The proposed approach depends on both image appearance and shape information. Shape information is gathered from a set of training shapes. Then we estimate the shape variations using a new distance probabilistic model which approximates the marginal densities of the vertebral body and its background in the variability region using a Poisson distribution refined by positive and negative Gaussian components. To segment a vertebral body, we align its 3D shape with the training 3D shape so we can use the distance probabilistic model. Then its gray level is approximated with a Linear Combination of Gaussians (LCG) with sign-alternate components. The spatial interaction between the neighboring voxels is identified using a new analytical approach. Finally, we formulate an energy function using both appearance models and shape constraints. This function is globally minimized using s/t graph cuts to get the optimal segmentation. Experimental results show that the proposed technique gives promising results compared to other alternatives. Applications on Bone Mineral Density (BMD) measurements of vertebral body are given to illustrate the accuracy of the proposed segmentation approach.

Keywords:

VB; BMD; Segmentation; Shape; GC

Published In:

Computerized Medical Imaging and Graphics Journal , 38 , 586595

(12)

A 3D-based Pose Invariant Face Recognition at a Distance Framework

Asem M. Ali

Abstract:

Face recognition in the wild can be defined as recognizing individuals unabated by pose, illumination, expression, and uncertainties from the image acquisition. In this paper, we propose a framework recognizing human faces under such uncertainties by focusing on the pose problem while considering the other factors together. The proposed work introduces an automatic front-end stereo-based system, which starts with image acquisition and ends by face recognition. Once an individual is detected by one of the stereo cameras, its facial features are identified using a facial features extraction model. These features are used to steer the second camera to see the same subject. Then, a stereo pair is captured and 3D face is reconstructed. The proposed stereo matching approach carefully handles illumination variance, occlusion, and disparity discontinuity. The reconstructed 3D shape is used to synthesize virtual 2D views in novel poses. All these steps are done off-line in an Enrollment stage. To recognize a face from a 2D image, which is captured under unknown environmental conditions, another fast on-line stage starts by facial features detection. Then, a facial signature is extracted from patches around these facial features. Finally, this probe image is matched against the closest synthesized images. Experiments are conducted on different public databases from where we investigate the effect of each component of the proposed framework on the recognition performance. The results confirm that without training and with automatic features extraction, our proposed face recognition at a distance approach outperforms most of the state-of-the-art approaches.

Keywords:

face recognition feature extraction

Published In:

IEEE Transactions on Information Forensics and Security , 9 , 2158 - 2169

(13)

Model-Based Segmentation, Reconstruction and Analysis of the Vertebral Body from Spinal CT

Melih Aslan Ahmed Shalaby Asem M. Ali Aly A. Farag

Abstract:

In this chapter, we present novel vertebral body segmentation methods in computed tomography (CT) images. Three pieces of information (intensity, spatial interaction, and shape) are modeled to optimize new probabilistic energy functions; and hence to obtain the optimum segmentation. The information of the intensity and spatial interaction are modeled using the Gaussian and Gibbs distribution, respectively. A shape model is proposed using new probabilistic functions to enhance the segmentation results. The models are generic shape information which is obtained using the cervical, lumbar, and thoracic spinal regions. The proposed methods are validated with clinical CT images and on a phantom with various Gaussian noise levels. This study reveals that the proposed methods are robust under various noise levels, less variant to the initialization, and quite faster than alternative methods. Applications on bone mineral density (BMD) measurements of vertebral body are given to illustrate the accuracy of the proposed segmentation approach.

Keywords:

Computational Methods - Computer Aided Diagnosis - Image Processing - Image Segmentation - Image based modeling - Spine CT - Spine Imaging

Published In:

Lecture Notes Computational Vision and Biomechanics, Shuo Li and Jianhua Yao: Spinal Imaging and Image Analysis , 18 , 381-437

(14)

Learning A NonLinear Combination of Mahalanobis Distances Using Statistical Inference For Similarity Measure

Eslam Mostafaa, Asem M. Ali, Aly Farag

Abstract:

In this work, we learn a similarity measure that discriminates between inter-class and intra-class samples based on a statistical inference perspective. Where, a nonlinear combination of Mahalanobis is proposed to reflect the properties of a likelihood ratio test. Since an object appearance is influenced by the identity of the object and variations in the capturing process, we represent the feature vector, which is the difference between two samples in the differences space, as a sample that is drawn from a mixture of many distributions. This mixture consists of the identities distribution and other distributions of the variations in the capturing process, in case of dissimilar samples. However, in case of similar samples, the mixture consists of the variations in the capturing process distributions only. Using this representation the proposed similarity measure accurately discriminates between inter-class and intra-class samples. To highlight the good performance of the proposed similarity measure, it is tested on different computer vision applications: face verification and person re-identification. To illustrate how the proposed learning method can easily be used on large scale datasets, experiments are conducted on different challenging datasets: LFW, PubFig, ETHZ, and VIPeR. Moreover, in these experiments, we evaluate different stages e.g., features detector, descriptor type and descriptor dimension, which constitute the face verification pipeline. The experimental results confirm that our learning method outperforms the state-of-the-art.

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IET Computer Vision Journal , ,

(15)

A Facial Features Detector Integrating Holistic Facial Information and Part-based Model

Eslam Mostafa, Asem M. Ali, Aly Farag

Abstract:

We propose a facial landmarks detector, in which a partbased model is incorporated with holistic face information. In the part-based model, the face is modeled by the appearance of different face parts and their geometric relation. The appearance is described by pixel normalized difference descriptor. This descriptor is the lowest computational complexity as compared with existing state-of-theart while it has a similar accuracy. On the other hand, to model the geometric relation between the face parts, the complex Bingham distribution is adapted. This is because the complex Bingham distribution has a symmetric property so it is invariant to rotation, scale, and translation. After that the global information is incorporated with the local part-based model using a regression model. The regression model estimates the displacement to the final face shape model. The the proposed detector is evaluated on two datasets. Experimental results show that it outperforms the state-of-the-art approaches in detecting facial landmarks accurately.

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