

MEETING ABSTRACTS

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01

## The application value of three-dimensional rotational angiography of intracranial micro-aneurysms in diagnosis and treatment

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### Aims

To evaluate the diagnostic value of three-dimensional rotational angiography (3D-RA) of intracranial micro-aneurysms (diameter  $\leq 3$  mm) and provide guidance on the value of endovascular treatment.

### Materials and methods

43 patients with intracranial micro-aneurysms were analyzed retrospectively, all patients had undergone angiography with both conventional 2D-DSA (Two-Dimensional Digital Subtraction Angiography) and rotational angiography with three-dimensional reconstruction; the frequency of detection of aneurysms, depiction of aneurysm neck, radiation dose, and the dosage of contrast agent were recorded respectively.

### Results

55 pieces of aneurysms were detected out from the 43 cases with intracranial micro-aneurysms by 3D-RA. But only 39 cases were detected out using 2D-DSA from the 55 samples, there were significant differences with regards to detection rate ( $P < 0.05$ ). There were significant differences in radiation dose and dosage of contrast agent ( $P < 0.05$ ) between the two methods of using 3D-RA can improve the detection rate of micro-aneurysms, which bestows obvious advantages on displaying the shape of aneurysms, the aneurysm neck at the best angle, and the relationship with the parent artery, at the same time, the amount of contrast agent and radiation dose are reduced in 3D-RA compared to 2D-DSA.

### Keywords

Three-dimensional rotational angiography, Intracranial micro-aneurysm, Three dimensional reconstruction

### Acknowledgments

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Laboratory: Shandong Key Laboratory of Advanced Medical Imaging Technologies and Applications.

02

## Recent advance of immunology-inspired medical imaging

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*BMC Medical Imaging* 2016, **16(Suppl 1)**:02

### Aims

In order to improve the medical imaging, some immune computation theories and immune algorithms were reviewed and compared.

### Materials and methods

The immune computation theories include the self and nonself theory, danger theory, artificial immune network etc. The immune algorithms include self/nonself detection algorithm, normal model construction algorithm, clonal selection algorithm, negative selection algorithm, danger model algorithm and hybrid immune algorithm etc. We improved the clonal selection algorithm to attain the optimal threshold for better segmentation of the medical images than the traditional approach.

### Results

The X-ray medical image of the tuberculosis was processed with the improved clonal selection algorithm and noise filtering, and the output medical image of our approach is better for diagnosis than that of traditional image processing methods.

### Conclusions

The immune algorithm can be improved to establish a better medical imaging, and this kind of medical application system is inspired from the human immune system.

### Acknowledgements

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## 03

**Medical image classification based on guided bagging**

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Traditional medical image classification methods focus on feature representation and classifier design. However, they seldom concerns data selection used for model training, which plays key role for model tuning and parameter optimization. This paper proposes a novel medical image classification method according to guided bagging.

**Materials and methods**

First, unsupervised learning is implemented for training image. Clusters are gained based on generative model. Then, at the discriminative model construction stage, training data is sampled covering all the data clusters, with a probability proportional to the density of each cluster. This method employs a well-distributed and balanced training data, and utilizes the virtue of generative and discriminative learning.

**Results**

The experiment uses the public available CT lung image dataset for evaluation. 379 lung CT images are contained, which are collected by 50 different CT lung scans. The standard data is described by the instruction of an expert. Experimental evaluations show that our proposed method has better performance in the field of lung nodule CT image classification comparing with traditional ones.

**Conclusions**

This paper utilizes the generative and discriminative training model, and a unified classifier is constructed for lung nodule classification. The proposed method is well-designed and the experimental results are preferable.

**Acknowledgements**

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## 04

**Cortical bone ultrashort TE study with inversion recovery preparation**

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Efficient improving contrast of cortical bone from surrounding long T2 tissues is important in ultrashort echo time (UTE) imaging.

**Methods**

UTE acquisition prepared by adiabatic inversion recovery were developed for this purpose. The effect of TI on cortical bone imaging was evaluated on mature bovine tibial mid-shafts using a 3-T clinical MR scanner. The imaging parameters were: TE/TR = 10  $\mu$ s/300 ms, TI = 80, 90, 100, 110, 120, 130, and 140ms, FA = 45°, Bandwidth =  $\pm$ 62.5 kHz, FOV = 8cm, slice thickness = 7mm, NEX = 2, single slice.

**Results**

With TI = 90ms, excellent suppression of long T2 signals was achieved with the CNR<sub>cortical-muscle</sub> value of 13.49  $\pm$  0.67, and the CNR<sub>cortical-marrow</sub> value of 12.26  $\pm$  0.86. Due to different T1s of muscle and fat, some residual signals from fat were presented. Therefore, the CNR<sub>marrow-muscle</sub> value was 1.24  $\pm$  0.35. Furthermore, approximate 80% signals from muscle and fat were suppressed.

**Conclusions**

The 2D adiabatic inversion UTE sequence with a TI of 90 ms provided excellent contrast depiction of bovine cortical bone. Due to the T1 difference, muscle and fat longitudinal magnetizations cannot arrive to the null point at the same time. Therefore, simultaneous reduction of long T2 signals is complicated.

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## 05

**Preliminary research on brain tumor detection in MRI scanning based on wavelet entropy and kernel support vector machine trained by sequential minimal optimization**Shuihua Wang<sup>1,2,3</sup>, Sidan Du<sup>4</sup>, Zhimin Chen<sup>5,6</sup>, Preetha Phillips<sup>7,8</sup>, Shuwen Chen<sup>9</sup>, Zeyuan Lu<sup>10,11</sup>, Ping Sun<sup>2,12</sup>, Zhengchao Dong<sup>13,14</sup>, Yudong Zhang<sup>1,15,16</sup>

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Brain tumors occur if abnormal cells form and accumulate within the brain. Two types of brain tumors exist as benign tumor and cancerous tumor. In order to detect brain tumors in MRI scanning in a more efficient way, we proposed a novel computer-aided diagnosis (CAD) system.

**Materials and methods:** A 100-image 256x256 T2-weighted MR brain dataset was obtained from the homepage of Harvard Medical School. Among the 100 images, 20 are normal control and 80 are with tumors. Our CAD system was established based on the hybridization of wavelet entropy (WE) and kernel support vector machine (KSVM). Our system firstly used WE to obtain distinguishing features from MR images on all subband coefficients obtained by discrete wavelet transform. 5-level Haar wavelet was utilized to obtain a sixteen-element vector.

The vector was fed into the classifier of KSVM that embedded kernel technique into plain support vector machine. The kernel was chosen as the radial basis function (RBF) function. We use grid-searching method to get the optimal RBF scaling factor as 1. KSVM was trained by sequential minimal optimization (SMO) algorithm.

**Results and Conclusion**

The 10 repetition of 10-fold stratified cross validation results showed the proposed WE + KSVM method achieved an excellent classification

performance with an average accuracy of 98.80%, an average sensitivity of 99.50%, and an average specificity of 98.63%. The proposed "WE + KSVM" method is a promising brain tumor detection method for MRI scanning.

#### Keywords

brain tumor; detection; wavelet entropy; sequential minimal optimization; computer-aided diagnosis; radial basis function; cross validation; kernel support vector machine.

#### Acknowledgements

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#### 06

##### Study on geometric efficiency for MDCT

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*BMC Medical Imaging* 2016, **16(Suppl 1):06**

#### Aims

To investigate the dependence of geometric efficiency of a MDCT system on several exposure parameters such as tube voltage, collimation and pitch.

#### Materials and methods

Dose profiles in PMMA phantom for Siemens Definition Flash CT and GE Discovery CT750 HD were derived in helical mode using different tube voltages, collimations and pitches. Corresponding geometric efficiencies and weighted geometric efficiencies were calculated. Kruskal-Wallis test was performed to test the differences between weighted geometric efficiencies using different exposure parameters and the Spearman's correlation coefficient was calculated to determine the correlation between different exposure parameters and weighted geometric efficiencies.

#### Results

With larger collimation the weighted geometric efficiency can be improved by 30%, while combined with larger pitch the weighted geometric efficiency can be reached to about 70%. Weighted geometric efficiencies had positive correlation with beam collimation and pitch ( $p < 0.05$ ) for both CT scanners, while there was no significant difference between weighted geometric efficiencies with different tube potentials ( $p > 0.05$ ).

#### Conclusions

The decrease of geometric efficiency leads to the increase of patient radiation dose. It is necessary to improve the geometric efficiency and reduce the burden of patients by optimal setting beam collimation and pitch for CT scans.

#### Acknowledgements

This work was supported by the National Natural Science Foundation of China (Grant No.81372923).

#### Keywords

multidetector computed tomography; geometric efficiency; radiation dose

#### 07

##### Study of white matter in adolescent patients with depression by MR-diffusion tensor imaging

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*BMC Medical Imaging* 2016, **16(Suppl 1):07**

# Ning Mao, Xinnuan Mu contribute equally to this work.

#### Aims

To explore the changes of the white matter in adolescent depression by using method of Tract-Based Spatial Statistics (TBSS).

#### Materials and methods

We have applied TBSS to 35 depressed adolescents and 40 matched control to exam WM microstructure. With TBSS, we have concluded the fractional anisotropy (FA), axial diffusivity (AD), radial diffusivity (RD) and mean diffusivity (MD) of adolescent patients with depression and controls.

#### Results

Research found unusual WM structure among adolescent depression. Our analysis showed that the FA values are lower ( $P < 0.01$ ), the RD and MD values are elevated ( $P < 0.01$ ), and the AD values are Invariant ( $P > 0.05$ ) in the patients' body of the corpus callosum (CC). There is a contrary relationship between the severity of depression and FA values in the body of the CC ( $P < 0.01$ ).

#### Conclusion

Our study showed that WM abnormalities are occurred in the pathophysiology of depression. What's more, our research suggested that these changes occurred in the early stages of the disease.

#### Keywords

Adolescent Depression; diffusion tensor imaging; white matter

#### 08

##### A landmark-based approach for mid-sagittal plane detection in 3D brain MR images

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*BMC Medical Imaging* 2016, **16(Suppl 1):08**

#### Aims

This paper presents a fully automated approach for the mid-sagittal plane (MSP) detection in 3D brain MR images. This method detects the MSP by accurately identifying highly-visible anatomical landmarks in the brain.

#### Materials and methods

The proposed method is landmark-based, this involves a training phase, which is performed once for a particular set of data, using some spatially aligned images with known anatomical landmark locations. The center points of the anterior commissure (AC), posterior commissure (PC) and midbrain-pons junction (MPJ) were manually delineated on the training images by an expert. In the detecting phase, the intensity of the testing image was normalized and transform into the same space as the training images. The image feature of AC, PC, MPJ obtained in the training stage were used to match the AC, PC, MPJ in the testing image. To accelerate the matching, the landmark detection was conducted in the neighborhood of the mean AC, PC, MPJ positions in the normalized space. A refinement procedure was carried out to

further adjust the detected landmarks. Finally, the formulation of the 3D MSP equation was estimated by the detected landmarks.

#### Results

The proposed method was applied to 30 T1-weighted brain MR images. All testing results were visually inspected and judged to be correct without obvious error. The directional difference of plane normal (DDPN) between automated detection and manual labeling has been evaluated, the average DDPN we achieved was 2.83°.

#### Conclusions

The promising results indicate this method can be potentially useful in clinical applications.

### 09

#### Medical image classification by multiple classifier learning

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*BMC Medical Imaging* 2016, **16(Suppl 1):09**

#### Aims

Medical image classification is a difficult task for its high similarity inter-class and low similarity intra-class. Traditional methods usually devise a single classifier. While, in this paper we focus on learning a multiple classifier for each type for medical image classification.

#### Materials and methods

The proposed method designs a boosted learning framework. First, an initial classifier is constructed according to the feature distribution of training image set. Then, more classifiers are trained in an iterative way. The overall performance can be enhanced successively. Moreover, the optimal weights can be gained on each individual classifier.

#### Results

The experiment uses the public available CT lung image dataset for evaluation. 379 lung CT images are contained in this dataset, which are collected by 50 different CT lung scans. The standard data is described by the instruction of an expert. Experimental evaluations show that the proposed method outperforms traditional methods with application to lung nodule CT image classification task.

#### Conclusions

This paper utilizes the boosted learning, combine multiple classifier for CT lung image classification. The proposed method exploits the feature representation distribution, and the experimental results are preferable.

#### Acknowledgements

This paper was supported by National Natural Science Foundation of China (No. 61472073).

### 10

#### Comparison between conventional and golden ratio based radial trajectories: an eddy currents study

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*BMC Medical Imaging* 2016, **16(Suppl 1):10**

#### Aims

Golden ratio based k-space trajectories are widely used in dynamic MRI since it provides approximate uniform k-space distribution. However, rapidly switching gradient induces eddy currents, generating artifacts in image. The golden ratio (GR) based radial strategy was compared with conventional radial strategy on 0.7T open superconducting MRI system.

#### Materials and methods

In conventional radial strategy, a constant angle increment  $\Phi_{\text{uniform}} = 180^\circ/P$  between neighboring profiles. In GR based radial strategy, the azimuthal spacing is  $\Phi_{\text{GR}} = 180^\circ/1.618 = 111.2^\circ$ . First, a simulation was carried out to the comparison between ideal and net gradient of Shepp-Logan phantom

with two radial strategies respectively. Second, a pure water phantom was sampled by Cartesian, conventional and GR based radial trajectory on the 0.7T open superconducting MRI system. Three orthogonal planes were acquired. SNR was compared between these three sampling trajectories, and images from Cartesian trajectory were used as reference.

#### Results

Result of simulation has illustrated that the impact of eddy currents on the ideal gradient with GR based radial strategy is more apparent. The result of a pure phantom shows that SNR values of both radial strategies (conventional: 40.76 GR:16.11) are far smaller than Cartesian strategy (145.15).

#### Conclusions

Eddy currents artifacts are more serious in GR based radial trajectory. Rapid switching gradient in GR based radial strategy induces more eddy currents than conventional radial strategy, which may limit the application of GR based trajectories especially in high magnet filed system.

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### 11

#### ROI segmentation by localizing region-based active contours

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*BMC Medical Imaging* 2016, **16(Suppl 1):11**

#### Introduction

Accurate segmentation of Region of interest (Region of Interest, ROI) has an important place in medical image analysis, and still remains a challenge task because of the complex background and structure.

#### Materials and methods

This paper proposed a novel active contour model based on localizing region for ROI segmentation in capsule endoscopy images. Features in regions centered on an active contour were used to compute the local region descriptors. For calculating the local energies, the image was separated by the initial circular shape curve into two parts: interior and exterior. And then each local region is fitted with a model to optimize the energies.

#### Results

Experiments show that in term of the average over segmentation rate, the proposed method is 2.8%, whereas traditional snake and GVF snake model are 3.2% and 3%, respectively; In term of the average under segmentation rate, the proposed method is 2.4%, whereas traditional snake and GVF snake model are 2.9% and 2.6%, respectively. All results demonstrated the superior of the proposed method to other existing methods in ROI segmentation.

#### Acknowledgement

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### 12

#### Accuracy and effectiveness of the respiratory self-gating signal in 3D cardiac cine MRI

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*BMC Medical Imaging* 2016, **16(Suppl 1):12**

#### Aims

Cardiac and respiratory self-gated free-breathing steady-state free precession (SSFP) has been proposed as an alternative to conventional SSFP for cardiac cine magnetic resonance imaging. In this

technique, the acquired k-space data within the given respiratory gating windows are used for image reconstruction. Therefore, the accuracy of respiratory self-gating (RSG) signal is important.

#### Materials and methods

The self-gated free-breathing 3D SSFP technique was performed on a 1.5T GE HDx scanner. Twenty five healthy volunteers were included. The imaging parameters were: TR/TE = 3.5/1.3 ms, flip angle = 40°, bandwidth = ±125 kHz, slice thickness = 7 mm (no gap), number of slices = 12-14, number of profiles = 5000. RSG and respiratory bellow (RB) triggers were compared by correlation and t-test analyses. The percentage of respiratory signal intensity within gating windows was calculated.

#### Results

The respiratory cycle duration is  $3314.7 \pm 1072.6$  ms. For all cases, the correlation coefficient between RSG and RB triggers is greater than 0.99, the P value of t-test is greater than 0.90. The percentage of RSG signal intensity within gating windows was  $66.1 \pm 4.1\%$  compared with  $60.1 \pm 3.4\%$  for RB.

#### Conclusions

There was an excellent correlation between RSG and RB triggers. There was no significant difference between two methods. RSG signal can well synchronize with RB signal and provide approximately the same respiratory cycle duration.

#### Acknowledgements

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### 13

#### Changes in fiber bundles with aging: a tractography-based MRI study

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#### Aims

The aim of this work was to investigate changes in fiber bundles with aging by utilizing quantified diffusion magnetic resonance imaging (MRI).

#### Materials and methods

A total of 125 normal subjects were separated into 5 groups (group 1: 16-30 years old, n = 20; group 2: 31-45 years old, n = 34; group 3: 46-60 years old, n = 24; group 4: 61-75 years old, n = 22; group 5: 76-90 years old, n = 25). All subjects underwent diffusion tensor imaging (DTI) and T1-weighted MRI in a 3T scanner, and DTI Studio software was used to process all DTI data and for tracing fiber bundles. Statistics for the total fiber number of brain and for the fiber density (FD) of 3 regions of interest (ROIs), namely the corpus callosum, cingulate, mesencephalon were gathered and analyzed using SPSS software.

#### Results

Significant differences were observed in total fiber number among all age groups ( $p < 0.05$ ). In group 1, a significant difference was found between the FD of left and right cingulate ( $p < 0.05$ ). Significant differences were found in comparisons of the FD of left and right cingulate ( $p < 0.05$ ), and the downward trend of the left cingulate was found to be faster than that of right cingulate. Furthermore, significant differences were found between the FD of corpus callosum and cingulate ( $p < 0.05$ ).

#### Conclusions

Thus, we can use quantitative MR DTI to study changes in brain fiber bundles.

#### Acknowledgments

This study was supported by the National Science and Technology Support Program (No.2015BAK31B01).

#### Keywords

diffusion tensor imaging; tractography; fiber bundle; aging

### 14

#### Ultrasonographic assessment of bony roof ratio in infant hip joints

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*BMC Medical Imaging* 2016, **16**(Suppl 1):14

#### Aims

This paper conducted research on a new method of ultrasound pediatric hip - bone top ratio measurement.

#### Material and methods

390 cases of pediatric hip (hip) ultrasound examination were selected since March 2011 to August 2016 according to Graf method of measuring the size of the angle  $\alpha$ . They were divided into three groups: Group 1,  $\alpha$  angle  $\geq 60^\circ$ , 130 cases; Group 2,  $\alpha$  angle  $< 60^\circ \sim \geq 43^\circ$ , 130 cases; Group 3,  $\alpha$  angle  $< 43^\circ$ , 130 cases. On the basis of Graf law, the ratio of the top bone was measured.

We measure bony roof ratios in the following way. A tangent (referred as X axis) to the iliac bone was drawn across the transition point of iliac periosteum and perichondrium. A line vertical to X axis (referred as Y axis) was drawn across the vertex of acetabular cartilage roof. A vertical line to Y axis (line A) was drawn across the inferior boarder of acetabular labrum, and the other vertical line to Y axis was drawn from the inferior margin of ilium (the lowest point of ossificious iliac bone) (line B). The length of lines A and B was measured (cm) and the ratio between the length (A:B) was calculated as acetabular bony roof ratio (bony roof ratio).

#### Results

Group 1,  $\alpha$  angle of  $78.38^\circ \sim 60.00^\circ$ , the top bone ratio 3.71 to 1.05; Group 2,  $\alpha$  angle  $< 60.00^\circ \sim \geq 43.00^\circ$ , the top bone ratio 1.21 to 0.54; Group 3,  $\alpha$  angle  $< 43.00^\circ \sim 30.00^\circ$ , the top bone ratio from 0.58 to -0.36. Top bone ratio method classification criteria: I type, top-bone ratio  $> 1.2$ ; II type, top-bone ratio of 1.2 to 0.6; eccentric, top bone ratio  $< 0.6$ .

### 15

#### Fast primal-dual TV-based reconstruction and practical image-domain decomposition for few-view dual-energy CT

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#### Aims

Dual-energy CT (DECT) has promising medical applications in differentiating bones and tissue. For full-view data, radiation dose is an important concern which makes few-view imaging research valuable. For few views, however, conventional filtered back-projection type methods fail to provide satisfying images, and direct decomposition is unstable due to noise boost. In order to obtain both high-quality CT and decomposition images for few views, this paper proposes a fast total variation (TV)-based image reconstruction algorithm and a practical image domain decomposition method for DECT.

#### Materials and methods

The reconstruction optimization problem, containing TV regularization term and data fidelity term, utilizes the pre-conditioned Chambolle-Pock method to design the algorithm which shows fast convergence. On the other hand, for noise suppression, the image decomposition uses the penalized weighted least square estimation, and applies the smoothness regularization term enforcing on estimation images. We implemented the proposed joint method on real DECT projections and compared it with state-of-the-art methods.

#### Results

The experiments on an anthropomorphic head phantom show that our methods have advantages on noise suppression and edge reservation, without blurring the fine structures in the sinus area. Furthermore, the proposed methods consume much less time than the compared iterative reconstruction algorithms.

#### Conclusions

This paper proposes a fast joint reconstruction-and-decomposition method for DECT imaging. Compared to the existing approaches, our

method achieves better performance in reconstruction accuracy and decomposition quality.

#### Keywords

dual-energy CT imaging, primal-dual reconstruction, total variation regularization, image-domain decomposition

#### Acknowledgements

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### 16

#### A way to create a colored functional medical image by hardware

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#### Aims

For many years, without software the medical imaging tools like X-ray, CT, Ultrasound, and MRI which only work in a monochromatic fashion. In order to display the colorful tissue image by hardware, we invented a color converter circuit to transfer the monochromatic tissue image into the color image to broaden the diagnostic and therapeutic possibilities.

#### Materials and methods

In order to colorize the monochromatic tissue images, the tissue reflection light is separated into the tissue image light and the bioluminescence fluorescence by a dichroic. Both lights are detected by two photo diodes and converted into the color signals by the color converter circuit.

#### Results

The two conditions of color changing on the color monitor are discussed as the following: (1) The black color on the monitor means there is no backscattered light coming from the tissue. (2) When there is fluorescent coming from the tissue, we can see the different color compounded showing on the color monitor.

#### Conclusions

By checking the color changed area on the color monitor to see the distribution of fluorescence on the tissue image, we can make the disease checking easier and clear.

### 17

#### Three dimensional ultrasound image analysis for renal calculi fragmentation monitoring during ESWL

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*BMC Medical Imaging* 2016, **16(Suppl 1):17**

#### Aims

Up to now, little research has been done in the area of monitoring the fragmentation progress during Extracorporeal Shock Wave Lithotripsy (ESWL) treatment or renal stones while no method has been widely suggested for clinical practice. Experience of technicians and doctors are key factors for efficient treatments. In this study the use of 3D ultrasound imaging has been used for the estimation of the fragmentation level of renal stones during ESWL.

#### Materials and methods

Generally, in the course of lithotripsy, fragmentation of the stones produce changes in the intensity and texture of the images. First, simulated fragmented stones were used in a gelatin phantom. Furthermore, pig kidneys containing plaster of Paris stone models were exposed to shock waves. Gray level co-occurrence matrix texture features (contrast, entropy ASM, IDM and homogeneity) were calculated in 3D regions of interest containing the stones.

#### Results

The calculated texture values from the 3D regions containing the stone fragments show progressive changes which relate to the stone fragmentation level. The results from the gelatin phantom experiments show agreement with the pig kidney experiments.

#### Conclusions

Three dimensional ultrasound imaging could be used for monitoring of the progress of shock wave treatments of renal stones.

#### Acknowledgements

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### 18

#### Combining a support vector machine with a convolutional neural network for fMRI data classification

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*BMC Medical Imaging* 2016, **16(Suppl 1):18**

#### Aims

Functional magnetic resonance imaging (fMRI) facilitates brain research and it is found to be widely used in clinic. Brain tasks can be related to regions of neural activity by classification of fMRI data. The design of previous systems has primarily been focused on classifier performance, whereas we focus on reliability.

#### Materials and methods

We use a hybrid system in which a convolutional neural network (CNN) is combined with a support vector machine (SVM). The CNN extracts features from the fMRI image and the SVM classifier finds patterns of features. Converting the dimension of the image and retaining its significant features increases processing speed and reduces the effect of noise, while the use of a simplified CNN reduces training time.

#### Results

Our system achieves a classification accuracy of 99.5% on Haxby's 2001 fMRI dataset, which is superior to decision tree, random forest, neural network, K-nearest neighbor, support vector machine, AdaBoost, and Haxby's models. We contend that this makes it suitable for clinical applications.

#### Conclusions

Our hybrid system combines the advantages of SVMs and CNNs, which are both widely used for image recognition. The salient features extracted by our hybrid system do not have to be hand-coded, unlike those used by most existing classifiers. We found that the complexity of our hybrid model increased much less during the classification process than that of Haxby's model.

#### Acknowledgements

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### 19

#### Spiking cortical model based structural representation for non-rigid multi-modal image registration

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*BMC Medical Imaging* 2016, **16(Suppl 1):19**

#### Aims

Structural representation based non-rigid multi-modal image registration (NMIR) methods have attracted much attention. However, many existing NMIR methods cannot provide satisfactory registration

results. To address this problem, we have proposed a novel spiking cortical model (SCM) based structural representation method for the accurate NMIR.

#### Materials and methods

The reference and floating images are input into the SCM to generate the firing mapping images (FMI). The weighted mean of all the differences among Tchebichef moments of image patches centered at each considered pixel and other pixels in a neighbourhood in the FMI is used as a local descriptor to represent the image structure. The similarity metric is computed as the sum of squared differences between structural descriptors for the two images. By combining free-form deformation (FFD) with L-BFGS-B optimization method, the similarity metric is optimized to produce the registered image.

#### Results

Extensive experiments have performed on MR and CT images from BrainWeb database and Atlas database as well as ten real prostate MR and ultrasound images. Experimental results demonstrate that the proposed method can produce more similar registration results to the reference images and provide smaller target registration errors than the NMIR methods based on the normalized mutual information, entropy images, Weber local descriptor (WLD) and modality independent neighbourhood descriptor (MIND).

#### Conclusions

The proposed SCM based registration method provides an effective means for the accurate NMIR due to its robustness to image noise and rotational invariance.

#### Acknowledgements

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## 20

### Automatic recognition of fetal facial standard plane using very deep convolutional neural network

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Ultrasound imaging has become a prevalent examination method in prenatal diagnosis. The most important precondition of routine US examination is the accurate acquisition of fetal standard plane from ultrasound videos. However, the labor-intensive and subjective assessment is too time-consuming and less reliability, and thus the development of the automatic fetal facial standard plane (FFSP) recognition method is urgently needed. In this paper, we propose to recognize FFSP using very deep CNN architecture (16 layer). In addition, a transfer learning strategy combine with special data augmentation technique is adopted to overcome overfitting problem and improves the classification performance. Also, a relatively shallower CNN architecture (8 layer) is exploited for FFSP recognition. The promising experimental results show the advantage of the proposed method vs the traditional manual features approaches, and indicate the effectiveness of deep CNN for detecting FFSP for clinical diagnose.

**Keywords:** Standard plane recognition; Ultrasound image; Deep CNN; Transfer learning.

## 21

### Medical Imaging analysis based on Cloud Services Platform

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#### Aims

With the rapid development of technology, Cloud Computing turned out to be a reliable method to construct flexible and resilient regional medical imaging services platform. It will be cost-efficient and high-performance.

#### Materials and methods

By using various media with Cloud Computing, this paper describes the construction of regional medical imaging services platform and analyzes the needs of regional medical image sharing and cooperation and technology progress, and then designs a FC SAN and HDFS combination of medical imaging. Scalable distributed processing is the key to the platform. Storage regional services for SAAS based on the research goes for architecture and parallel medical imaging services.

#### Results

In consideration of the features of Hadoop, the requirement of medical imaging cloud platform and the basic structure of medical imaging, Cloud Computing is particularly designed for rapid large volumes of data (petabytes) storing and processing.

#### Conclusions

The reconstruction of medial cloud computing imaging services platform confronted great challenges in funds and technology with traditional technology. While newly-developed cloud computing and service model is a practicable approach to construct an economical, reliable and scalable regional medical imaging services platform.

## 22

### Modelling and simulation of small world in memory network

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#### Aims

In order to model and simulate the small world topology in brain network on memory function, and explore the corresponding relationship between memory phenomena and functional characters.

#### Materials and methods

We design the deterministic algorithms to simulate the memory network of brain referring to the theories of graph, control and networks combing with the functional magnetic resonance imaging data.

#### Results

We simulate a memory network with evolution algorithms. By computing of network, the model has the small-world characters in clustering and average path length in accordance with the functional magnetic resonance imaging data results.

#### Conclusions

From computational model algorithm and memory phenomena, brain memory functional network also can be simulated with the same results of functional magnetic resonance imaging data. The method of cross subject research can provide a feasible way for the study of brain memory function network.

#### Acknowledgements

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## 23

### Longitudinal analysis on altered functional connectivity in individuals at risk for Alzheimer's disease

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Disruption of functional connectivity is increasingly considered to be associated with Alzheimer's disease (AD) patient and that at high risk for AD. In this paper, altered functional connectivities are explored in longitudinal participants of 34 patients with EMCI, 23 patients with LMCI and 15 patients with AD, compared with 31 healthy control subjects. We evaluate the altered function connectivities with the progression of disease based on a priori defined 273 regions of interest. Different levels of analysis based on functional connectivity are explored. Many inter- network connectivities and intra-network connectivities are found to be impaired in both MCI group and AD group. The longitudinal alterations of functional connectivity within DMN (Default Mode Network) were correlated with variation in cognitive ability, and the SAL (Salience Network) as well as the interaction between DMN and SAL was disrupted in MCI group. Importantly, the longitudinal alternation of functional connectivity in the earlier stage is greater than that in the late stage, and the increase of altered network connectivity pattern is associated with the increase of disease severity. The altered connectivities are correlated significantly with both MMSE scores and ADAS-Cog. This study indicates that altered connectivity might be a potential biomarker of AD progression.

#### Acknowledgements:

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#### 24

##### Medical image segmentation with immunity-based improved fuzzy clustering algorithm

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#### Aims

In order to optimize the initial center value for the medical image segmentation, an improved fuzzy clustering algorithm was proposed on the immune computation.

#### Materials and methods

The immunity-based improved fuzzy clustering algorithm searched the suitable initial center value quickly, increased the efficiency and accuracy, and avoided the blind local optimum. The antigen represented the grayscale image data, and the antibodies were generated at random to create the clusters. We designed a similar concentration factor and adjusted this parameter dynamically.

#### Results

The simulation results show that our improved algorithm can adaptively calculate the centers of the medical image clusters. The C-mean clustering algorithm used the initial cluster center (10, 80) and got the final threshold 103 in 6.1 seconds. Our proposed immune algorithm used the initial cluster center (65, 220), and got better final threshold 214 in 0.4 seconds.

#### Conclusions

We proposed an immune fuzzy clustering algorithm based on the improved preliminary optimum initial cluster centers, to avoid falling into the local minimization area and accelerate the searching speed. The lung image segmentation can be improved with our algorithm to help the doctors to analyze the lung disease better.

#### Acknowledgements

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#### 25

##### Sparse representation via adaptive dictionary for angiogram image denoising

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Image denoising is always an active research topic in the field of computer vision. The denoising performance had been greatly improved by the prior state-of-the-art methods based on non-local self-similar (NSS) patches. However, the prior NSS patch-based methods usually smoothed the edges and useful structures. The main reason is that the sparsity of the NSS patches cannot be correctly represented. In this paper, we propose a sparsely augmented Lagrangian image denoising (SALID) model over NSS patches via adaptive dictionary. With the adaptive dictionary, the sparsity of the NSS patches can be represented more efficiently. The results of widely synthetic experiments demonstrate that, with the single and effective alternating directions method of multipliers (ADMM) to solve the SALID model, the proposed denoising method can obtain highly competitive denoising performance and high-quality images, even superior to other advanced denoising methods. Moreover, the extensively experimental results of clinical X-ray angiogram images further verify that our method can obtain high-quality visual images. **Keywords:** Angiogram image denoising; Non-local self-similar patch; Alternating directions method of multipliers

#### 26

##### Structural and functional changes in patients with classical trigeminal neuralgia

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#### Aims

In order to detect whether there are structural and functional changes of central nervous system in pain processing in classical trigeminal neuralgia (CTN) patients.

#### Materials and methods

Twenty-two patients with CTN and twenty-one age and sex-matched healthy volunteers were recruited. Whole brain 3D T1-weighted images and resting-state functional MRI datasets were obtained with SIMENS 3.0T MRI scanner. Voxel-based morphometry (VBM) based on DARTEL was used to identify the differences of gray matter volume and the Regional Homogeneity (ReHo) method was used to compare the brain spontaneous activity differences between patients and healthy controls.

#### Results

Compared with the health controls, the CTN patient presented with decreased GM volume in several brain regions including the right inferior temporal gyrus, inferior frontal gyrus, amygdala, thalamus, precuneus, cingulate gyrus and bilateral superior temporal gyrus, para-hippocampus, as well as increased GM volume in right frontal gyrus. Decreased ReHo values are in the left temporal and para-hippocampus, as well as increased ReHo values were noted in the bilateral thalamus and left parietal lobe between CTN patients and healthy controls.



### Conclusions

CTN patients have multiple cerebral regions of GM volume abnormality and the abnormal spontaneous activity. These structural and functional abnormal regions are associated with the perception and processing of pain. All of these might reveal the exploration of central mechanisms of CTN.

### Keywords

classical trigeminal neuralgia (CTN); Voxel-based morphometry (VBM); Regional Homogeneity (ReHo); Central nervous system

### Acknowledgments

This study was supported by the National Science and Technology Support Program (No.2015BAK31B01).

### 27

#### What the original regional gray matter volume based cortical brain network can reveal of normal aging

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### Aims

This study seeks to determine what alterations of the cortical brain network constructed using original regional gray matter volume (ORGMV) can be revealed for normal aging.

### Materials and methods

The subjects are acquired from OASIS database. IBASPM toolkit was used to perform ORGMV measurement. Pearson correlation was used to build the network after linear regression. Network analysis was done by BCT. The attributes are interregional correlations, small-world configurations, nodal and modular properties. Lastly, statistical analysis was applied to verify the significant alterations.

### Results

1) Decreased interregional correlation was found between the superior temporal pole and middle temporal pole in the right hemisphere, whereas increased cases occurred mostly in the frontal lobe between bilateral regions. 2) The distributions of hubs exhibited left-lateralized and right-lateralized in the young and aging group, separately. The fusiform gyrus and Rolandic operculum were identified as hubs for the young and aging groups, respectively. 3) Only one connector-module was found in the aging group, and the inter-module connections of one module in the aging group is relatively sparse.

### Conclusions

To our knowledge, this study is the first to realize brain network construction by ORGMV. The findings suggest that it could enhance the understanding of the underlying physiology of normal aging and serve as a supplement approach to help exploring the mechanism of the human brain.

### Acknowledgements

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### 28

#### The advantages of ultrasound in the treatment of abdominal malignant tumors by 125-iodine seed implantation

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### Aims

Abdominal viscera have its own particularity, so the choice of imaging guidance shows more importance in the process of 125-iodine seed implantation. The goal of this study was to classify the advantages of ultrasound in the treatment of abdominal malignant tumors by 125-iodine seed implantation.

### Materials and methods

20 patients were evaluated in this study and they accepted 125-iodine seed implantation guided by ultrasound. This paper aims to analyze the ultrasound guidance influence factors and measures and make clear its advantages.

### Results

Among all 20 patients, 4 cases were liver malignant tumors. General anesthesia combined with breathing controlled could reduce the activity of liver, achieve fast and accurate punctures and the 4 cases had no serious complications; 7 cases were pancreatic cancer. Using ultrasonic probe to squeeze the stomach could reduce or avoid injury caused by multiple punctures, and the 7 cases had no gastric bleeding and fistula; 9 cases were retroperitoneal tumors. Using ultrasonic probe to press abdomen could reduce or avoid bowel and mesentery injury, gastrointestinal hemorrhage and the rates of intestinal fistula and abdominal infection, and the 9 cases had no melena; Real-time guidance was equivalent to direct vision, the puncture process could be monitored and showed its security.

### Conclusion

This study found that ultrasound guided 125-iodine seed implantation in the treatment of abdominal malignant tumors could achieve accurate puncture, reduce the puncture injury safely and effectively.

### Keywords

Ultrasound, Radioactive seed implantation, 125-iodine, Abdominal malignant tumor

### 29

#### Medical images classification using Mapreduce based convolutional neural network and its application for big data processing

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### Aims

With the arrival of big data stage, big data analytics has become new challenge. High resolution computed tomography (HRCT) is major source of medical big data. HRCT classification is widely used in medical imaging missions. Motivated by the success of convolutional neural networks (CNN), we combine deep learning and big data methodology together to address the challenge.

### Materials and methods

We take advantage of distributed computing and design the system on clusters. Different from traditional approach using single machine, we propose Mapreduce based CNN (MRCNN) significantly increasing training speed and reducing computation cost simultaneously. The feature vector is sent to Naïve Bayes classifier (NBC) for classifying interstitial lung disease and other medical HRCT. To avoid overfitting and local minima, we utilize genetic algorithm and Bayesian regularization (GABR) pre-training networks and initializing the weights. Furthermore, we design Mapreduce based NBC to increase efficiency of training classifier.

### Results

Compared with other methods in past years, our method achieves benchmark performance. It's capable of enhancing recognition accuracy and suitable for medical imagery big data processing.

### Conclusions

MRCNN is efficient for storage and processing of HRCT big data. Due to the powerful feature representation ability of CNN, distributed MRCNN framework can be applied to other medical imaging big data analytics.

### Acknowledgements

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### 30

#### Hippocampus volume atrophy in Alzheimer's disease base on sex

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### Aims

Hippocampus, which is critical for memory, learning and declaration of emotional behaviors plays important role in Alzheimer's disease (AD). We investigated hippocampus gray matter atrophy using analysis of variance (ANOVA) on 3-Tesla 3D T1weighted magnetic resonance imaging (MRI) data among four groups of participants.

### Materials and methods

The experiments included 68 patients with AD and 68 normal control (NC) from ADNI database. They were divided into four groups (34 male patients with AD, 34 age-matched male NC, 34 female patients with AD and 34 age-matched female NC). Data processing was performed using Statistical Parameter Mapping (SPM8) and the VBM toolbox with default setting. All structural MRIs were bias-corrected, segmented into gray matter, white matter, and cerebrospinal fluid components. MarsBaR toolbox with Automated Anatomical Labeling (AAL) template was employed to label the hippocampus and then their volumes were calculated.

### Results

The distribution of hippocampus gray matter atrophy is strongly influenced by sex. Also the development and severity in the female patients with AD is much greater compared to male patients.

### Conclusions

The study of AD based on the sex may help to figure out the root of AD mechanisms and potentially can be used as an imaging marker at early stages of study in the future.

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### 31

#### Atlas based dynamic functional connectivity of resting-state MEG data

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### Aims

This study seeks to develop an atlas-based beamformer approach of dynamic functional connectivity (FC) for resting-state MEG data, which is comparable with other imaging methods.

### Materials and methods

The dynamic FC was calculated based on atlas with a sliding-window method. We first segmented the MEG data with a 2-seconds window, then performed a whole brain LCMV beamformer scan. The source with maximum power of each ROI was selected to compute the FC matrices. To avoid the problem of volume conduction, PLI was used to quantify the phase synchronization. Lastly, a k-means algorithm was applied to the windowed correlation matrices, each cluster centroid putatively reflects a stable FC state. We studied 16 healthy subjects of the Human Connectome Project (HCP) database.

### Results

From the k-means analysis, we got 7 FC states. State 1 accounts for about 52% over all windows, which has the homologous pattern with the mean connectivity matrix. States 2-7 occur less frequently (ranging from 7.1% to 24.4%), but represent substantial different patterns with the mean connectivity.

### Conclusions

In this work we proposed a novel framework to study the temporal variability of FC for resting-state MEG data through an atlas-based beamformer approach. Preliminary experimental results showed that even in the resting-state recording, FC changes among several distinct states.

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### 32

#### Image quality assessment and enhancement of a thermal imager for photothermal therapy monitoring

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### Aims

This work is to investigate the spatial resolution and noise property of a thermal imager, FLIR C2, and to use this information to enhance the image quality of the thermal images for monitoring the millimeter-size treatment spot during a photothermal therapy.

### Materials and methods

The slant-edge method was used to estimate the modulate transfer function (MTL) of FLIR C2 for the calculation of the point spread function (PSF). Three image enhancement methods were used to enhance the raw thermal images: 1) bi-lateral filtering (BF); 2) blind deconvolution with damping (BD); and 3) total-variation regularized deconvolution (TD) with PSF.

## Results

The original spatial resolution of FLIR C2 is 0.37 cycles/mm (at 10% of MTF) and the noise is 0.53% at 23 °C and 0.60% at 50 °C. For test thermal images, TD achieved the best performance among three image enhancement methods on both edge recovery and noise suppression. Quantitatively, the TD method improves the spatial resolution of FLIR C2 to 0.68 cycles/mm and the noise slightly to 0.51% at 23 °C and 0.58% at 50 °C.

## Conclusions

The TV-based method can significantly improve the resolution (84%) of FLIR C2 and enable temperature monitoring of the millimeter-size photothermal treatment spot with less than one percent variation.

## Acknowledgements

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### Beamformed RF signals reconstruction in ultrasound imaging using sparse FFT

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## Aims

Sparse fast Fourier transform (SFFT) is a class of sub-linear time algorithms for estimating the  $k$  largest frequency coefficients of a signal which is sparse in the frequency domain. As with the compressive sensing, it is possible for SFFT to acquire sparse signals far below the Nyquist rate, but SFFT is considerably simpler because the original signal can be simply restored by inverse fast Fourier transform. In addition, SFFT can get better reconstructed signal quality from fewer frequency coefficients. The purpose of this paper was to study the SFFT reconstruction for ultrasound beamformed signals.

## Materials and methods

We used Field II ultrasound program with a linear array probe and cyst phantom to simulate the beamformed signals. The SFFT algorithms utilized 3% of signal length as the sparsity parameter  $k$ . A total of 50 rebuilt radio frequency (RF) scan lines were applied to assess the impact of SFFT reconstruction on associated beamformed image.

## Results

The SFFT reconstruction quality was evaluated by keeping 10%-50% candidate frequency coefficients of the original beamformed signal. The results show SFFT can restore the normalized original beamformed scan lines with a mean absolute error range of [0.007-0.015]. The normalized root mean square error ranges for associated beamformed image is [0.052-0.095].

## Conclusions

This paper shows the feasibility of SFFT for reconstructing the ultrasound beamformed signal. The future works include the reconstruction of raw channel RF signals and extending the study in 3D ultrasound imaging system.

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### Medical imaging application of improved genetic algorithm

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## Aims

In order to solve the slow convergence and early mature problems in searching for the image threshold with the traditional

genetic algorithm and Otsu method, the genetic algorithm was improved for better image segmentation in the medical imaging of the lungs.

## Materials and methods

According to the different evolution generation and the individual fitness, this improved genetic algorithm adjusted the strategies of elite selection and genetic operator dynamically, so it not only can speed up the convergence and the diversity of community, but also can get the best image segmentation threshold finally in a stable range. We used the dynamic crossover probability with the formula  $p_c = \frac{k_1}{1+e^{\alpha \times gen}} + \lambda$ , and we set the parameters with  $k_1 = 1$ ,  $\alpha = 0.055$ ,  $\lambda = 0.3$ .

## Results

The simulations were implemented with Matlab and some medical images of the lungs. The lung images showed that the left half pulmonary part was not healthy, the health condition of the right half part was better than the left one. Our approach got the better result and cost less computing time than both the simple Otsu method and the traditional genetic algorithm.

## Conclusions

The proposed algorithm effectively segmented the original medical image, which made the target and background well separated. Our approach not only minimized the noise disturbance, but also enhanced the medical images of the left and right lungs, which was conducive to the subsequent medical diagnosis.

## Acknowledgements

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### Combining graph cuts with improved Voronoi diagrams for the segmentation of overlapped cervical cells

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The segmentation of overlapped cervical cells from Pap smears is one of the most challenging problems in medical image processing field. We present a novel automated system for the cervical cell segmentation of cytoplasm and nuclei from multi-cell images. First, this system employed a graph cuts method including two algorithms, namely unsupervised  $k$ -means initialization and max-flow/min-cut optimization for scene segmentation. The segmented clumps were considered as foreground regions. Then, we used Voronoi diagrams to divide every clump of overlapping cells into individual non-overlapped regions, each containing one nucleus. Finally, to improve the overlapped segmentation, each individual cell in a clump was fitted by a minimum enclosing ellipse and the overlapped region was replaced by the corresponding area in this ellipse. This overlapped area and the connected free-lying region were combined to form a region of one complete cell. The experiments were conducted on two publicly released datasets downloaded from websites of University of Adelaide. The quantitative performance presents the average Dice Coefficient (DC) higher than 0.85. According to the explanation of evaluation metric in datasets, the "good" segmentation is evaluated with the  $DC > 0.7$ . Thus, the result of our proposed system outperforms 0.7 and achieves the state-of-art performance.

## Keywords

Medical image processing, cervical smear image, overlapping segmentation, graph cuts, Voronoi diagrams.

## Acknowledgements

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**Intensity inhomogeneity correction algorithm for brain MRI image segmentation**Wei Liu<sup>1</sup>, ZhiJun Gao<sup>2</sup>, LiSha Tan<sup>3</sup><sup>1</sup>Network Center of Shenyang Jianzhu University, Liaoning, China;<sup>2</sup>Graduate School of Shenyang Jianzhu University, Liaoning, China;<sup>3</sup>Students' Affairs Division of Shenyang Jianzhu University, Liaoning, China**Correspondence:** ZhiJun Gao (gzjun@sjzu.edu.cn)*BMC Medical Imaging* 2016, **16(Suppl 1)**:36**Aims**

To overcome the difficulty in accurate segmentation of brain magnetic resonance imaging (MRI), and reduce noise, partial volume effect and intensity inhomogeneity in MRI images.

**Materials and methods**

A brain MRI image segmentation strategy considering the intensity inhomogeneity is discussed in this paper. We improve basic fuzzy C-means clustering algorithm and propose a new algorithm using anisotropic diffusion for image segmentation. The correction of intensity inhomogeneity is also studied to be implemented to the actual work of MRI image segmentation.

**Results**

The improved algorithm has better restraint effect on intensity inhomogeneity and noise in brain MRI images, so the segmentation accuracy is enhanced. It can also well estimate the information of intensity inhomogeneity.

**Conclusions**

Our scheme can effectively estimate the intensity inhomogeneity information of images. We can get clearer segmentation images by removing intensity inhomogeneity, using the estimation of intensity inhomogeneity when performing image segmentation.

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**A voxel-based approach for sulci detection in 3D brain MR images**

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This paper describes a fully automated method for sulci detection in 3D Magnetic Resonance (MR) images of human brain.

**Materials and methods**

To detect the brain sulci in 3D MR images, several consecutive steps were adopted. Brain image was automated segmented into white matter, gray matter and cerebrospinal fluid (CSF). A topological correction was carried out to make sure there is no direct contact between white matter and CSF. The gray matter/white matter boundary was extracted, and the Euclidean distance transformation was calculated from the boundary to the external regions. The gradient vector field of the distance map was calculated and diffused. Based on the diffused vector field, a divergence map was calculated. Candidate locations for the brain sulci were extracted from the divergence map by a thresholding procedure. Finally, morphological correction, including 3D connected component analysis and morphological operations, were applied to refine the detection results.

**Results**

This algorithm was implemented in C++ on a Windows platform and applied to label the brain sulci in 10 T1-weighted 3D brain MR images. Visual inspection indicates brain sulci in all testing images are correctly identified. Additionally, two major sulci (precentral sulcus and postcentral sulcus) in each hemisphere of the brain were manually labeled by a trained expert. And the overlap ratio between the manual labeling and the results of automated detection was calculated. Six imaging slices were selected from each testing image for the comparison. The average overlap ratio is 0.987±0.021 (the standard deviation).

**Conclusions**

The experimental results indicate this approach can be applied to extract the brain sulci in volumetric brain MR images.

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**CT angiography study on the configuration of the circle of Willis and measurement of posterior communicating artery**

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**Correspondence:** Shaoyin Duan (xmdsy@xmu.edu.cn)*BMC Medical Imaging* 2016, **16(Suppl 1)**:38**Aims**

To observe the configuration of the circle of Willis (CW), measure the size of posterior communicating artery (PcomA).

**Materials and methods**

73 cases CTA data of head and neck (without any lesion in the CW and its surrounding structures) were selected from our hospital. 3D images of CW were obtained, then CW was observed as two classifications and PcomA were measured.

**Results**

In 173 cases, classification 1 of CW found type I-IV is 41 cases (23.7%), 103 (59.5%), 4 (59.5%) and 25 (14.5%), respectively; classification 2 found type I-IV is 26 cases (15%), 11 (6.4%), 116 (67.1%) and 20 (11.5%), respectively. Bilateral PcomA were showed in 45 cases with diameter of  $128 \pm 0.34$ mm, and the maximum is 1.8mm; the unilateral was showed in 36 cases with diameter of  $1.14 \pm 0.36$  mm, and maximum 2.1mm; it is not significant difference of PcomA diameter between unilateral and bilateral, the left and right; no PcomA was showed in 92 cases.

**Conclusion**

Most of CW is the types of complete anterior circulation with incomplete posterior or developmental dysplasia. Diameter of PcomA is 1-2mm, and no PcomA is 53.18%.

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**Early diagnosis of Parkinson disease via multimodal data**Haijun Lei<sup>1</sup>, Jian Zhang<sup>1</sup>, Zhang Yang<sup>2</sup>, Baiying Lei<sup>3</sup><sup>1</sup>College of Computer Science and Software Engineering, Shenzhen

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In this study, we proposed a new united features selection framework based on improved loss function to simultaneously perform classification and clinical scores prediction in Parkinson diseases via multi-modality neuroimaging data. The goal of the new united features selection model is to capture discriminative features that are used to train support vector regression model for clinical scores (sleep scores and olfactory scores) prediction and support vector classification model for class label identification. A promising classification and prediction performance was achieved on a dataset of 179 subjects (56 NC, 123 PD), with a 10-fold cross-validation. The experiment results demonstrated that, compared to only employ one single modality, multi-modality with MRI and DTI can effectively improve the performance in Parkinson classification. Compared to the state-of-art methods, the proposed method achieves a better performance in terms of disease status identification and clinical scores prediction.

**Keywords:** Parkinson's disease, Feature selection, Classification, Prediction, Multi-modality