of services, such as database, process, DICOM communication service and image routing service. These collected data is encapsulated as structural data, embedded into XMPP Message and then sent to CMM through XMPP channel. The CMM extracts data from receiving message and analyze it for resource statistic, performance estimation. When node failure or service unavailable occurs, CMM invokes rule engine with customized rule sets loading to diagnose and restore. As the rule engine is running, control-type message could be generated and sent to MC for executing. Besides, the CMM publishes services for CC to query the latest or even real-time monitoring data. The CC could be a browser which is used to display the historical and current status of whole system and customize workflow of diagnosis and restoring. It could also be an application which schedule the storage and computing resource considering load balance and quality of service.

Results:

The intelligent monitoring and management system for cross-enterprise biomedical data sharing platform were able to endure with the stress of monitoring more than 100 nodes concurrently, each monitoring client cost lower than 50MB memory and little CPU and network utilization rate, and doesn't cause obvious performance degradation of the system.

New Technologies and Results to be presented:

We designed a message communication framework based on XMPP (Extensible Messaging and Presence Protocol) which provide send-response and publish-subscribe communication pattern. We also adopt rule engine for diagnosis and restoring node failure. It helps promote the flexibility since it separates changeable business logic from code.

Conclusion:

The intelligent monitoring and management system for cross-enterprise biomedical data sharing platform integrated in our e-Science platform provides the function of quickly monitoring ,early failure detection and restoring, It promotes the robustness, reliability and service continuity of cross-enterprise biomedical data sharing platform.

8674-30, Session PSWed

3D segmentation and image annotation for quantitative diagnosis in lung CT images with pulmonary lesions

Suo Li, Shanghai Institute of Technology and Physics (China); Jianguo Zhang, Shanghai Institute of Technical Physics (China)

Pulmonary nodules, honeycombing and ground glass opacities are highly significant findings in high-resolution computed tomography (HRCT) of patients with COPD (Chronic Obstructive Pulmonary Disease). Currently, most of the studies have focused on two-dimensional quantitative analysis of these kinds of deceases. Compared to two-dimensional images, three-dimensional quantitative analysis can take full advantage of isotropic image data acquired by using thin slicing HRCT in space and has better quantitative precision for clinical diagnosis. This presentation gives an approach to segment 3D disease areas of nodules, honeycombing and ground glass opacities in lung CT images, and use AIML (Annotation and image makeup language) to annotate the segmented 3D pulmonary lesions which may provide more features and information to the radiologists in clinical diagnosis.

8674-31, Session PSWed

Rapid deployment of a Monte Carlo simulation system using diskless remote boot in Linux in a PACS environment

Yuan-Jen Chang, Central Taiwan University of Science and Technology (Taiwan); Yan-Lin Liu, Cheng-Ting Shih, National Tsing Hua Univ. (Taiwan); Shu-Jun Chang, Institute of Nuclear Energy Research (Taiwan); Jay Wu, China Medical Univ. (Taiwan)

Monte Carlo (MC) simulation has been widely used as the gold standard for interaction of radiation with matter in the fields of medical physics, radiation therapy, and nuclear medicine. However, it is time consuming and may require a lot of computational resources. Generally, a dedicated high performance computing cluster is use to improve the efficiency, but it is costly and lacks of the ability to run routine tasks. In this study, we proposed a method for rapid deployment of computing platform for MC simulation in the PACS environment using review workstations as computing nodes. The workstations were booted from the network and initialed a RAM disk as the boot sector. The simplified Linux operating system and the Monte Carlo N-Particle Transport Code Version 5 were transferred from a DRBL (Diskless Remote Boot in Linux) server to each computer automatically. The cluster computing environment can be established within 4 minutes. We compared a commercially available dedicated cluster (HyperCluster, Infowrap, Taiwan) with the DRBL cluster. The results show that the commercial cluster had slightly higher AF than the DRBL cluster. The simulation time of the commercial and DRBL clusters for 2.0x108 histories was 37,151 and 40,021 sec, respectively. When the number of rendezvous increased to 20, the maximum time differences between both clusters were 95 and 85 sec for the megabit and gigabit switches. We conclude that the DRBL cluster can be quickly deployed to the non-workloaded review workstations in the PACS. Thus, the MC technique could be broadly used for radiological research in the healthcare facility.

8674-32, Session PSWed

Integration of PACS and CAD systems using DICOMDIR and open-source tools

Jiaxin Huang, Alexander Ling M.D., Ronald M. Summers M.D., Jianhua Yao, National Institutes of Health (United States)

The advancements of the last 30 years have made picture archiving and communication systems (PACS) an indispensable technology to improve the delivery and management of clinical imaging services. Similarly, the maturation of algorithms and computer aided detection (CAD) systems has enhanced the interpretation and diagnosis of radiographical images. However, the lack of integration between the two systems inhibits the rate of development and application of these recent innovations in reaching the clinical users of PACS. We aim to enhance the clinical efficiency of CAD systems by developing an accessible, fully automated, user-friendly, and integrated linkage of CAD and PACS systems. This is the first integration initiative to take advantage of DICOMDIR file and its ability to index DICOM files, allowing images outside of PACS to be viewed within PACS. In this demonstration, the CAD system evaluates CT chest exams to detect lesions in the ribs and produces whole rib map images, screenshots, and detection report. A script executes the rib CAD system and creates a DICOMDIR file using 'DCMTK', an open-source DICOM toolkit. We evaluated our system on thirty 5mm slice thickness and thirty 2mm slice thickness image studies and demonstrated a time saving efficiency of 93s±14s and 221s±17s per exam, respectively, compared to the current non-integrated workflow of using CAD systems. The advantages of this system are that it is easy to implement, requires no additional workstation and training, and allows CAD results to be viewed in PACS without disrupting radiology workflow, while maintaining the independence of both technologies.

transformation is correct within 0.05mm and 0.05 degrees.

Influence of a feature point jitter of 0.5px is 0.03mm for a point close to the cameras and 0.3mm for a point close to the back of the patient's head. Tracked poses are correct within 0.17mm and 0.001 degrees.

8668-85, Session PSWed

Truncation correction for VOI C-arm CT using scattered radiation

Bastian Bier, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Andreas K. Maier, Siemens AG (Germany); Hannes G. Hofmann, Chris Schwemmer, Yan Xia, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Tobias Struffert, Univ. Erlangen (Germany); Joachim Hornegger, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany)

In this paper, we presented a new method of truncation correction using scattered radiation. First tests showed that the method works as well as other state-of-the-art correction methods, like the Water-Cylinder Correction, which are already in clinical use. Our method has advantages if bones are truncated. Dense objects can be reconstructed in the area outside the FOV, and no cupping occurred in our method.

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8668-86, Session PSWed

A papillary muscle guided motion estimation method for gated cardiac imaging

Jizhe Wang, George S. K. Fung, Tao Feng, Benjamin Tsui, Johns Hopkins Univ. (United States)

This research aims to develop a new feature guided motion estimation method for the left ventricular wall in gated cardiac imaging. The guiding feature is the "footprint" of the papillary muscle, which is the attachment of the papillary muscle on the endocardium. Since the footprint can be tracked accurately, this feature guided approach will significantly improve the accuracy and robustness of traditional optical flow based motion estimation method. First, the 4-D XCAT phantom, with papillary muscles, cardiac motion and motion vector field (MVF), was used to simulate typical gated myocardial PET images. The 4-D MVF of the heart model of the phantom was generated as a reference. Second, for each gated cardiac image, the 3-D "footprint" surface of the papillary muscle was extracted and its centroid was calculated. Third, the motion of the centroid of the "footprint" throughout a cardiac cycle was tracked and analyzed in 4-D. This motion was extrapolated to build a papillary muscle guided initial estimation of the 4-D MVF of the left ventricular wall according to the relationship between the magnitude of the longitudinal motion and the longitudinal height of the myocardium reported in the literature. Last, we applied our previously developed motion estimation algorithms with three different initial MVF estimates, including zero initial (0-initial), papillary muscle guided initial (P-initial), and true MVF from phantom (T-initial) on the simulated gated myocardial PET images. Qualitative and quantitative comparison between the estimated MVFs and the true MVF has shown that P-initial always achieves more accurate motion estimation than 0-initial with 25% to 75% improvement and comparable estimation with T-initial in longitudinal motion.

8668-87, Session PSWed

Noise reduction of low-dose computed tomography by using the multi-resolution total variation minimization algorithm

Cheng-Ting Shih, National Tsing Hua Univ. (Taiwan); Shu-Jun Chang, Institute of Nuclear Energy Research (Taiwan); Yan-lin Liu, National Tsing Hua Univ. (Taiwan); Jay Wu, China Medical Univ. (Taiwan)

Computed tomography (CT) has become a popular tool in radiologic diagnosis due to the ability of obtaining high-resolution anatomical images. However, radiation doses to patients are substantial and can increase the risk of cancer incidence. Although lowering the tube current is a direct way to reduce absorbed doses, insufficient photon numbers can cause severe quantum mottle and subsequently degrade the diagnostic value of CT images. In this study, we proposed an algorithm for noise reduction of low-dose computed tomography (LDCT) based on the multiresolution total variation minimization (MRTV) method. The discrete wavelet transform was used to decompose the CT image into high- and low-frequency wavelet coefficients. The total variation minimization with suitable tuning parameters was then applied to reduce the variance among the wavelet coefficients. The noise-reduced image was reconstructed by the inverse wavelet transform. The results of the Shepp-Logan phantom added with Gaussian white noise showed that the noise was eliminated effectively and the SNR was increased by a factor of 9. In the clinical head CT scan with a tube current of 9.12 mA, the MRTV successfully removed the severe noise in the parenchyma region, and SNR was increased by 3 to 4 times. In addition, the details of the septal structure of the sinus cavity were maintained. We conclude that the MRTV approach can effectively reduce the image noise caused by tube current insufficiency, and thereby could improve the diagnostic value of LDCT images.

8668-88, Session PSWed

Monte Carlo modeling of field angle-dependent spectra for x-ray imaging systems

Edward B. Gindele, Carestream Health, Inc. (United States)

The photon spectrum for x-ray capture systems is a function of field angle. The spectrum variability is most pronounced for cone beam CT systems with wide field angles operating close to the anode angle limit. Filtration devices also contribute to the change in photon spectrum with field angle especially for variable-thickness filters, e.g., bow-tie filters. The change in photon spectrum is primarily due to the distance traversed through anode and filtration materials with field angle. Although Monte Carlo x-ray simulations can include the materials and geometries for these source assembly elements, the computational requirements can be prohibitive. As a consequence, most x-ray Monte Carlo simulation implementations ignore field angle spectral effects. Our uses a probabilistic rejection scheme to model the field angle spectral effects within the context of a Monte Carlo simulation tool. A bounding spectrum is constructed that supercedes all possible spectrums for all field angles. Photons are generated with the bounding spectrum and rejected or accepted based on the probability of transmission through the cascade of anode and filtration materials relative to a pre-calculated maximum probability of transmission. The resultant photon spectrum properly models the intensity and spectral shape of emitted photons as a function of field angle. For a wide field angle CBCT system, approximately 20% of the generated photons are rejected, with less than a 10% additional computation cost.