THAI MEDICAL PHYSICIST SOCIETY

9th Annual Scientific Meeting

Proceedings

FEBRUARY 26-28, 2015
UDONTHANI
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Thai Medical Physicist Society

9th Annual Scientific Meeting

"Advancement in Imaging and Radiotherapy through Medical Physics"

February 26-28, 2015

At

Centara Hotel and Convention Centre

Udonthani

Thailand

Message from President

Dear Colleagues,

On behalf of the Thai Medical Physicist Society, it is my great pleasure to welcome you to the 9th Annual Scientific Meeting on February 26-28, 2015 at Centara Hotel and Convention Centre Udonthani, Thailand. The theme is "Advancement in Imaging and Radiotherapy through Medical Physics". The reason for organizing the 9th Congress in Udonthani is that we would like to extend our warm welcome to participants from Lao PDR for their beginning in radiotherapy service.

Thai Medical Physicist Society was officially founded on June 12, 2001 with the purpose of the promotion of the cooperation and communication between medical physicists in Thailand. The main purpose is to organize the Scientific Conferences, Meetings or Courses with other scientific organizations in the country, regional and inter regional medical physics organizations. The Society organizes the annual meeting as the followings:

First Meeting	(2006):	Lopburi province
Second Meeting	(2008):	Cholchan Pattaya Resort, Cholburi
Third Meeting	(2009):	Aor Por Ror Building, Chulalongkorn University
Forth Meeting	(2010):	The Golden Jubilee Building, New Petchaburi Road
Fifth Meeting	(2011):	BP Samila Hotel &Resort, Songkhla
Sixth Meeting	(2012):	Amarin Lagoon Hotel, Phitsanulok
Seventh Meeting	(2012):	Khum Phu Come Hotel, Chiang Mai
Eighth Meeting	(2014):	Montien Riverside, Bangkok

This meeting was prepared to bring you a meeting of the scientific and educational quality. 13 Invited lectures, 2 Symposia and Proffered paper sessions of 9 oral presentations are arranged. While attending the meeting, you will have the best opportunity to learn and share new information and recent advance of medical physics, radiology and other relevant fields through lectures, symposium, workshop from distinguished invited speakers, oral presentations and commercial exhibition of advanced products.

My sincere thanks are forwarded to Professor Franco Milano, University of Florence, Professor Roger Fulton University of Sydney, Dr.James CL Lee, National Cancer Centre Singapore for their kind contributions to our Society. Special thanks to eminent senior physicists and young medical physicists for lectures, symposium and research presentations in the proffered paper sessions. Lastly, my thanks give to commercial exhibitions, for all of your supports to the Annual Scientific Meeting in Udonthani.

I wish you enjoy the meeting, scientific exhibitions, Reception party, Welcome Dinner and have the enjoyable trip back home.

Please keep our constant concern and cooperation for Thai Medical Physicist Society

Thank you.

Anchal

Anchali Krisanachinda,Ph.D.
President, TMPS
February 26, 2015

Organizing Committee

Chair	Anchali Krisanachinda
Deputy chair	Surat Vinijsorn
Scientific	Sivalee Suriyapee Chirapha Tannanonta Chumpot Kakanaporn Napapong pongnapang Puangpen Tangboonduangjit
Present & Certificate	Petcharleeya Suwanpradit Swe Swe Lin Ohnmar Swe Chatsuda Songsang
Registration	Paranee Sahachjesdakul Kamonrat Sueangamiam Watcharaphawn Sanklaa Khanitha Chanudom
Secretary	Taweap Sanghangthum
Master of Ceremony	Napapong Pongnapang Chumpot Kakanaporn
Public Relations	Panya Pasawang
Scientific Exhibition	Sivalee Suriyapee Panya Pasawang Petcharleeya Suwanpradit Swe Zin Lat Yin Yin Pyone
Audio-Visual	Taweap Sanghangthum Piyatas Sangdao Jaroonroj Wongnil Yutthana Netwong
Editor	Tawatchai Chaiwatanarat

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Puangpen Tangboonduangjit

09.30-10.30 "SRS & SBRT"
Pornpan Yongvithitsatid, Kumutinee Pairat

10.30-11.00 Coffee break and visit commercial and scientific exhibitions

11.00-12.00 "The non-targeted effects of proton and carbon radiotherapy: From molecular and cellular response to the clinic"
Narongchai Autsavapromporn

Room: Namsom3 ***Medical imaging***

Moderator: Napapong Pongnapang

08.30-09.30 "Patient dosimetry in diagnostic radiology"
Napapong Pongnapang

09.30-10.30 "PET/CT quality control"
Panya Pasawang, Anchali Krisanachinda

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11.00-12.00 "Methods for rigid motion compensation in human and awake animal imaging"
Roger Fulton

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Room: Bannpue

Moderator: Surat Vinijsorn

13.00-13.45 "SPECT image reconstruction"
Yothin Rakvongthai

13.45-14.45 Absorbed dose determination and chamber cross-calibration for MeV electrons in radiotherapy (TRS398)
James CL Lee

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Friday, 27 February 2015

Room: Thungsrimuang

07.00-08.30 Registration

08.30-09.00 Opening ceremony

Invited Lecture

Moderator: Puangpen Tangboonduangjit

09.00-10.00 "Physics of proton therapy and its establishment at NCCS"
James CL Lee

10.00-10.30 "Compensation for rigid patient motion in helical CT"
Roger Fulton

10.30-11.00 Coffee break and visit commercial and scientific exhibitions

11.00-12.00 "The role of scientific professional societies in the event of a radiation disaster. Planning the patient radiological assessment and its medical management"
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Kanogpan Prasartvit, Pimolpun Changkaew, Nuanpen Damrongkijudom, Puangpen Tangboonduangjit

Room: Namsom3 ***Medical Imaging***

Moderator: Napapong Pongnapang

13.00-13.30 Fukushima nuclear disaster
Anchali Krisanachinda

Proffered paper

13.30-13.40 "Effect of automatic motion correction on SPECT myocardial perfusion imaging"
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Panya Pasawang, Ohnmar Swe, Anchali Krisanachinda

13.50-14.00 "Influence factors on the effectiveness of cyclotron and synthesizer applications for PET/CT scans in Thailand and Japan"
Jessadapong Phumruamjai, Karn Wimolwattanasarn, Kanokwarin Chiangsong, Tarinee Boonyawan, Nonglak Vilasdechanon

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14.20-14.30 "Experimental comparison of CT image quality with scan protocols for upper abdomen using a Catphan phantom"
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14.40-15.00 Coffee break and visit commercial and scientific exhibitions

18.00-22.00 Welcome party at Room Pansiri, Pannarai Hotel hosted by Business Alignment

CLASSIFICATION OF NOISES IN COMPUTED RADIOGRAPHY IMAGE

Boonserm Nerysungnoen[1], Jessada Tanthanuch[2]

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Introduction: The purposes of this study are to create the instances for machine learning and to classify noises in Computed Radiography (CR) image, which is restricted to whether Gaussian noise or Poisson noise. In the study, the phantom was assumed to represent a patient.

Methods: The CR image of the phantom was refined, which was supposed to be the noiseless original image. Process of the study is as follows. First, the instances were created by overlaying known-noises to the original image. The MSE, PSNR, and SD were calculated from each modified image. After that, decision tree (J48) was applied to classify the types by 4 attributes (MSE, PSNR, SD and Class). Finally, the noises overlaid to CR image were classified.

Results & Discussion: The results were presented by the following. The 1,228 instances were created for machine learning, which provided the accuracy for 71.99% and 14 rules for the classification. Furthermore the unknown-noise CR image was examined. It was found that it possessed the noise of Poisson type.

Conclusion: This research is a technique to analyze medical x-ray images which is a basis for development in the future.

Classification of Noises in Computed Radiography Image

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Abstract— **The purposes of this study are to create the instances for machine learning and to classify noises in Computed Radiography (CR) image, which is restricted to whether Gaussian noise or Poisson noise. In the study, the phantom was assumed to represent a patient. The CR image of the phantom was refined, which was supposed to be the noiseless original image. Process of the study is as follows. First, the instances were created by overlaying known-noises to the original image. The MSE, PSNR, and SD were calculated from each modified image. After that, decision tree (J48) was applied to classify the types by 4 attributes (MSE, PSNR, SD and Class). Finally, the noises overlaid to CR image were classified. The results were presented by the following. The 1,228 instances were created for machine learning, which provided the accuracy for 71.99% and 14 rules for the classification. Furthermore the unknown-noise CR image was examined. It was found that it possessed the noise of Poisson type. This research is a technique to analyze medical x-ray images which is a basis for development in the future.**

Keywords— **Classification, Gaussian noise, Poisson noise, Computed Radiography, Machine Learning**

I. Introduction

Computed radiography (CR) uses a photostimulable storage phosphor that stores the latent image with subsequent processing using a stimulating laser beam and can be easily adapted to a cassette based system analogous to that used in screen-film radiography [1]. There are many advantages of having digital X-ray, e.g. the images can be viewed, extended, measured and compared on a monitor by the Radiologist. Since the images are produced digitally, they can be stored for long term and have less risk of losing and less storage space than the conventional X-ray films have. Digital radiography has wide dynamic range and can be processed repeatedly without compromising on quality [2]. However, image noise is a key factor that reduces the quality of X-ray images. It sometimes causes the deficiency of images which leads to misdiagnose.

Gaussian noise is statistical noise having a probability density function (PDF) equal to that of the normal distribution, which is also known as the Gaussian distribution. In other words, the values that the noise can take on are Gaussian distributed. The probability density function PDF of a Gaussian random variable g is given by:

$$PDF_{Gaussian}(g) = \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{(g-\mu)^2}{2\sigma^2}}$$

where *equation* represents gray level, μ is the mean value and σ is its standard deviation.

Individual photon detections can be treated as independent events that follow a random temporal distribution. As a result, photon counting is a classic Poisson process, and the number of photons k measured by a given sensor element over a time interval t is described by the discrete probability distribution

$$P(k) = \frac{e^{-\lambda t}(\lambda t)^k}{k!}$$

where λ is the expected number of photons per unit time interval, which is proportional to the incident scene irradiance. This is a standard Poisson distribution with a rate parameter λt that corresponds to the expected incident photon count. The uncertainty described by this distribution is known as photon noise [2].

Poisson noise prevails in situations where an image is created by the accumulation of photons over a detector. Typical examples are found in standard X- ray films, CCD cameras, and infrared photometers [3].

Classification techniques can be grouped into two main types: supervised and unsupervised. Supervised classification relies on having example pattern or feature vectors which have already been assigned to a defined class. Using a sample of such feature vectors as our training data, a classification system was designed with the intention and the hope that new examples of feature vectors no used in the design will subsequently be classified accurately. In supervised classification then, the aim is to use training examples to design a classifier which generalizes well to new examples. By contrast, unsupervised classification does not rely on possession of existing examples from a known pattern class [4].

A decision tree is defined as a connected, acyclic, undirected graph, with a root node, zero or more internal nodes (all nodes except the root and the leaves), and one or more leaf nodes (terminal nodes with no children), which will be termed as an ordered tree if the children of each node are ordered (normally from left to right). A tree is termed as univariate, if it splits the node using a single attribute or a multivariate, if it uses several attributes.

A binary tree is an ordered tree such that each child of a node is distinguished either as a left child or a right child and no node has more than one left child or more than one right child. For a binary decision tree, the root node and all internal nodes have two child nodes. All non-terminal nodes contain splits [5].

The basic algorithm for decision tree is a greedy algorithm that constructs decision tree in a top-down recursive divide-and-conquer manner. Assuming that a training set consisting of feature vectors and their corresponding class labels are available, the decision tree is then constructed by partitioning the feature space in such a way as to recursively generate the tree. This procedure involves: create a root node; for each known feature value of the sample, partition the samples grow a branch node from the root node. And determining which nodes are terminal nodes (it is leaf node), assign class labels to terminal nodes. Obviously, the most important step is partition the samples to grow the branch node. One of the popular algorithms for design the decision tree is C4.5 [6]. The information gain is used as the criterion for splitting the nodes. The feature attribute of the sample with the high information gain is chosen as the test attribute for the current node. This feature attribute minimizes the Information needed to classify the samples in the resulting partitions and reflects the least randomness in these partitions. It guarantees that a simple tree is found.

The objectives of this study are to create the instances for machine learning and to classify noises in CR image, which is restricted to whether Gaussian noise or Poisson noise.

II. Materials and Methods

A. Materials

Toshiba KXO-50R, FCR Capsula XLII and imaging plate 20.1 cm x 25.2 cm were x-ray equipment in this study. The phantom utilized in this study was constructed as shown in Fig. 1. They were composed of 2 cm thick acrylic sheets of sizes 12 cm x 12 cm, 10 cm x 10 cm, 8 cm x 8 cm and 6 cm x 6 cm.

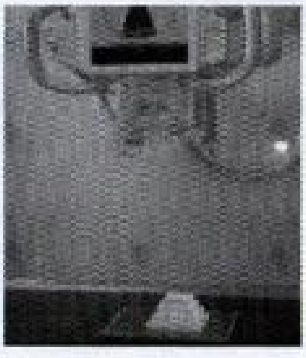

Fig. 1 Phantom

B. Methods

The instances were created for study as shown in Fig. 2. The original image was produced from CR system then adjusted to the lowest noise. The image was assumed noiseless and was added the known-noise, Gaussian and Poisson.

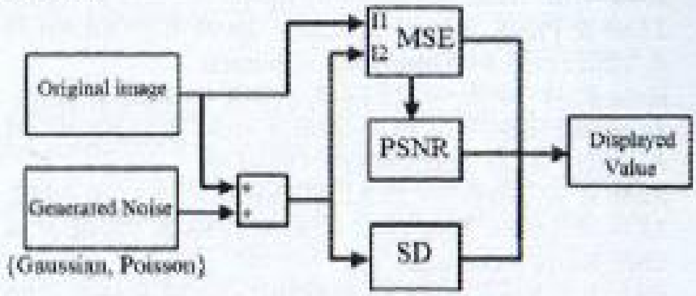

Fig. 2 Diagram for created instances

The machine learning processes were trained by training data and testing data using decision tree method, C4.5 or J48 algorithm to classify from 4 attributes (MSE, PSNR, SD, and class).

The classification of Gaussian and Poisson noises used unseen data, CR image was classified.

III. Results

The results of evaluation are shown in Table 1.

Table 1 Classification of noises

Retrieved or Classified as	(Gaussian)	(Poisson)	Test set	Class weight
Gaussian	309	306	615	0.50
Poisson	38	575	613	0.50
	347	881	1228	1.00

The evaluating categorical output of machine learning is shown in Table 2.

Table 2 Evaluating categorical output

	Precision	Recall	F-Measure
Gaussian	0.89	0.50	0.64
Poisson	0.65	0.94	0.77
Average	0.77	0.72	0.70
Weighted average	0.77	0.72	0.70

The correctness of classification using J48 is 71.99%. Overall error is 28.01%.

The training used to classify Gaussian and Poisson noises as 14 rules, all the following.

Rule 1: IF MSE <= 25.14 & PSNR <= 34.32 Then Noise = Poisson

Rule 2: IF MSE <= 25.14 & PSNR > 34.32 & MSE <= 22.94 & PSNR <= 34.75 Then Noise = Poisson

Rule 3: IF MSE <= 25.14 & PSNR > 34.32 & MSE <= 22.94 & PSNR > 34.75 & MSE <= 19.94 Then Noise = Poisson

Rule 4: IF MSE <= 25.14 & PSNR > 34.32 & MSE <= 22.94 & PSNR > 34.75 & MSE > 19.94 & PSNR <= 34.97 & MSE <= 21.81 Then Noise = Poisson

Rule 5: IF MSE <= 25.14 & PSNR > 34.32 & MSE <= 22.94 & PSNR > 34.75 & MSE > 19.94 & PSNR <= 34.97 & MSE > 21.81 Then Noise = Gaussian

Rule 6: IF MSE <= 25.14 & PSNR > 34.32 & MSE <= 22.94 & PSNR > 34.75 & MSE > 19.94 & PSNR > 34.97 Then Noise = Gaussian

Rule 7: IF MSE <= 25.14 & PSNR > 34.32 & MSE > 22.94 & MSE <= 23.24 & sd <= 15.29 Then Noise = Gaussian

Rule 8: IF MSE <= 25.14 & PSNR > 34.32 & MSE > 22.94 & MSE <= 23.24 & sd > 15.29 Then Noise = Poisson

Rule 9: IF MSE <= 25.14 & PSNR > 34.32 & MSE > 22.94 & MSE > 23.24 Then Noise = Gaussian

Rule 10: IF MSE > 25.14 & PSNR <= 31.51 & MSE <= 44.26 & PSNR <= 31.24 Then Noise = Poisson

Rule 11: IF MSE > 25.14 & PSNR <= 31.51 & MSE <= 44.26 & PSNR > 31.24 & sd <= 17 Then Noise = Poisson

Rule 12: IF MSE > 25.14 & PSNR <= 31.51 & MSE <= 44.26 & PSNR > 31.24 & sd > 17 Then Noise = Gaussian

Rule 13: IF MSE > 25.14 & PSNR <= 31.51 & MSE > 44.26 Then Noise = Gaussian

Rule 14: IF MSE > 25.14 & PSNR > 31.51 Then Noise = Gaussian

The unseen data is CR image. It did not process from vendor's software for noise reduction. The classification was used rule 3, IF MSE <= 25.14 & PSNR > 34.32 & MSE <= 22.94 & PSNR > 34.75 & MSE <= 19.94 Then noise is Poisson.

IV. Discussion

The all instances were created from original image that it was generated known-noise, varying Gaussian and Poisson noises [7]. The machine learning provided the accuracy for 71.99% and 14 rules for the classification. Furthermore the unknown-noise CR image was examined. It was found that it possessed the noise of Poisson type [8, 9]. The CR image, which is unseen data, was assumed radiography image and noise. It was categorized by decision rules, results from machine learning.

V. Conclusions

The 1,228 instances were used for machine learning to classify the Gaussian and Poisson noises in CR image. The Poisson noise was classified by decision tree rule, J48 algorithm. This research is a technique to analyze medical x-ray images which is a basis for development in the future. Our next research will focus on applying the algorithm for noise reduction. Because image noise is a key factor that reduces the quality of X-ray images. It sometimes causes the deficiency of images which leads to misdiagnose.

Acknowledgments

We thank Maharat Nakhon Ratchasima Hospital, School of Information Technology, and School of Mathematics, Suranaree University of Technology, for supporting and allowing us to work on this research.

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