APPLICATION OF PSF-BASED VIRTUAL NODULES TO ASSESS THE PERFORMANCE OF LUNG CANCER CT SCREENING CAD SYSTEM

Janaka C Marasinghe[1,2], Masaki Ohkubo[1], Hajime Kobayashi[1], Kohei Murao[3], Toru Matsumoto[4], Shinji Niizuma[5], Shusuke Sone[6], Shinichi Wada[1]

[1]*Graduate School of Health Sciences, Faculty of Medicine, Niigata University, Niigata, Japan*
[2]*Department of Radiography/Radiotherapy, Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Fujitsu Ltd., Tokyo, Japan*
[4]*Kensei Clinic, Chiba,Japan*
[5]*Plaka Health Care Center, Niigata, Japan*
[6]*Nagano Health Promotion Corporation, Nagano, Japan*

Introduction: Computer Aided Diagnosis (CAD) has been attracting extensive research interest during the last two decades. It has recognized that the full potential of CAD can only be realized by improving the performance and robustness of CAD algorithms and this requires good evaluation methodology that would permit CAD designers to optimize their algorithms.Anaccredited method has not yet been established for evaluation of performances of CAD systems.However, CAD systemsare commercially available and used in clinical practices. In this study we have proposed a new approach of application of virtual nodules based on Point Spread Function (PSF) on clinical images to assess the lung cancer CT screening CAD system performances dependency on nodule characteristics as well as slice thickness.

Methods: Computer-simulated nodules based on the PSF measured in CT systems were used to generate virtual nodules with different densities and sizes. Clinical images of two clinics where the lung screenings have done with thin slices (1mm) and thick slices (8mm) were selected. In order to get data regarding slice thickness and nodule density dependency,virtual nodules with equal size and different densities were fused on screening images of each clinic. Then Virtual nodules with different diameters from 4 to 8 mm were generated and applied on clinical imagesofthick slices to get data for nodule size dependency. After taking the CAD outputsROC curves were plottedby using TPR and FP and analyzed for slice thickness, nodule density and nodule size dependency.

Results&Discussion: According to the obtained results for the slice thickness and nodule density dependency, used CAD system shows good performance (TPR>0.8) with both thick (8 mm) and thin (1 mm)slices. However,ROC curves of thick slices show higher (about 10%) TPRthan that of corresponding thin slices with the nodules of same size and density.ROC curves show that when the nodule size increases CAD performance also increases up to the nodules with 6 mm diameter. Nodules with diameter above 5 mm can be detected with TPR more than 0.8. Almost equal detection efficiency can be seen for nodules with diameter above 6 mm.

Conclusions: Newly proposed PSF based virtual nodules could be effectively used to assess the performance of CAD system for lung cancer CT screening. Tested CAD system has performed more efficiently with thick slices and high density noduleswith diameter above 5 mm.