A Feasibility Study of Deep Learning Technique in Distinguishing Normal Lungs, Pulmonary Tuberculosis and Non-tuberculous Mycobacterial Lung Disease on Chest CT

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ABSTRACT

Recently, the deep learning techniques have been introduced to the various image tasks instead of using traditional image processing or computer vision, for example, image classification, object detection and semantic segmentation. Using the deep learning methods contribute to developments in those area in the aspect of accuracy and computational cost. Driven by the advancements, not only the usage of medical imaging data, like CT(Computed Tomography) or MRI(Magnetic Resonance Imaging), is increasing but also researches of using this data. The wealth of features contained in this data is likely to have novel usages in diagnosis and care, if we are able to handle with the information. The advancement of deep learning offers some hope of coming up with an efficient way to deal with this information based on content to give an advice to the experts in medical.

In this paper, our purpose is to evaluate the diagnostic performance of deep learning technique in distinguishing normal lungs, pulmonary tuberculosis (TB) and non-tuberculous mycobacterial (NTM) lung disease on chest CT.

All CT data were obtained in 329 patients with normal lungs (n = 113), pulmonary TB (n = 115) and NTM lung disease (n = 101). From these CT data, we included 11641 CT images of normal lungs, 5851 CT images of pulmonary TB and 5963 CT images of NTM lung disease in the training and test sets. We used the VGG (visual geometry group)-16 network, which is one of the most popular networks currently for classifying images and won the second place on the ILSVRC (ImageNet Large Scale Visual Recognition Challenge) 2014 competition. It has enough layers and parameters for finding features in large complex images. We used the pre-trained parameters trained on the ILSVRC classification task before fully connected layers and got feature vectors for each image. Each image turn into 4096 length feature vectors and passed through one hidden layer and output layer for classifying the image belongs to normal, TB and NTM groups. We trained with 17255 CT images consist of 6917 normal images, 5393 TB images and 4945 NTM images. After training, we tested 6200 CT images which were not included in the training set. We also trained and tested for normal group versus abnormal group consisting of TB and NTM.

The test result showed 80.6% in the two groups (79.6% in normal group and 83.8% in abnormal group). Our study revealed that the deep learning technique may have
potential and good feasibility for distinguishing normal lung images with abnormal lung images.

![Diagram](image)

Figure 1. A classification model using VGG-16 network.

![Images](image)

Figure 2. (a) A filtered image after 1st conv. layer (b) Some filtered images after 5th conv. layer

REFERENCES


