Semi-Supervised Detection of Chest Diseases using Generative Adversarial Networks

Noor Sajid[1], Paul Taylor[1,3], Daniel C. Alexander[2,1], and Waty Lilaonitkul[3]

[1] University College London (UCL), London, UK
[2] Dept. of Computer Science, UCL, UK
[3] Institute of Health Informatics, UCL, UK

Abstract. In the UK, chest diseases are responsible for over 20% of all deaths annually. These diseases include tuberculosis, chronic obstructive pulmonary disease, pneumonia and other lung diseases. The correct and timely detection of these could greatly enhance the real world diagnosis processes. Chest radiography has become an important tool used for diagnosing these. However, making effective use of these x-rays for automated diagnosis, has been limited due to lack of publicly available labeled data-sets and benchmark studies. Due to these challenges, we frame this as an anomaly detection problem with the intent of accurately differentiating between normal and healthy chests. By employing this approach, we aim to highlight that a conditional generative adversarial network, with encoder-decoder-encoder sub-networks in the generator network, is informative in its ability to detect abnormal characteristics. During the training phase, the latent representation of the high-dimensional healthy chest image space is learnt. At inference, the distance from healthy chest latent representation is measured and larger distance is indicative of an anomaly. The model is trained on an existing large corpus of normal chest radiography collected under the University College London Hospital's Find and Treat outreach program. Before training, each image is sliced into $n * n$ parts to mimic the local-global process a radiologist goes through when looking for symptoms indicative of a chest disease. During the inference phase, the model is tested on a number of different diseases including tuberculosis, pneumonia, fibrosis, hernia, edema. The results show that the proposed approach is able to identify localised abnormal characteristics for accurate detection. We further analyse the networks within the GANs to understand what parts of the chest x-ray is responsible for characterising abnormality using gradient-based saliency maps.

Keywords: generative adversarial networks · anomaly detection · chest x-rays