

IDENTIFICATION OF TUBERCULOSIS IN CHEST RADIOGRAPHS USING LEVEL SET SEGMENTATION AND SCALE INVARIANT KEYPOINTS

Satyavratan Govindarajan, Niranjana Srinivasan, Ramakrishnan Swaminathan
Department of Applied Mechanics, Indian Institute of Technology Madras, Chennai, India
email: s.vratan@gmail.com, nsrini2@gmail.com, sramki@iitm.ac.in

ABSTRACT

Localized intensity variations in lung regions and its boundaries provide valuable image-based information for the diagnosis of lung diseases such as Tuberculosis (TB). The Chest X-ray (CXR) is often used as a preliminary non-invasive examination tool in the diagnosis of TB. The manifestations such as bilateral nodular infiltrates and effusion of active TB demonstrate subtle abnormal findings in the CXRs. Appropriate image processing techniques are necessary to handle high shape and intensity variations and low-gradient edges in lungs for the detection of such abnormalities. In this work, an attempt is made to identify TB affected lungs in chest radiographs using Level Set method and Scale Invariant Feature Transform (SIFT) keypoints. The CXR images for this study are considered from the Montgomery County TB dataset. Distance Regularized Level Set Evolution (DRLSE) technique is applied to segment lung fields in normal and TB CXRs. Similarity and overlap measures are computed from segmented lung fields and are validated against ground truth. SIFT keypoints are extracted from segmented images to characterize the local image information. Results demonstrate that the DRLSE method is able to extract lung fields in normal and TB X-ray images. The number of SIFT keypoints are able to differentiate right and left lung normal and TB images. The segmentation validation measures are found to be in high correlation with the ground truth. Significant discrimination in mean and standard deviation of number of SIFT keypoints for normal and abnormal bilateral lung images is observed. Thus, this study appears to have a clinical significance in the identification of bilateral TB affected lungs.

Keywords: Chest X-ray; Tuberculosis; Distance regularized level set; Scale invariant feature transform; Keypoint

INTRODUCTION

Tuberculosis (TB) is a contagious lung disease caused by the bacteria bacillus Mycobacterium tuberculosis. This airborne communicable disease is the second leading causes of deaths globally [1]. In 2017, 10.4 million people developed TB and an estimated 1.6 million died from the disease worldwide [2]. Image based TB diagnosis is performed with the help of Magnetic Resonance (MR) Imaging, Radiographs, and Ultrasounds.

Chest radiographs have proven to be a highly reliable diagnostic tool for the analysis of lung-related diseases. X-rays are useful in the mass screening of TB and related disorders. It is widely used in medical imaging due to its low radiation dose and economic feasibility [3]. However, manual interpretation and subjectivity causes errors in the diagnostic readings. Therefore, Computer Aided Diagnostic (CAD) systems in chest radiographs are essential to decrease the risk of detection errors and to improve mass screening efficiency [4].

TB typically affect lung regions. Image biomarkers of TB such as bilateral nodular patterns, opacity due to effusion and lung collapse can be easily identified in CXR images [5]. Severity of TB abnormalities are asymmetrical in lungs, although many of the subjects had both lungs infected [6-7]. Comparative studies to between right and left lungs identify TB have been performed [6-8]. Hence, local intensity variations in the lung regions and its boundaries prove to be a useful tool in early diagnoses of lung disorders thereby affirming a strong need for the segmentation.