Content-Based Image Retrieval for High Resolution Computed Tomography Lung Images

ABSTRACT

The interstitial lung diseases (ILDs) are a diverse group of pulmonary disorders. High Resolution Computed Tomography (HRCT) scanning is considered as the most preferred imaging method for the ILDs. However, due to lack of diagnostic specificity in most settings, visual interpretations of large number HRCT images results in substantial intra- and inter- observer variability. Content-Based Image Retrieval (CBIR) has been identified as an important research topic in application to the development of clinical decision support, differential diagnosis, medical education and research. Most of the CBIR developed for ILDs either uses simple distance function in the feature space or a classifier to compute the similarity between the query and database images. The performances of these systems solely depend upon the strength of the feature set or classifier. The objective of our work is to develop a CBIR system for ILDs and define measures for its evaluation.

We aim to develop learning based CBIR system that learns fuzzy class membership for the query image and has ability to adapt the distance function in accordance to the confidence in learning. Unlike conventional classifier based retrieval approaches, the proposed system uses all the output classes as search space, thereby reducing the variation in the result. New CBIR algorithms are also proposed where the system learns the similarity using multiple classifiers. Use of multiple learning paradigms exploits individual learning ability which helps to improve the learning and thereby improves the retrieval performance. The confidence in learning is also explored to take decision on the search space which reduces the search time. As the HRCT findings of ILDs are classified into different categories based on their texture like appearances, the effectiveness of all the proposed algorithms are tested on standard texture databases. A new performance metric called “Complementary Cumulative Distribution Function” is proposed that analyses the extremity of the system behavior. There popular segmentation algorithms are evaluated to identify the best for the segmentation of pathological bearing region in HRCT images. All the proposed CBIR algorithms are evaluated on a standard publicly available ILDs database and the best algorithm for the application is identified.

Keywords: Content-based Image Retrieval, Interstitial Lund Diseases, HRCT Lung images, retrieval performance evaluation, Fuzzy Class Membership, Classification Confidence