Integrated Chest Image Analysis System "BU-MIA"

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We introduce "BU-MIA," a Medical Image Analysis system, developed at Boston University, that integrates various advanced chest image analysis methods for detection, estimation, segmentation, and registration. BU-MIA evaluates repeated computed tomography (CT) scans of the same patient to facilitate identification and evaluation of pulmonary nodules for interval growth. Nodule growth measurements are essential to screen for primary and metastatic lung cancer but are currently made by time-consuming, inaccurate, and inconsistent manual methods.

BU-MIA provides a user-friendly graphical user interface with a number of interaction tools for development, evaluation, and validation of chest image analysis methods. More detailed descriptions of these methods can be found in our previous publications, e.g., [1, 2]. Other interface systems for accessing chest CT images have been developed by Reinhardt et al. [4] and Qian et al. [3].

Figure 1 shows BU-MIA's nodule comparison functionality in use. The structures that BU-MIA processes include the thorax, lungs, and trachea, pulmonary structures, such as lobes, fissures, nodules, and vessels, and bones, such as sternum, vertebrae, and ribs. In order to segment these structures, various techniques have been implemented, for example, attenuation-based matching of linearly deformable templates, active contour methods, and adaptive thresholding methods. In order to register chest landmarks, a rigid-body transformation method has been implemented. An efficient, multi-level, iterative closest-point method is used to align the lung surfaces. The correspondence of pulmonary nodules in two CT scans of the same patient can be inferred from this alignment. Nodule growth measurements can then be made.

To validate experimental results, radiologists may use BU-MIA's interaction tools to mark various lung structures, edit the marked regions, and manage selected lung structures, for example, add, delete, query, modify, or compare the structures. Different storage formats are used to maintain different types of lung structure data generated in the system.

The system may be used to develop and evaluate solutions for a wide range of chest imaging problems in addition to diagnostic CT imaging of primary and metastatic lung cancer. An important application, for example, is functional lung imaging to assess asthma and emphysema.

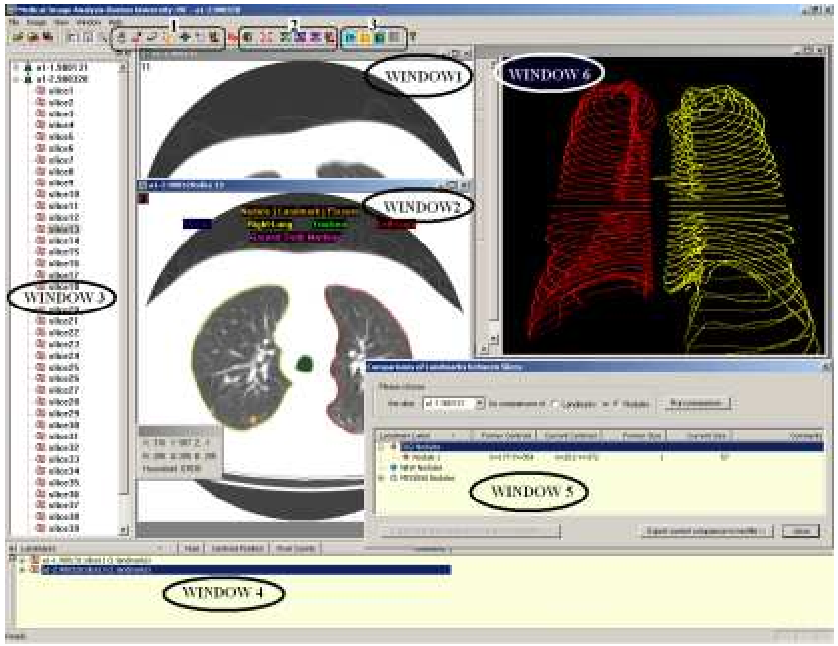

Fig. 1. The BU-MIA interface: Windows 1 and 2 contain axial images of two CT chest studies of the same patient scanned at different time. Users can browse through each study slice by slice (Window 3). Window 4 tabulates landmark information included in the current slice. Window 5 compares information on corresponding landmarks (e.g. nodules) computed from selected images. In Window 6, a 3D lung surface is rendered based on segmented lung contours. The buttons on the top toolbar are used to select various system functionalities: (1) interaction tools like marking various lung structures or editing the marking regions, (2) image analysis programs, e.g, chest, lung, or fissure segmentation, and (3) visualization tools to view various image analysis results.

References

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