3D shape analysis for early diagnosis of malignant lung nodules

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An alternative method for diagnosing malignant lung nodules by their shape rather than conventional growth rate is proposed. The 3D surfaces of the detected lung nodules are delineated by spherical harmonic analysis, which represents a 3D surface of the lung nodule supported by the unit sphere with a linear combination of special basis functions, called spherical harmonics (SHs). The proposed 3D shape analysis is carried out in five steps: (i) 3D lung nodule segmentation with a deformable 3D boundary controlled by two probabilistic visual appearance models (the learned prior and the estimated current appearance one); (ii) 3D Delaunay triangulation to construct a 3D mesh model of the segmented lung nodule surface; (iii) mapping this model to the unit sphere; (iv) computing the SHs for the surface, and (v) determining the number of the SHs to delineate the lung nodule. We describe the lung nodule shape complexity with a new shape index, the estimated number of the SHs, and use it for the *K*-nearest classification to distinguish malignant and benign lung nodules. Preliminary experiments on 327 lung nodules (153 malignant and 174 benign) resulted in the 93.6% correct classification (for the 95% confidence interval), showing that the proposed method is a promising supplement to current technologies for the early diagnosis of lung cancer.