3D shape analysis for early diagnosis of malignant lung nodules

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2011 Article

Bibliometrics
· Dow nloads (6 Weeks): 0
· Dow nloads (12 Months): 0
· Citation Count: 0

Published in:
· Proceeding
MICCAI'11 Proceedings of the 14th international conference on Medical image computing and computer-assisted intervention - Volume Part III
Springer-Verlag Berlin, Heidelberg ©2011
table of contents ISBN: 978-3-642-23625-9

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An alternative method of 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 that 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 a new prior visual appearance model; (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 into malignant and benign lung nodules. Preliminary experiments on 327 lung nodules (153 malignant and 174 benign) resulted in a classification accuracy of 93.6%, showing that the proposed method is a promising supplement to current technologies for the early diagnosis of lung cancer.