Multi-Scale Image Analysis of Lung CT Images

Noboru Niki
Institute of Technology and Science,
University of Tokushima,
Tokushima, 770-8506, Japan
niki@tokushima-u.ac.jp

CT images are a central information source in image diagnosis and treatment for diseases of the thorax such as lung cancer, chronic obstructive pulmonary disease (COPD) and interstitial pneumonia. We develop diagnosis and treatment technologies by analyzing the diseases of thorax using a multi-scale CT image (low-dose CT image (600~800μm), magnified CT image (200~300μm) and synchrotron radiation CT image (5~20μm)).

A CAD (computer aided detection) system is developed for detecting lung cancer, COPD and osteoporosis simultaneously using a low-dose CT images. This system contains four modules: thorax structure analysis and three detection modules for lung cancer, COPD and osteoporosis. Lung cancer detection module is conducted by clinical research for two years at the National Cancer Research Center, thereby realizing a high-performance system to spiral up problems.

We research the prognosis of lung cancer by using magnified CT images. Using 412 cases of stage IA, CT image features (8 variables), pathological examinations and tissue diagnosis (3 variables) were evaluated by a multivariate Cox proportional hazard model. We proposed a five-type classification based on the intensity histogram as CT image feature. Multivariate analyses demonstrated that the five-type classification, abutting pleural surfaces and lymphatic permeation were independent risk factors for lung cancer recurrence. It is expected to be used in treatment policy through calculating the risk value of recurrence.

We analyze the three-dimensional micro-structure of lung using synchrotron radiation CT images. We target normal secondary pulmonary lobule (10-30mm) which is the basic unit of the lung. Viewing and quantitative evaluation of a secondary pulmonary lobule' 3D structures become possible. These structures include acinar region, sub-acinar region, sub-sub-acinar region, terminal bronchiole, respiratory bronchiole, arteriole and venule.