QUANTITATIVE LUNG NODULE ANALYSIS SYSTEM (NAS) FROM CHEST CT

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I. Big Picture – Data-Driven System for Lung Nodule Analysis

System Components, as illustrated below:
1) Lung Tissue Segmentation
2) Nodule Detection
3) Nodule Segmentation
4) Nodule Categorization

These steps require proper nodule models

II. Main Purpose and Contribution

- This work devises an automatic approach for creating elastic deformable nodule templates using the AAM approach and biomarkers on the nodule contours
- New templates were used in the detection process resulting in simultaneous improvement in sensitivity and specificity
- Framework presented that conducts feature extraction and classification using cascaded SVM in a CNN architecture to identify non-nodules, malignant and benign nodules.

III. Deformable Active Appearance Modeling

- Given location \( x \) in the nodule’s spatial support, \( C = \{ c_j | j \in [1, L] \} \) represents a single set of realizations (e.g., shapes or appearances or both). The combined AAM approach represents the shape \( S(x) \) and appearance \( A(x) \) such that:
\[
S(x) = \sum_{i=1}^{L} [s_i(x)] \quad \text{and} \quad A(x) = \sum_{i=1}^{L} [a_i(x)]
\]

- Extract features for each nodule image per types using high and low curvature regions
- Register the nodule samples using the maximum or minimal curvature points as reference

IV. NAS Data Driven System

- Data-driven system for lung nodule analysis
- Novel Automatic Nodule Annotation and Alignment
- Generate nodule models using 24 manually annotated nodules per category
- Extract feature points for each nodule image per types using high and low curvature regions
- Register the nodule samples using the maximum or minimal curvature points as reference

V. Performance of AAM vs. Parametric Templates for Nodule Detection

- A fully automatic approach has been developed to create deformable templates from an ensemble of lung nodules
- A fully model-based mechanism to detect, authenticate (reduce false positives) and segment/crop the nodules for the last step in the CAD system, classification, is presented

VI. Conclusions

- Given location \( x \) in the nodule’s spatial support, \( C = \{ c_j | j \in [1, L] \} \) represents a single set of realizations (e.g., shapes or appearances or both). The combined AAM approach represents the shape \( S(x) \) and appearance \( A(x) \) such that:
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VII. Sample References


International Conference on Acoustics, Speech and Signal Processing
April 15-20, 2018
IEEE