Multi-view Convolutional Neural Network for lung nodule false positive reduction

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Abstract
Background and objective: Computer-Aided Detection (CAD) systems save radiologists time and provide a second opinion in detecting lung cancer by performing automated analysis of the scans. False positive reduction is one of the most crucial components of these systems that play a great role in the early diagnosis and treatment process. The objective of this paper is to efficiently handle this problem by detecting nodules and separating them from a large number of false positive candidates.

Methods: The proposed algorithm segments lungs and nodules through a combination of 2D and 3D region growing, thresholding and morphological operations. Vessels and most of the internal lung structure have a tabular shape that differs from the compact rounded shape of nodules, therefore they are eliminated by building and thresholding a 3D depth map, to produce the initial candidates. To reduce the number of false positives, a rule-based classifier is used to eliminate the obvious non-nodules, followed by a multi-view Convolutional Neural Network. The convolutional network is built specifically to handle the provided inputs and is customized to provide the best possible outputs without the extra computational complexity that is required when compared to a 3D network. 650 cases from the LIDC dataset are used to train and test the network. For each candidate, the axial, coronal and sagittal views are extracted and fed to the three network streams.

Results: The proposed algorithm achieved a high detection sensitivity of 85.256%, a specificity of 90.658% and an accuracy of 89.895%. Experimental results indicate that the proposed algorithm outperforms most of the other algorithms in terms of accuracy and sensitivity. The proposed solution achieves a good tradeoff between efficiency and effectivity and saves much computation time.

Conclusion: The work shows that the proposed multi-view 2D network is a simple, yet effective algorithm for the false positive reduction problem. It can detect nodules that are isolated, linked to a vessel or attached to the lung wall. The network can be improved to detect ground glass nodules in the future.