Segmentation of Pulmonary Nodules in Computed Tomography Using a Regression Neural Network Approach and its Application to the Lung Image Database Consortium and Image Database Resource Initiative Dataset

Description

We present new pulmonary nodule segmentation algorithms for computed tomography (CT). These include a fully--automated (FA) system, a semi-automated (SA) system, and a hybrid system. Like most traditional systems, the new FA system requires only a single user-supplied cue point. On the other hand, the SA system represents a new algorithm class requiring 8 user-supplied control points. This does increase the burden on the user, but we show that the resulting system is highly robust and can handle a variety of challenging cases. The proposed hybrid system starts with the FA system. If improved segmentation results are needed, the SA system is then deployed.

The FA segmentation engine has 2 free parameters, and the SA system has 3. These parameters are adaptively determined for each nodule in a search process guided by a regression neural network (RNN). The RNN uses a number of features computed for each candidate segmentation. We train and test our systems using the new Lung Image Database Consortium and Image Database Resource Initiative (LIDC--IDRI) data. To the best of our knowledge, this is one of the first nodule-specific performance benchmarks using the new LIDC--IDRI dataset. We also compare the performance of the proposed methods with several previously reported results on the same data used by those other methods. Our results suggest that the proposed FA system improves upon the state-of-the-art, and the SA system offers a considerable boost over the FA system.

The download links provided below provide easy access to specific subsets of images from our study, which are described in much greater detail in our publication (https://doi.org/10.1016/j.media.2015.02.002).

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Clark K, Vendt B, Smith K, Freymann J, Kirby J, Koppel P, Moore S, Phillips S, Maffitt D, Pringle M, Tarbox L, Prior F. T**he Cancer Imaging Archive (TCIA): Maintaining and Operating a Public Information Repository**, Journal of Digital Imaging, Volume 26, Number 6, December, 2013, pp 1045-1057. (paper)

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Messay T, Hardie RC, Tuinstra TR. (2015). **Segmentation of pulmonary nodules in computed tomography using a regression neural network approach and its application to the Lung Image Database Consortium and Image Database Resource Initiative dataset**. Medical Image Analysis. Elsevier BV. https://doi.org/10.1016/j.media.2015.02.002

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