Some external discussion about the lung nodule detection problem

冯浩哲

2017 年 7 月 20 日

Outline

Here is a little summary about our discussion in the morning.

At the first part,I simply add some review about the history and the current achievement on the lung nodule detection problem.

Then I propose an opinion that with the current standard of annotation,the current achievements only solve the "where" problem.

In the end of this summary,I will combine the current achievement and problems with our discussion in the morning and summarize our novelty and our next directions.

Review about the history and the current achievement

Actually,the history about the lung nodule detection can be dated back to 1999, and the main problem is the "where" problem, more precise, we just need to find the center position of the possible lung nodules in a batch of CT-scans.[1]

The traditional machine learning method used in this stage are:

- KNN(for clustering)
- SVM(for classifying)

The main technical problem is the high percentage of false-positive.

Review about the history and the current achievement

Recent advances in deep learning have greatly reduced the FP percentage in lung nodule detection problem.

However, the techinque still mainly stays on the aspect of "where":

- In kaggle 2017, the request is to give the annotation in 5 aspects:

  (1)diameter (2)lobulation (3)spiculation
  (4)malignancy (5)calcification (6)sphericity

- In Tianchi AI competition,the request is only the location.

I think it is because our technique is constrainted by the dataset, more precisely, the standard of annotation.

The standard of current annotation

A standard annotation from an expert is like this :

seriesuid	coordX	coordY	coordZ	diameter_mm
LKDS-00375	-122.004	128.0882	384.53	7.779042311
LKDS-00640	69.8244	103.0397	251.6	23.80062926
LKDS-00728	93.10568	163.8554	225.5	11.08265432
LKDS-00095	115.438	-153.883	-104.8	8.405076669

With only the center location and the diameter of a nodule as the ground truth for training, the deep learning can't provide more precise information such as volume and topological form.

Our novelty and directions

Our discussion in the morning is a direction for solving the basic problem: how to get a more precise training data.

If we can get a pixel-to-pixel binary map from the tradition annotation, we will be able to train a stronger pixel-to-pixel deep network which segments the lung nodule and the other part of lung.

I think this network is similar to the network for Biomedical Image Segmentation, and the main difference is that most of CT-images don't have any lung nodules, which is the main reason for high FP percent in detection.

Our novelty and directions

To solve the problem of annotation, we may use the method about:

- 3D segmentation approaches to get a pixel level annotation
- Suggestive annotation system to reduce the cost of annotation

We want to achieve the goal that with expert click at a nodule,we can get a precise segmentation of the nodule as our pixel-level ground truth.

Mentioned above are our possible directions, and it can also be extened to many other stages such as hemorrhage detection in color fundus images.

Ayman El-Baz, Garth M Beache, Georgy Gimel'farb, Kenji Suzuki, Kazunori Okada, Ahmed Elnakib, Ahmed Soliman, and Behnoush Abdollahi.
Computer-aided diagnosis systems for lung cancer: challenges and methodologies.
International journal of biomedical imaging, 2013, 2013.