Sarcopenia Diagnosis: Deep Transfer Learning versus Tradicional Machine Learning

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Introduction

In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP) defined sarcopenia as "a syndrome characterized by progressive and generalized loss of skeletal muscle mass and muscle strength, with risk of adverse effects such as physical disability, poor quality of life and death". Since the creation in 2012 of AlexNet, the winner of the "ImageNet" Large Scale Recognition Challenge" (ILSVRC), deep learning attracts attentions in the field of machine learning.

Methodology

Datasets were obtained from 144 images (ROIs of the original images, 61 normal muscles and 83 sarcopenic muscles). In figure 1 are the examples of the extracted ROIs images.

Before the creation of the datasets, we applied the data augmentation process, where we did rotations, adition of noise and flip. This process have produced 7200 images. In order to make a conclusion about the proportions effect on the final results, we divided the datasets with different proportions of each step.

The percentages assigned to the training, validation and testing steps were the following:

a) dataset A: 60% for training, 20% for validation and 20% for testing.

b) dataset B: 70% for training, 15% for validation and 15% for testing.

c) Dataset C: 80% for training, 10% for validation and 10% for testing.

We did another three datasets with the same proportions of the previous ones with two ROIs per image, creating 14350 images.

For the analysis we used the neuronal network Inception-V3 and 3 traditional classifiers, which had the best test performance in a group of 25 classifiers presented in matlab classification learner app.

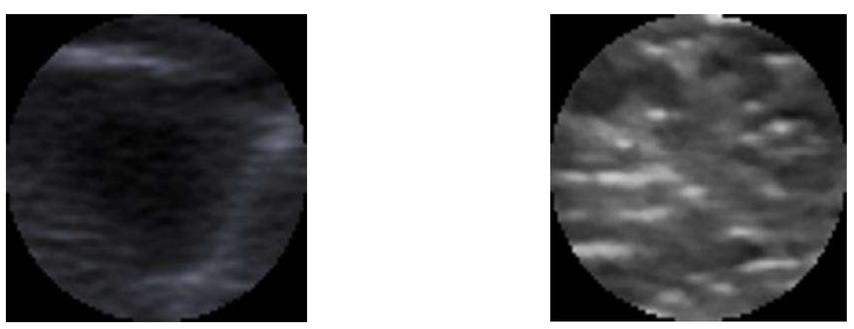

Figure 1. (a) Normal muscle ROI (b) Sarcopenic muscle ROI.

Results and Discussion

As we can see in table 1, the best accuracy obtained was 98.3% with the Inception-V3 network. Further we can observe that traditional classifiers obtained better results in the datasets with two ROIs per image, which indicate that traditional classifiers are more dependant of data then deep transfer learning. The best traditional classifier was cubic SVM with an accuracy of 97.9%.

Finally we also can see that the accuracy is a lot more consistent when we consider the datasets with double ROI in each method.

Method	Dataset A	Dataset B	Dataset C	DatasetA 2R	DatasetB 2R	DatasetC 2R
Cubic SVM	95.0%	93.3%	90.7%	97.1%	97.9%	97.9%
Fine KNN	91.9%	91.5%	89.6%	95.4%	96.5%	96.5%
Subspace KNN	92.9%	92.1%	90.3%	95.9%	97.1%	96.4%
Inception V3	98.3%	93.3%	90.9%	97.9%	98.0%	97.9%

Table 1. Accuracy values achieved by the four implemented methods.

Final Remarks

This study aims to do an effective comparison between deep transfer learning and traditional classifiers.

Looking closely to the obtained results, we concluded that deep transfer learning has a superior performance when compared to traditional classifiers.

Future suggested improvements include different values of data augmentation operations, different sizes of ROIs and the aquisitions of more images of normal and sarcopenic muscles.

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