Dynamic data analysis for pediatric airways

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Abstract. The analysis of pediatric airway geometry using computed tomography (CT) images has provided rich diagnostic cues for doctors. Recently, dynamic CT data provides a better characterization of pediatric airways throughout the breathing cycle, for example to assess tracheomalacia. However, how to preprocess the increasing amount of dynamic data and how to analysis these data are still open questions. In this work, I performed dynamic data analysis using computer vision and machine learning approaches on synthetic and real airway data. In the future, I aim at building a 4D atlas for pediatric airways and to extend the approaches to other dynamic data modalities.

1 Introduction

The analysis of pediatric airway geometry using computed tomography (CT) image has provided rich cues for doctors to diagnose respiratory issue for patients. For example, given a 3D segmentation of CT image, doctors can diagnose tracheal stenosis by locating the position has smaller cross-sectional area in the airway and compare it to an normal control atlas [1].

Recently, dynamic CT data (4D CT) provides a better characterization of pediatric airways throughout the breathing cycle, for example to assess tracheomalacia, which is a disease of temporally collapse of partial airway. Comparing with spirometry, geometry analysis on 3D CT image provides additional information about *where* the respiratory issue might cause. Then 4D CT image provides more information about *when* the respiratory issue might cause during the breath cycle.

However, how to preprocess the increasing amount of dynamic data and how to analysis these data are still open questions. While standard techniques for analysis 3D CT could be applied on analysis 4D CT in a frame-by-frame fashion, two major challenges can be addressed as follow. First, manually annotations or preprocessing cost of each subject has increased a factor proportional to the number of CT scans in a breath cycle. Second, no information sharing between time steps might cause temporal inconsistence for the analysis.

In this work, I am going to address the above issues by performing dynamic data analysis using computer vision and machine learning approaches. Discussion based on experiments on real airway data would be compiled in the end of this report. In the future, I aim at building a 4D atlas for pediatric airways and to extend the approaches to other dynamic data modalities.

2 Methods

2.1 Landmark detection

2.2 Statical atlas building

2.3 Atypicality measurement

So and so ..

3 Results

4 Discussion

References

1. Hong, Y., Davis, B., Marron, J.S., Kwitt, R., Singh, N., Kimbell, J.S., Pitkin, E., Superfine, R., Davis, S., Zdanski, C.J., Niethammer, M.: Statistical atlas construction via weighted functional boxplots. Medical Image Analysis **18**(4) (2014) 684–698