ATS 2024 Highlights

Respiratory Structure and Function Early Career Professionals

Get to know members of the RSF Assembly

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Is your research clinical, basic science or translational?

Basic science and translational.

Tell us about your research?

I am employing state-of-the-art imaging and image analysis technology to facilitate investigations of the relative airway and vascular roles regarding susceptibility to COPD and other environmental lung diseases. We are utilizing dual energy, contrast enhanced computed tomography (DECT) to train deep learning models to automatically extract the pulmonary vascular tree and to separate veins from arteries. Once separated, a next step has been to define standardized metrics to characterize arterial to lung volume size relationships. While airway dysanapsis (airway size relative to lung size) has been demonstrated to significantly increase susceptibility to COPD, even in non-smokers, our studies are now demonstrating that pulmonary arterial dysanapsis is correlated with airway dysanapsis. The imaging and deep learning algorithms being developed provide new tools for differentiating airway vs vascular phenotypes associated with lung disease etiologies.

Where do you see yourself in 5 years?

Working within a collaborative teaching and research environment developing and employing advanced imaging technologies with a cardio-pulmonary focus.

What do you find is the major benefit of RSF Assembly Membership?

Expanding my interactions with a community of experts seeking to better understand lung structure/function relationships in both health and disease.

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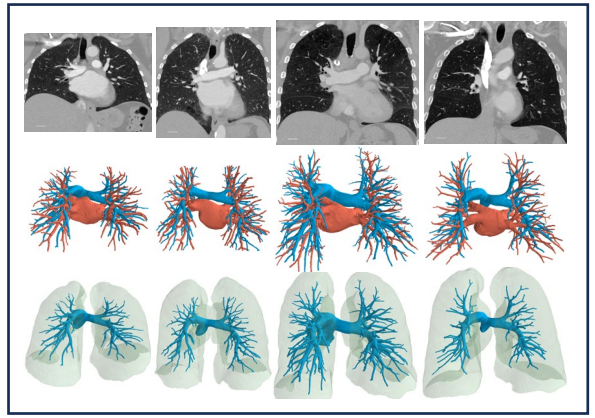
1



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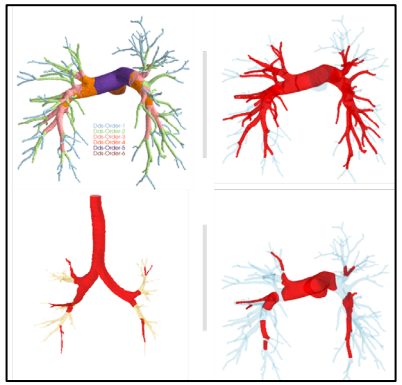

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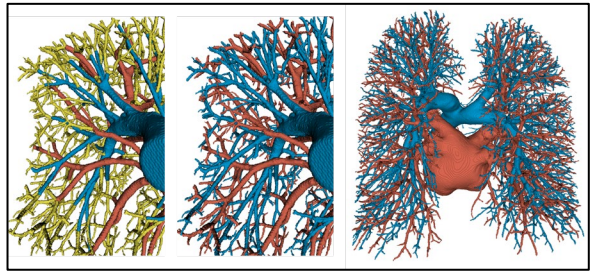

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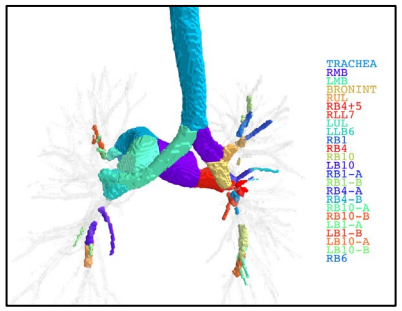

Fig-1: Showing 4 cases in the dataset, with CT images and arterial and venous tree segmentations, overlaid on the lungs. **Fig-2:** The more central segmentations in the dataset, can be extended into the peripheries by growing the former into peripheral segmentations available otherwise. **Fig-3:** Top: Color-coded branch orders after diameter-defined Strahler analysis, and branches of selected order range; Bottom: 24 standard locations on the airways (RB1, RB4, ..), and 24 matching locations on the arteries. **Fig-4:** Finding automatic matches of airway locations on the arterial tree, coded as same colours.

Pulmonary Arterial Dysanapsis Index Evaluated in Participants with Smoking-Associated COPD via Contrast Enhanced Dual Energy CT

Objective: To study the correlation between arterial-to-lung size mismatch (dysanapsis) and airway-to-lung size mismatch. We need to establish standard locations on the arterial tree to make size measurements consistent across subjects.

Methods: We have developed two methods. One is solely based on the arterial tree, and uses Strahler ordering of the branches to pick a particular order range to calculate the diameter averages from. The second method uses correspondence with the airway tree, and finds matching locations to standard locations on the airways, like RB1, RB4, ..

Results: We have studied indices thus created against some lung functional and structural biomarkers. In adjusted analyses, using branch volumes and TLC as reference, a 1-SD increment in Arterial-to-Lung Ratio (ArtLR) was associated with 6.65 unit decrease in %Emphysema-910 (95%CI: 2.78 to 10.52; $p = 0.001$), 0.9187 unit increase in %Broncovascular-Texture (95%CI: 0.5906 to 1.247; $p < 0.0001$), and 0.31 SD increase in Airway-to-Lung Ratio (95%CI: 0.03 SD to 0.60 SD; $p = 0.034$). Using branch diameters and FRC as reference, a 1-SD increment in ArtLR was associated with a 0.028 unit increase in PreBronch-FEV1/FVC (95%CI: 0.002 to 0.053; $p = 0.035$).

Conclusion: With this newly developed image-based assessment of the pulmonary arterial tree, we provide a means of comparing the relative significance of airway vs vascular influences and responses associated with pulmonary pathophysiology.

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