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Effects of lung disease on the three-dimensional structure and air flow pattern in the human airway tree TRISTAN VAN DE MOORTELE, Univ of Minnesota , ANDRAS NEMES, CHRISTINE WENDT, FILIPPO COLETTI, University of Minnesota — The morphological features of the airway tree directly affect the air flow features during breathing, which determines the gas exchange and inhaled particle transport. Lung disease, Chronic Obstructive Pulmonary Disease (COPD) in this study, affects the structural features of the lungs, which in turn negatively affects the air flow through the airways. Here bronchial tree air volume geometries are segmented from Computed Tomography (CT) scans of healthy and diseased subjects. Geometrical analysis of the airway centerlines and corresponding cross-sectional areas provide insight into the specific effects of COPD on the airway structure. These geometries are also used to 3D print anatomically accurate, patient specific flow models. Three-component, three-dimensional velocity fields within these models are acquired using Magnetic Resonance Imaging (MRI). The three-dimensional flow fields provide insight into the change in flow patterns and features. Additionally, particle trajectories are determined using the velocity fields, to identify the fate of therapeutic and harmful inhaled aerosols. Correlation between disease-specific and patient-specific anatomical features with dysfunctional airflow patterns can be achieved by combining geometrical and flow analysis.

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