Dynamic Analysis of Airflow Features in a 3D Real-Anatomical Geometry of the Human Nasal Cavity

Researcher: Hao Tang
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Overview

Drug delivery in the human respiratory tract is a long standing challenge due to the complexity of the geometry and materials properties. This study presents a brief summary of flow features in the human respiratory system and simulates an airflow field based on a 3D real-anatomical geometry of the human nasal cavity. A Lagrangian particle-tracking approach is adopted in the flow field solver for the dispersed phase. The dispersion characteristics of particles through the airflow are investigated under the quiet breathing.

Dynamic Analysis

The flow features of the airway in the human respiratory system are extremely complex, involving characteristics of multiple-phase flows in laminar, turbulent and interactive conditions. The proposed research extends and fulfils the study of numerical aerosol deposition using the realistic 3D reconstructed airway model, which is created by the image techniques from CT and MRI scan images of human. This 3D reconstructed airway model represents the lung anatomy more accurately than the 3D reconstructed airway model based on morphometric model. Also, this research attempts to include the effect of electrostatic charge into the numerical simulation. The overviews of methodology in this study can be roughly separated into 4 steps including 1) Geometrical model reconstruction, 2) Mesh generations, 3) Computing process, and 4) Post processing and data analysis. Firstly, the geometrical model reconstruction creates the model of airways using imaging techniques. After that, this volumetric model will be meshed for creating grid using Mesh generation software. Computing process is implemented by CFD program to calculate flow field and aerosol deposition. Finally, these data are analyzed and post processed to display.