An Experimental Study of Airflow and Particle Transport in the Human Upper Airway

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Overview

The air flow and particle transport phenomenon within the human upper airway is of interest to those concerned with the effective treatment lung diseases, the exposure of people to airborne pollutants, and more recently, the aerosol medicine delivery as well as basic medical science research. The understanding and prediction of particle transport and deposition characteristics in the human upper respiratory airways is important for targeting the delivery of drug particles or assessing the health risks of inhaled pollutant particles. This study will provide extensive information to probe significant insights to the particle deposition characteristics within the complex airway passages and better understanding of any important phenomena associated with the fluid-particle flow. It will also lead to an improved understanding of fluid/particle transport under realistic physiological conditions. The aim of this study is to experimentally study the air/particle flow in the respiratory airways, and provide experimental data for the validation of the numerical predictions. Figure 1 shows the geometry of a human upper airway.

Experimental Rig

The in vitro experimental investigations of the air/particle flow distribution inside the glass or clear silicone models will utilize state-of-the-art 3D Laser Doppler Anemometry (LDA), Phase Doppler Anemometry (PDA), and 3D stereoscopic Particle Image Velocimetry (PIV) techniques. A designed experimental rig is currently being constructed, as shown in Figure 2. This rig will facilitate the simultaneous measurements of flow parameters and particles.

Figure 1. The geometry of the human airway.  Figure 2. The experimental rig.