EXPERIMENTAL INVESTIGATION OF 3D AEROSOL MOTION WITHIN AN ALVEOLATED DUCT

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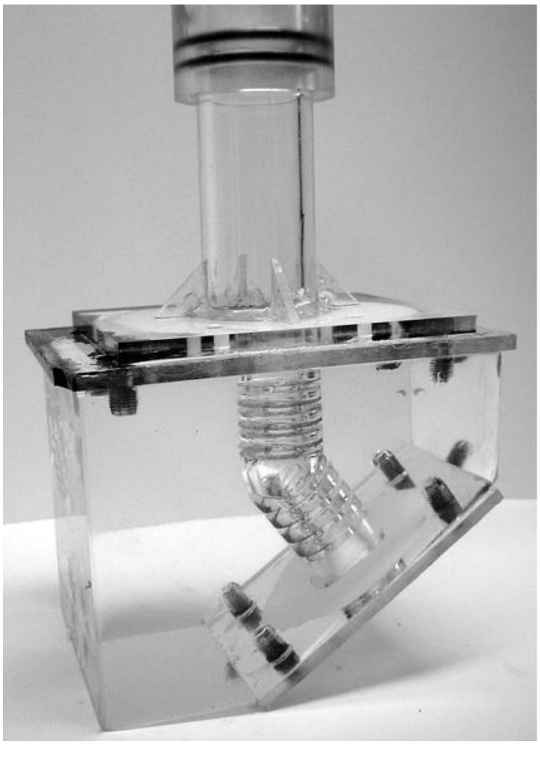
Aerosol motion within the pulmonary airways and the effect of particulate matter on human health has been a major medical concern in both the realms of inhalation toxicology and inhaled pharmaceuticals. Airborne particles are responsible for many lung diseases; inhaled antigens cause allergic lung disease such as asthma and inhaled microbes can cause infections from viral to tuberculosis. Inhalation therapy is often turned to combat these diseases. A better understanding of the trajectory and deposition patterns of aerosols within the human respiratory system could help to better understand and treat these ailments. The aim of this study is to investigate the trajectory of aerosol particles within the alveolated region of the human lungs. This experimental study deals with the investigation of aerosol trajectories in a 3D model of an alveolated duct. The measurements are performed using a developed 3D particle tracking technique. This technique is used to validate numerical simulations of aerosol trajectories performed by Chantal Darquenne at the University of California as San Diego. Experiments were performed to develop and validate the technique as the approach was newly developed at the VKI. A study into the optical influences is presented along with results of the validation experiments. The optical challenges are addressed and no alterations are considered necessary for the present work. Further experiments are then performed on an alveolated duct for different lung generation flow rates. Two different particle sizes are used to simulate the aerosols to determine the effect of particle size on trajectory and deposition patterns. It is found that the 12µm particles are more susceptible to deposition which increases with increasing generation. 5 µm particles are also investigated and are found to be affected much less by gravitational deposition and are able to reach the distal regions of the lung. Comparisons are also made to previous experimental work and trajectory patterns are found to be consistent with previous work of Theunissen and Buchmann. Finally, it is found that the trajectory patterns of 5 µm patterns agree with the numerical trajectories obtained by Darquenne.



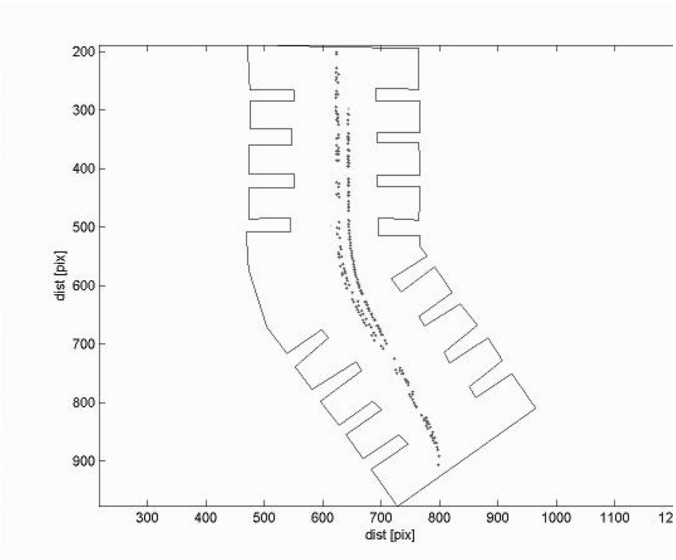


Figure 1: left: Alveolated duct model used in experiment. Right: 5µm particle trajectories for 22nd lung generation, front view.