XX Fluid Mechanics Conference KKMP2012,
Gliwice, 17-20 September 2012

MULTIPHASE FLOW SIMULATIONS IN THE UPPER AIRWAYS AND TRACHEOBRONCHIAL GEOMETRIES OF THE LUNG

Chris LACOR
Vrije Universiteit Brussel

In this lecture an overview is given of the research conducted at the Fluid Mechanics and Thermodynamics research group of VUB in the field of CFD simulations in the airways.

A first part focuses on drug administration to the lung for the therapy of asthma and chronic obstructive pulmonary diseases. For an efficient treatment, the inhaled aerosol particles, with sizes in the micrometer range, need to bypass the complex airway morphology and reach the alveolar zone of the respiratory tract where they eventually get absorbed. In the presentation it will be shown that due to the complexity of the upper airways – including mouth, pharynx, larynx and trachea – an important fraction of the particles deposits before leaving the trachea. Results obtained with RANS and LES simulations on a realistic upper airway and tracheobronchial model, obtained from CT scans, and an idealized upper airway geometry will be compared.

The second part is devoted to the CFD study of the behavior of nanoparticles in the upper airways. Nanoparticles constitute 90% of the particles in the air and a considerable fraction is due to traffic emission (diesel engines). Concentrations can go up to 10 million particles per cm3. Epidemiological studies show that these particles have greater adverse respiratory effects than the micron-sized particles. Here we investigate the deposition of these particles in an idealized upper airway model using RANS and LES within an Eulerian approach. Comparison will be made with measurements on the same model done at the Helmholtz center in Munich.

The last part of the lecture is devoted to CFD simulations in tracheobronchial geometries. RANS simulations are used to compare the massflow in the lung lobes before and after surgery.