Breathing Deeply

Published date: July 25, 2014

Technology description

Human Airways – Numerical Simulation of Human Respiration
Diseases of the respiratory organs are among the most frequent causes of death worldwide. Asthma, pneumonia or bronchitis, sinusitis or rhinopathy may cause either unpleasant or hazardous health problems. Often, only symptoms can be treated whereas causes remain unknown. To detect the sources of respiratory problems and plan surgical operations, measuring methods such as rhinomanometry, and imaging techniques such as computed tomography (CT) are used. There are, however, no methods suitable for reliable quantification of the success of medications or surgeries in daily clinical practice.
Within the Human Airways Project at Institute for Applied and Numerical Mathematics (IANM) and Institute for Mechanical Process Engineering and Mechanics (MVM), integrated simulations of respiration in the entire complex human respiratory tract are being developed. Highly efficient micron-precise flow and particle simulations are carried out on supercomputers to model the nose and mouth, the throat, the larynx and trachea, the bronchia and pulmonary alveoli.
For individual patient’ s models and schematic multiscale parameter models, different types of particle flows can be calculated and visualized. From CT images combined with statistical methods, models of the nose and lung are segmented to serve as simulation geometries. The resulting particle distribution can be used, for example, for early detection of lung cancer and risk factors such as particulate matter emission or smoke or for prediction of aerosol drug targeting processes and targeted drug transport. In addition, sensitivity-based approaches to shape and topology optimization, for example by shifting and thus optimal positioning of the nasal septum, allow a more precise planning of surgeries with reliable success prognoses. The simulation results can be analyzed three-dimensionally from different views, and more precise results can be obtained on constrictions or geometric defective positions.

Institution

Karlsruhe Institute of Technology

联系我们

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com