**Implementation of a transport equation for the air humidity to analyze nasal cavity flows**

Methods to diagnose pathologies in the human respiratory system have evolved recently from mainly focusing on medical imaging data to the consideration of computational fluid dynamics (CFD). In the past, the thermal lattice-Boltzmann (TLB) solver of the simulation framework multiphysics Aerodynamisches Institut Aachen (m-AIA) has been frequently used to numerically qualify the nasal cavity by analyzing the fluid mechanical properties of the respiratory flow, such as the pressure loss, the temperature distribution, and the mass flux distribution. However, an important quantity that has not been considered so far in these studies is the humidity of the inhailed air. Dry nasal passages can lead to discomfort and irritated sinuses and in the worst case to lung infections.

In this study air humidity in nasal cavity flow is investigated. A passive scalar transport and diffusion equation is implemented with a humidity source term on the muscus, to predict the humidity concentration at the entry of the trachea. This equation is fully coupled with the velocity, pressure and temperature field by the conservation laws.

For the purpose of this study a patient with breathing impairments has provided CT recordings from a status before and after a nasal surgery. These data are used to extract the surfaces of the nasal cavity and to conduct numerical simulations with the implemented humidity term. The goal is to work out a detailed analysis of the changes caused by the surgery.

Tasks:

- Implement the humidity source terms
- Couple the humidity field to the pressure and temperature fields
- Conduct simulations and analyze the flow fields before and after the surgery

If you are a student in Mechanical Engineering, CES, or Simulation Sciences and would like to write your Masters thesis about the topic presented above, feel free to contact me.

Contact person: Moritz Waldmann
Tel.: +49 241 80 90 400
Email: m.waldmann@aia.rwth-aachen.de