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INVESTIGATION OF NATURAL HUMAN BREATHING IN A 5 GENERATION LUNG MODEL WITH NUMERICAL SIMULATIONS

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Summary: To understand the human breathing and get better mechanical ventilation systems it is important to understand pressure drops and volume flow. To investigate a 5 generation lung model with instationary numerical simulations is created.
The whole lung with 23 generations is nearly impossible to simulate, because it would imply to implement the 223 branches of the bronchail tree. Knowledge of pressure drop and volume flow in a single branch aids in reducing the extend of the whole model. For this the impact from the pressure losses on one furcation to another must be known.
The geometry of the simulation is based on the lung model of weibel and is fully parametrized. Depending on the volume flow the flow conditions will change, therefor a SST with gamma-theta turbulence model is used.
The zero crossing of the volume flow at the inlet is difficult to realize, because veolcity of the pressure is sonic speed. Consequently the pressure will work in opposite direction then the volume flow. To challenge this problem, at every opening in the 5th generation a closed box will be placed. The pressure decreases in this box and only the incoming air can be exhaleted, so no opening is neccesary, only a inlet will be used for in- and outflow. The outflow is only pressure driven, like the natural human breathing.
The results were validated with an analytical solution.
With the results oft this numerical simualtions the whole bronchail tree can be reduced to a model of only one branch.