Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Three Dimensional Alveolar Flow Phenomena Using a CFD Approach[1] JOSUE SZNITMAN, FABIAN HEIMSCH, THOMAS HEIMSCH, THOMAS ROESGEN, Institute of Fluid Dynamics, ETH Zurich — Respiratory flows in the lung periphery are characterized by low Reynolds numbers (typically $Re<1$) in sub-millimeter airways marked by the presence of alveoli (gas exchange units). We present for realistic breathing conditions using CFD simulations (CFX-5.7.1), 3D velocity fields and flow patterns induced by the expansion/contraction of alveoli and acinar ducts during oscillatory flow. Based on anatomical data, the alveolus and airway are modeled as a spherical cap connected to a cylindrical duct, both subject to moving wall boundary conditions simulating respiration. The resulting 3D flow patterns are complex and governed by the ratio of the alveolar to ductal flow rates. This ratio describes the interplay between alveolar recirculation, induced by the ductal shear flow over the alveolus opening, and alveolar radial flow, induced by the expansion/contraction motion. Our 3D results are in good agreement with 2D simulations reported in the literature. Although convection mechanisms may transport gas along acinar ducts and deeper into the acinus, velocity fields within alveoli predict that upon gas entering them, transport is then solely dominated by diffusion mechanisms.

[1]We thank D. Rusch for advice and discussions during the implementation of our CFD simulations and E.R. Weibel for his guidance.

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Date submitted: 03 Aug 2005

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