Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Airflow Simulation and Particle Deposition in a 3D Rat Lung Model JESSICA OAKES, Mechanical and Aerospace Engineering, Department of Medicine, Division of Physiology at University of California, San Diego, SHAWN SHADDEN, Department of Mechanical, Materials & Aerospace Engineering, Illinois Institute of Technology, CHANTAL DARQUENNE, Department of Medicine, Division of Physiology at University of California, San Diego, ALISON MARSDEN, Mechanical and Aerospace Engineering at University of California, San Diego —
Knowledge of the fate of aerosols in the lung is needed to understand the efficiency of inhaled drug therapy. Invasive animal experiments and imaging allows for detailed quantitative comparison with computational modeling. In this study we built a three-dimensional (3D) airway tree model using rat magnetic resonance images. A custom 3D finite element solver was used to obtain animal specific velocities and pressures. Inlet boundary conditions were chosen to match a previous rat ventilation experiment and resistance outlet boundary conditions were selected to match a desired airflow split based on uniform ventilation. The Maxey-Riley particle equations were solved using Lagrangian particle tracking methods with realistic aerosol particle dimensions and density. The particle dynamics were validated using analytical solutions in idealized geometries. The impact of the choice of outlet boundary conditions for airflow simulations is quantified and aerosol particle deposition and distribution within the lung lobes are explored.

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Date submitted: 05 Aug 2010 Electronic form version 1.4