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Simulation of flow and aerosol in the airway tract

The numerical prediction of the propagation of aerosols in airways is an area of growing interest. For instance, predicting the deposition patterns of particles in the mouth-throat or the inner lung pathways is needed for designing inhalers. Two approaches are commonly used to model such multiphase flows, namely the Eulerian and Lagrangian approaches, but much of the literature on aerosols in airways rely on the Lagrangian tracking approach. In our talk, we will show that an Eulerian model can efficiently predict aerosol propagation in a 3-D patient-based geometry of the airway tract. CT images of the thorax were processed to generate the geometry of the trachea and the first four bronchus generations. The air flow was then obtained by solving the Navier–Stokes equations for different values of the flow dimensionless parameters. Numerical results for aerosol propagation in these geometries were obtained by coupling our Eulerian model with the previous flow solutions. The results show that the particle density and deposition patterns are easily obtained at all time steps without any need for particle count or the delicate selection of initial particle positions, as for the Lagrangian tracking approach. The general simulation strategy, as well as techniques to handle critical aspects of the simulations, will be covered in the talk.