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An immersed-boundary framework for patient-specific optimization of inhaled drug delivery LAURA NICOLAOU, Imperial College London, TAMER ZAKI, Johns Hopkins University, Imperial College London — Predictive numerical simulations have the potential to significantly enhance therapies for lung disease by providing a valuable clinical aid and a platform to optimize drug delivery. A difficult challenge, however, is the influence of inter-subject variations of the airway geometries and their impact on the airflow and aerosol deposition. A personalized approach to the treatment of respiratory diseases is therefore required. An in silico framework for patient-specific predictions of the flow and aerosol deposition in the respiratory airways is presented. The approach efficiently accommodates geometric variation and airway motion in order to optimize pulmonary drug delivery. A non-rigid registration method is adopted to construct dynamic airway models conforming to the patient's breathing. Accurate predictions of the flow in realistic airway geometries are computed using direct numerical simulations (DNS) with boundary conditions enforced using a robust, implicit immersed boundary (IB) method for curvilinear meshes. A Lagrangian particle-tracking scheme is adopted to model the transport and deposition of the aerosol particles in the airways. Examples of flow and aerosol deposition in realistic extrathoracic airways and of a patient-specific dynamic lung model are presented.

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