Abstract Submitted
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An image-based automatic mesh generation and numerical simulation for a population-based analysis of aerosol delivery in the human lungs[1] SHINJIRO MIYAWAKI, The University of Iowa, MERRYN H. TAWHAI, The University of Auckland, ERIC A. HOFFMAN, CHING-LONG LIN, The University of Iowa — The authors propose a method to automatically generate three-dimensional subject-specific airway geometries and meshes for computational fluid dynamics (CFD) studies of aerosol delivery in the human lungs. The proposed method automatically expands computed tomography (CT)-based airway skeleton to generate the centerline (CL)-based model, and then fits it to the CT-segmented geometry to generate the hybrid CL-CT-based model. To produce a turbulent laryngeal jet known to affect aerosol transport, we developed a physiologically-consistent laryngeal model that can be attached to the trachea of the above models. We used Gmsh to automatically generate the mesh for the above models. To assess the quality of the models, we compared the regional aerosol distributions in a human lung predicted by the hybrid model and the manually generated CT-based model. The aerosol distribution predicted by the hybrid model was consistent with the prediction by the CT-based model. We applied the hybrid model to 8 healthy and 16 severe asthmatic subjects, and average geometric error was 3.8% of the branch radius. The proposed method can be potentially applied to the branch-by-branch analyses of a large population of healthy and diseased lungs.

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Shinjiro Miyawaki
The University of Iowa

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