Abstract Submitted
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An automatic generation of non-uniform mesh for CFD analyses of image-based multiscale human airway models[1] SHINJIRO MIYAWAKI, University of Iowa, MERRYN H. TAWHAI, University of Auckland, ERIC A. HOFFMAN, CHING-LONG LIN, University of Iowa — The authors have developed a method to automatically generate non-uniform CFD mesh for image-based human airway models. The sizes of generated tetrahedral elements vary in both radial and longitudinal directions to account for boundary layer and multiscale nature of pulmonary airflow. The proposed method takes advantage of our previously developed centerline-based geometry reconstruction method. In order to generate the mesh branch by branch in parallel, we used the open-source programs Gmsh and TetGen for surface and volume meshes, respectively. Both programs can specify element sizes by means of background mesh. The size of an arbitrary element in the domain is a function of wall distance, element size on the wall, and element size at the center of airway lumen. The element sizes on the wall are computed based on local flow rate and airway diameter. The total number of elements in the non-uniform mesh (10 M) was about half of that in the uniform mesh, although the computational time for the non-uniform mesh was about twice longer (170 min). The proposed method generates CFD meshes with fine elements near the wall and smooth variation of element size in longitudinal direction, which are required, e.g., for simulations with high flow rate.

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