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Simulation of the flow field and particle deposition in a realistic geometry of the human airways[1] JORGE A. BERNATE, ELEANOR LIN, ERIC S.G. SHAQFEH, GIANLUCA IACCARINO, Stanford University — Using the dynamic Smagorinsky sub-grid scale model, we carry out Large Eddie Simulations (LES) of the flow field in a realistic geometry reconstructed from a CT scan of an adult male human subject (Zhang et. al J AEROSOL SCI 46, 34 (2012)). The geometry comprises the oral cavity, larynx, trachea, and bronchi extending to generations 6 to 9. The computed time-averaged flow field is validated with magnetic resonance velocimetry (MRV) measurements obtained in a 3D printed model of the realistic geometry (Andrew J. Banko, Filippo Coletti, Daniele Schiavazzi, Christopher J. Elkins, John K. Eaton, submitted to this conference). The comparison is done at a constant inspiratory flow rate of 60 L/min, at which turbulence is expected to develop. Probing the mean flow, we compare integral factors quantifying the ventilation, the shape of stream-wise velocity profile, and the strength of secondary flows in different branches. Via simulations, we also characterize the unsteadiness of the flow, focusing on the dynamics of the laryngeal jet and its effect on the structure of the flow field and particle deposition patterns.

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