Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Numerical Study of Turbulent Laryngeal Jet in the MDCT-based Human Lung Model. CHING-LONG LIN, Dept. of Mech. and Industrial Engr., IIHR-Hydroscience & Engr., The Univ. of Iowa, MERRYN H. TAWHAI, Bioengineering Inst., The Univ. of Auckland, GEOFFREY MCLENNAN, ERIC A. HOFFMAN, Dept. of Biomedical Engr., Medicine and Radiology, The Univ. of Iowa — The geometry of the human upper respiratory tract is constructed from x-ray-based multidetector computed tomography (MDCT: Sensation 64) images using in house developed segmentation software. The geometry consists of a mouth piece, the mouth, the oropharynx, the larynx, and up to 6 generations of the intra-thoracic airway tree. We applied a custom-developed Characteristic-Galerkin finite element method, which solves the three-dimensional incompressible Navier-Stokes equations, to study the effect of turbulence on air flow structures in the MDCT-based lung model. In order to gather sufficient data for analysis of turbulence statistics, a constant flow rate of about 320 ml/s at the peak inspiratory phase is imposed at the terminal branches to draw air into the upper respiratory tract. The flow rate yields an average speed of about 2 m/s and a Reynolds number of 1,700 in the trachea. The characteristics of mean velocity and turbulent kinetic energy are analyzed. A curved sheet-like high-speed laryngeal jet with high turbulence intensity is formed in the trachea. Some peak frequencies associated with the jet flow are detected. Their association with turbulent coherent structures is examined. The work is sponsored by NIH Grants R01-EB-005823 and R01-HL-064368.

Ching-Long Lin
The University of Iowa

Date submitted: 31 Jul 2006 Electronic form version 1.4