Conf luenceS IMFT

Mercredi 18 mai à 14 h 00

Institut de Mécanique des Fluides
Salle Castex Rez de chaussée - Allée du Pr Camille Soula, Toulouse

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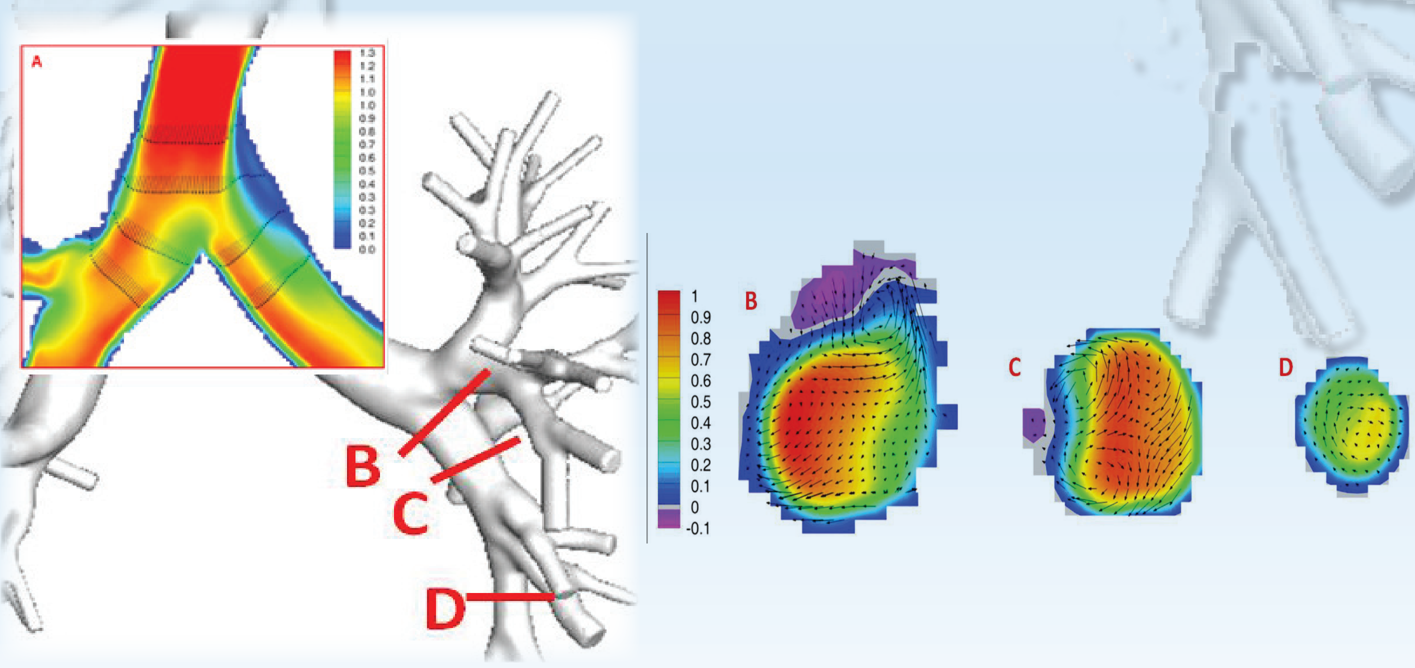
Respiratory flows in realistic and idealized bronchial trees

The details of the air motion through the lungs critically affect the respiratory process. In particular, the direction and intensity of vortical air flow within the airways have important consequences for gas exchange and deposition of inhaled particles. Here we focus on the formation and persistence of such vortical motions by experimentally studying the velocity and vorticity field through 3D printed airway models. We consider both idealized geometries (based on a symmetric bronchial tree of canonical proportions) and realistic ones (based on high-resolution medical imaging of human subjects). We use Magnetic Resonance Velocimetry to reconstruct the volumetric velocity field at a sub-millimeter resolution, under a broad range of steady and oscillatory regimes. The measurements in the idealized geometry highlight the effect of the flow regime on the momentum transport and the development of streamwise vortices. A marked change in topology is found at a specific Reynolds number, above which the influence of the upstream flow prevails over the effect of the local curvature of the bronchi. When considering realistic airways, the flow does show similarities but also qualitative differences in the very mechanisms responsible for the formation of the vortices, which are found to be stronger than in the idealized cases. The results suggest that the real human anatomy may generate more dispersion and mixing than canonical symmetric models. We close highlighting implications for the respiratory flow in diseased airways.



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