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Unsteady Particle Tracking of Micro-particle Deposition in the Human Nasal Cavity under Cyclic Inspiratory Flow

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Abstract

In this study, a fully unsteady computational fluid dynamics (CFD) model was used and the transient airflow properties during the entire breathing cycle, including inhalation and exhalation in a human nasal cavity, were evaluated. Unsteady particle tracking was performed to find the particle motion and deposition in the nasal airway using a Lagrangian approach. In most of earlier computer simulations, the assumption of quasi-steady or steady airflows averaged over the inhalation cycle were typically used to reduce the computational cost. In the present work particular attention was given to assessing the accuracy of these assumptions and their consequence on particle deposition in a human nasal cavity with paranasal sinuses. The simulation results for the airflow field showed significant differences between the unsteady and quasi-steady cases at low breathing rates near the beginning and end of the inspiration cycle. For