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The Utilization of FSI Technique and Two-Way Particle Coupling System on Particle Dynamics in the Human Alveoli

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Abstract : This study represented the respiratory alveoli system, and determined the trajectory of inhaled particles more accurately using the modified three-dimensional model with deformable walls of alveoli. The study also considered the tissue tension in the model to demonstrate the effect of lung. Tissue tensions are transferred by the lung parenchyma and produce the pressure gradient. This load expands the alveoli and establishes a sub-ambient (vacuum) pressure within the lungs. Thus, at the alveolar level, the flow field and movement of alveoli wall lead to an integrated effect. In this research, we assume that the three-dimensional alveolus has a visco-elastic tissue (walls). For accurate investigation of pulmonary tissue mechanical properties on particle transport and alveolar flow field, the actual relevance between tissue movement and airflow is solved by two-way FSI (Fluid Structure Interaction) simulation technique in the alveolus. Therefore, the essence of real simulation of pulmonary breathing mechanics can be achieved by developing a coupled FSI computational model. We, therefore conduct a series of FSI simulations over a range of tissue models and breathing rates. As a result, the fluid flows and streamlines have changed during present flexible model against the rigid models and also the two-way coupling particle trajectories have changed against the one-way particle coupling.

Keywords : FSI, two-way particle coupling, alveoli, CDF
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