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Titel des Beitrags: Fluid-structure interaction including volumetric coupling with homogenized subdomains for modeling respiratory mechanics

Abstract: In this article, a novel approach is presented for combining standard fluid-structure interaction with additional volumetric constraints to model fluid flow into and from homogenised solid domains. The proposed algorithm is particularly interesting for investigations in the field of respiratory mechanics as it enables the mutual coupling of airflow in the conducting part and local tissue deformation in the respiratory part of the lung by means of a volume constraint. In combination with a classical monolithic fluid-structure interaction approach, a comprehensive model of the human respiratory system can be established that enables clinically relevant investigations, e.g., of ventilator-associated lung injury in an efficient manner. To illustrate the validity and versatilility of the novel approach, three numerical examples including a patient-specific lung model are presented. The proposed algorithm proves its capability of computing clinically relevant airflow distribution and tissue strain data at a level of detail that is not yet achievable, neither with current imaging techniques nor with existing computational models.

Stichworte: