Personalized Pulmonary Poromechanics

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PERSONALIZED PULMONARY POROMECHANICS

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Lung biomechanics has been extensively studied by physiologists, experimentally as well as theoretically, laying the ground for our current fundamental understanding of the relationship between function and mechanical behavior. However, many questions remain, notably in the intricate coupling between the multiple constituents. These fundamental questions represent real clinical challenges, as pulmonary diseases are an important health burden. Interstitial lung diseases, for instance, affect several million people globally. Idiopathic Pulmonary Fibrosis (IPF), notably, a progressive form of interstitial lung diseases where some alveolar septa get thicker and stiffer while others get completely damaged, remains poorly understood, poorly diagnosed, and poorly treated [1].

In this presentation, I will first describe our recently developed lung poromechanical model [2]. It lies at the organ space scale and breathing time scale, and is written in a general poromechanical mixture framework [3]. I will also detail the specific boundary conditions imposed on the lungs themselves, modeling the effect of diaphragm-induced loading and rib cage.

The second part of the presentation will deal with the personalization procedure we developed alongside the model [2]. It allows to personalize parts of the boundary conditions and material model from biomedical images, after processing [4]. I will notably insist on the inverse problem of finding the unloaded configuration associated to the loaded configuration observed *in vivo*, and associated issues. Then I will show how regional mechanical parameters can be estimated in diseased lungs, illustrating how this model could be used as a diagnosis tool in the clinic.

References

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