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ACTIVE AND PASSIVE MECHANICS IN PATIENT-SPECIFIC MODELLING OF SOFT BIOLOGICAL TISSUES

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ABSTRACT

The functions of human organs are often regulated by the presence of muscle tissue. There are various types of muscle tissues that are typical of different organs: smooth muscle (arteries, intestines, hollow organs), striated muscle (skeletal muscles), cardiac muscle tissue (heart). The mechanics of muscles is due to the combination of active and passive behaviours. Under the action of a potential induced by the transfer of ionic charges through cell walls, muscles contract (active action), giving rise to a mechanical reaction (passive action). In this MS, we address the theoretical conception and the numerical implementation of constitutive models for active biological tissues and their application in boundary value problems concerning patient-specific human organs. Beside traditional phenomenological models, we welcome constitutive models of higher complexity, including multiscale, multi-phase (porous materials), time-dependent, evolutionary (growth and degeneration) behaviours, micro-mechanical models, and innovative models instructed and surrogated by Machine Learning algorithms. The MS will focus also on methods developed for the numerical coupling between the different physics and data assimilation techniques (functional and geometries from medical images such as CT scans) for the customization of the integrated model, in order to carry out in-silico scenario studies and analyses. The MS promotes a strong interdisciplinary and synergistic approach between mathematical and numerical modelling, micro-mechanics of biological tissues, clinical practice and computational medicine.

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