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HIGHLY AUTOMATIC GENERATION OF PATIENT-SPECIFIC FOOT MODELS FOR BIOMECHANICAL SIMULATIONS

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The field of computational biomechanics is reaching a level of maturity that starts to bring meaningful advice to medical professionals. However, due to the large inter-patient variability, the predictions of a generic model become too vague for real clinical applications. The solution is the creation of patient-specific models that answer specific clinical questions for the patient with enough reliability to help in the clinical practice, the so-called personalized medicine [1]. But the creation of such tailored models is highly time-consuming which keeps them only practical for research purposes [2]. Therefore, the challenge is the generation of patient-specific models within the time period of the clinical decision-making process and at mass scale.

In the present work, we validate a highly automated workflow to generate patient-specific foot finite element models with detailed inner structure including: the bones, the ligaments, the tendons, the cartilages, the fascia the fat pads, and the skin. The generation process consists of a combination of three models that feed each other semiautomatically via custom codes. First, a CAD model reconstructs the patient's anatomy base on a CT-scan. Second, a multibody model reconstructs the patient walking muscle activation pattern base on gait lab measurements. Third, a finite element model combines the patient-specific anatomy and movement to generate a digital replica of the mechanical response of the patient. Then, the biofidelity of the model is assessed against a broad range of *in-vivo* measurements.

The fast and automatic creation of patient-specific models opens new avenues not only in the field of personalized medicine but also in the fields of *in-silico* clinical trial, human digital twin and surgery planning [3].

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