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# ABSTRACT BOOK

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## IMPACT OF PERSONALISATION OF GEOMETRY ON THE PASSIVE KINEMATIC RESPONSE OF THE KNEE JOINT IN FLEXION-EXTENSION

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In an effort to improve diagnostics and treatment of knee joint laxity and to minimize post-operative complications, development of patient-specific computational models of the knee joint is subject of current interest and investigation. A key strength of computational models is that they can provide an insight on the relative contributions of the musculoskeletal components on the passive biomechanical response. This knowledge is paramount for improving surgery outcomes. In vivo personalization of geometry and mechanical properties however still represents a significant challenge in daily clinical setup. The objective of this contribution was therefore to investigate relative contribution of geometry and material properties on the passive kinematic response of the knee joint in Flexion-Extension using Finite Element (FE) modelling.

Experimental data of passive knee Flexion-Extension tests of 8 fresh frozen lower limbs previously acquired [1] were used to generate the associated subject-specific FE geometrical models. During the experiment, each ligament attachment location had been marked with radio opaque paint and bone segments had been CT-scanned. These data were used to personalize the geometry of both the bones (femur, tibia and patella) and ligament insertions in the FE model. A previously described method was used to get a regular subject specific mesh. First, generic material properties obtained in a previous study were assigned to the ligaments and the static response was computed using an implicit solver in ANSYS. Second, an inverse procedure was used to calibrate the material properties of the ligaments to improve the experimental-numerical agreement.

Preliminary results regarding the femoro-tibial kinematic response are given in the figure below. Analysis of the individual responses with generic material properties showed that the deviation between the experimental and numerical responses (reported as median(interquartile range)) of Rx, Ry, Tx, Ty and Tz were 1.2  (2.3 ), 9.8  (8.8 ), 5.6mm (2.7mm), 1.7 mm (1.9mm) and 1.9mm (2.3mm) respectively. Personalization of the ligament allowed to improve the goodness-of-fit resulting in the following femoro-tibial kinematic results respectively: 1  (1.4 ), 2.9  (2.6 ), 4.4mm (1.2mm), 1.1mm (1.9mm) and 1.9mm (2mm).

Results obtained in this contribution on eight specimens strongly suggest that personalization of both geometry and mechanical properties are paramount in order to properly assess and analyze the individual passive kinematic response of the knee joint. Perspective work include assessing the response in other clinically relevant loading scenarios (AP drawer, internal-external rotation, and varus-valgus).

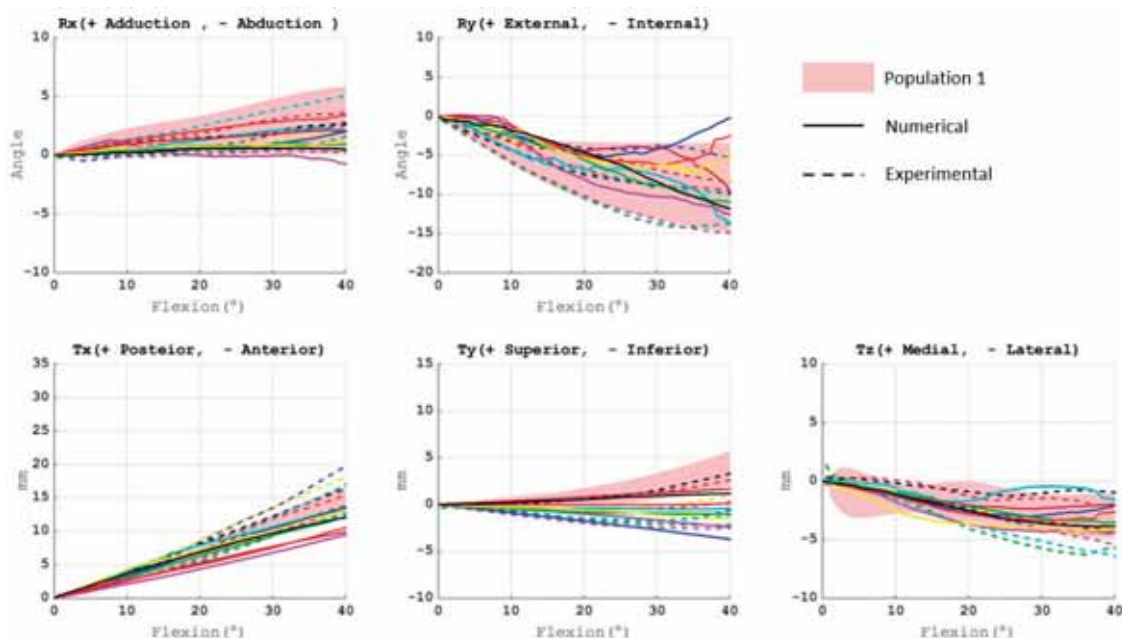


Figure Caption: Femoro-tibial kinematics of the knee joint.

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#### References:

[1] Rochongor, G., Pillet, H., Bergamini, E., Moreau, S., Thoreux, P., Skalli, W., Rouch, P., 2016. A new method for the evaluation of the end-to-end distance of the knee ligaments and popliteal complex during passive knee flexion. *The Knee*. 23(3), 420-425