# Finite element analysis of musculoskeletal loadings

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In vivo measurements of mechanical stresses in the knee joint are limited to the use of instrumented implants and therefore connected with severe surgical treatments. For this reason there is great interest in numerical simulations providing detailed information concerning the mechanical behavior of hard and soft tissues in different medical application areas.

Our goal is to get a better understanding for the key factors influencing the stress distribution in the knee joint. As large animals are standard models for the investigation of fundamental mechanical behaviors in this field of study our investigations are based on data concerning sheep locomotion. Investigations of the sensitivity concerning some of the involved mechanical parameters will lead to better insight into the complex interrelations in the knee joint.

In our knee model we use linear elastic bones modeled by simplicial grids. Adaptive refinement using parametrized boundaries permits satisfying approximation of the curved bone surfaces which are reconstructed from high resolution CT scans. Furthermore our model contains cruciate and collateral ligaments modeled by one-dimensional non-linear Cosserat rods. Coupling these mixed-dimensional elements drives into heterogeneous problems which are encountered using a Dirichlet-Neumann scheme. The underlying multi-body contact problems are solved by a multigrid method which combines a high degree of reliability and effectiveness.

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