Master Thesis
FE model to investigate the influence of changes in external loads on the hip fracture risk

Project description:
The increasing incidences in hip fracture due to osteoporosis (bone loss) and falls are the major cause of concern in aging society globally. The risk of undergoing a fracture due to overload (along the direction of impact) may be increased due to previous damage, accumulated under repeated loading conditions (daily activities) [1]. Accordingly, this thesis aims toward investigating the damage accumulation in bone tissue and its role in femoral fracture risk dependent on different loading scenarios. In other words, it strives towards establishing the numerical basis to simulate the coupling of bone damage accumulation between different loading modes for repetitive loadings.

Fig. 1. Failure location (white ring) in X-ray and corresponding FEM model prediction [3].
The FEM models of proximal femurs in stance and fall configuration will be designed [2, 3] using Solid Works (or any CAD software). These models will be simulated either in COMSOL Multiphysics® or python-based FEniCS investigating and quantifying the volumes which are affected most by changing the stress states due to change in loading conditions. The models will be further adapted for identification of constitutive material model that is able to describe the coupling of bone damage accumulation between different loading cases for repetitive loadings.

References: