Human Knee Joint for Impact Analysis
- Human Body Modelling

Evaluation of the injury risk in automotive impacts is today commonly evaluated by means of finite element human body models. The models are used both for research and development of protective system such as seat belts and airbags. With these models injury risk can be evaluated at a level of detail not possible with other existing tools. An example of such a model is the SAFER HBM V10 model. In the model significant efforts have been put into the capability of the model to predict rib fracture and concussion risk. The model can predict injuries for vehicle occupants as well as for pedestrian, bicycle and motorcycle riders. A common denominator is that the knee joint is important both as a load path and for injury risk. However, there is still a need to improve these human body models.

There is a need to enable detailed injury assessment for the knee joint in impact analysis. The knee joint is a fascinating part of the human body. The knee joint is the largest and most complex joint. The knee joins the thigh bone (femur) to the shin bone (tibia). The smaller bone that runs alongside the tibia (fibula) and the kneecap (patella) are the other bones that make the knee joint. Tendons connect the knee bones to the leg muscles that move the knee joint. Ligaments join the knee bones and provide stability to the knee:

There is a need to develop a detailed knee joint for both load transfer and injury assessment for vehicle occupant as well as for pedestrian and rider analysis

Objective and Method

The aim of this project is to develop and validate a finite element model of the human knee:

- Review published data about finite element modelling of knee joint,
- Review published data about impact testing of knee joints
- Review suitable LS-DYNA material models for ligament modelling,
- Reconstruct some physical tests knee tests in LS-DYNA and,
- Integrate the knee joint in the SAFER HBM V10 model

Learning outcomes:

Students will learn and develop skills in performing explicit FE simulations in the software LS-DYNA with focus biomechanical modelling.

Supervisors/Examiners (at Applied Mechanics)

Johan Iraeus (Johan.iraeus@chalmers.se) Division of Vehicle Safety