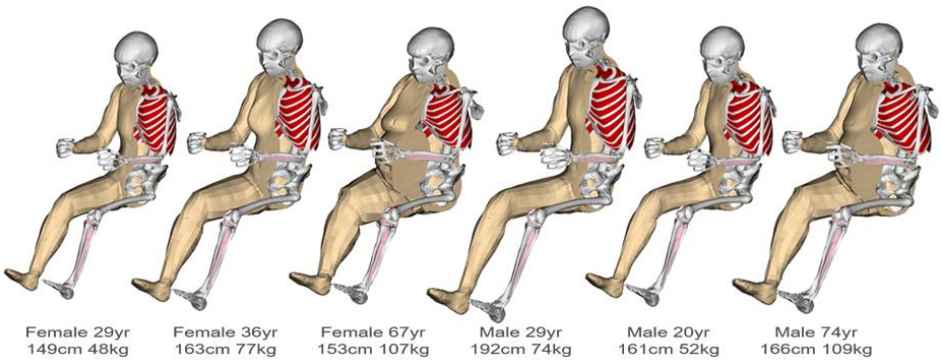
Morphometric analysis of variation in the upper extremities with body composition, age and sex

- A study to be conducted part of the time at UMTRI in Michigan and part of the time at Chalmers.

Today, development of safe vehicles is a virtual process almost exclusively based on explicit finite element (FE) simulations. Crash test dummies are being replaced by Finite Element Human Body Models (HBMs). These are tools which can be used to simulate the detailed pre- and in-crash occupant response. These models can be morphed into a population of HBMs, representing both genders and variation in body composition and injury tolerance. Such morphing enables vehicle manufactures to take a significant step forward in the development of safer restraint systems, i.e. to develop adaptive and personalized restraint systems.



The University of Michigan Transportation Research Institute (UMTRI) is world leading when it comes to morphing of HBMs. UMTRI have over the last decade collected and analyzed medical data (mainly clinical CT data) to develop statistical models that are the basis for this morphing. As of today all major bones, except for the bones in the upper extremities, are analyzed and statistical models have been developed. These models have also been incorporated in the morphing procedure.

Objective and Method

The aim of this thesis project is to analyze how the bones in the upper extremities vary with body composition, age and sex. It will include the following subtasks:

- Compile a literature review of the anatomy of the upper extremity with focus on the population variation.
- Process a number, n=30-50, of clinical CT scans of the upper extremities (scapula, clavicle, humerus, radius and ulna) using the MIMICS®, Hypermesh, and Matlab
- Analyze the anatomical variation, due to age, sex, stature and BMI, and develop statistical models to estimate bone geometries based on human attributes.

The major part of this project will be carried out in Ann Arbor, Michigan, US.

Learning outcomes:

Students will learn and develop skills in creating FE models based on medical image data with some of the best in the world within this research area.

Supervisors/Examiner

Emma Larsson and Jingwen Hu* / Johan Iraeus, Division of Vehicle Safety, Department of Mechanics and Maritime Sciences / * University of Michigan Transportation Research InstituteEmma.larsson@chalmers.se / Johan.iraeus@chalmers.se