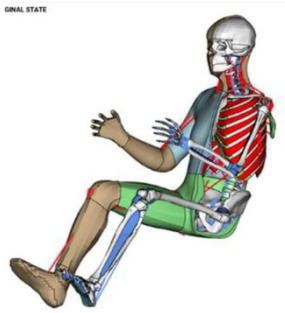
Biofidelity Validation of Human Body Models for Injury Prediction: Method Development

Background



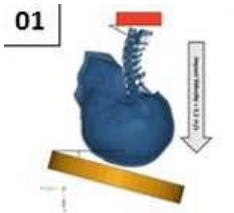
Detailed virtual models of humans, finite element human body models (FE-HBMs), are used by the automotive industry to evaluate the injury risk in an impact. The models are used both for research and development of protective system such as seat belts and airbags. With these HBMs injury risk can be assessed at a level of detail not possible with other existing tools, e.g. crash test dummies. An example of a HBM is the SAFER HBM V10. In this model significant efforts have been put into the capability to predict rib fracture and concussion risk. However, there is a need to confirm that the model predictions correspond to what happens with a human when the model and human are exposed to identical loading.

Therefore, there is a need to develop a methodology for systematic comparison of model predictions to results from tests with humans to enable confirmation and documentation of the capability of the model to represent human response when loaded.

Objective and Aim

The aim of this project is to develop a method for HBM validation which can performed every time there is an update of the model. Specific tasks are:

- Review published biomechanical data to identify load cases suitable to beused for replication with the human body model
- Review published methods for model predictions to mechanical test comparisons
- Develop a general method for comparing human body model predictions with resultsfrom biomechanical tests and decide if the model predictions are sufficiently close totest results
- Replicate selected load cases in LS-DYNA with SAFER HBM V10 and compare model predictions with results from biomechanical tests
- Demonstrate validation methodology “tool-chain”



Nightingale et al. (1996)

Learning outcomes:

Students will learn and develop skills in model validation and objective rating and performingexplicit FE simulations in the software LS-DYNA (including pre- and postprocessors) with focus biomechanical modelling.

Supervisors/Examiners (at Applied Mechanics)

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Detailed Description

The capability of the unique world leading human body model SAFER HBM to predict human kinematics and injury risk when loaded is continuously improved. The level of detail of the model is increasing. The goal is to, with high confidence, achieve kinematic predictions and injury risk that correspond to human response.

Therefore, during the development there is a need to compare predictions from the model when loaded with results from biomechanical tests in relevant load cases. For the comparison numerous biomechanical tests are replicated. The load cases are modelled at a high level of detail and thoroughly documented.

The project is to develop a methodology to enable efficient and repeated execution of load cases and comparison of model predictions and test results. A selected number of load cases will be modelled and documented to prove the method.