



## SAFER SUCCESS STORY: SAFER A-HBM (Active - Human Body Model)

*"With this unique SAFER-developed tool, advanced integrated (passive and active) safety systems for occupant protection are developed to save even more lives and reduce even more injuries."*

*Bengt Pipkorn  
Director, Simulation and Active Structures, Autoliv*

- Development of world first tool, "SAFER A-HBM" simulating occupant in braking with a following crash event enabling industrial application for development of active safety systems and advanced protection systems.
- State-of-the-art research on car occupant muscle-responses, attracting international research collaboration.
- Unique set of volunteer data on occupant kinematics in potential pre-crash events.

Human Body Models (HBMs) are state-of-the art tools for injury biomechanics research and occupant protection system development. HBMs are mathematical models of human bodies. Developments of active safety technologies (eg. braking, steering) call for human models functioning both in a pre-crash and the crash phase, why the effect of occupant postural and reflexive responses must be accounted for in HBMs by the addition of neuromuscular control schemes.

### Benefit to the project partners and impact on society:

- A unique FE-HBM with active muscle control has been developed and validated by SAFER partners, called the SAFER A-HBM.
- Up to date, the SAFER A-HBM has been used to study the effect of reversible seat belt pre-tension on occupant pre-crash posture during braking events.
- Recently, the pre-crash functionality of the SAFER A-HBM has been connected to the crash functionality of the model, enabling study of a whole sequence of pre-crash braking with a following frontal crash. This is a first of its kind FE-model.
- Industrial implementations in product development processes are ongoing.
- Through a number of research projects, collaborations with internationally renowned researchers within the field of neuromuscular control have been established.
- Long term research project plan established (for a total period of over 10 years), aiming at advances addressing complex events in multiple directions involving control of muscle activation.

### Approach:

Based on SAFER partner needs, an existing HBM was further enhanced by the addition of a model package containing muscles and a neuromuscular control scheme. The model is validated using data derived from large volunteer studies performed to study car occupant muscle responses to autonomous and driver braking interventions. In close collaboration with the industry partners, academic research staff carried out complex volunteer tests with state-of-the-art measurement methods in real vehicles driving in almost naturalistic conditions.

### Measurable results:

- 1 Ph.D., 2 Lic. Eng.
- 6 journal articles in high level journals
- Several conference presentations
- 1st price in the recognized international STAPP car crash conference student paper award

**Funding:** 3,6 MSEK SAFER internal (cash and inkind), approx. 22,6 MSEK external

**Partners:** AB Volvo, Autoliv, Chalmers, Saab Automobile, Umeå University, Volvo Cars

**Funders:** FFI

**Period:** 2009 – ongoing