Gothenburg 2019-10-02

Master Thesis Proposal: Intelligently Moving Manikin in Pre-Crash Vehicle Maneuvers

Background

Injury prevention in passenger car crashes starts already during normal driving. As a crash becomes imminent, knowledge on sitting postures and occupant kinematics in pre-crash vehicle maneuvers is important in order to predict initial conditions and subsequently injury outcomes in crashes. While there are detailed active human body models developed to cover the complete sequence of events some seconds before and during a crash, more knowledge and methods are sought regarding how a population of occupants may react during the pre-crash phase. This knowledge could serve as a base for applying occupant positioning countermeasures as well as for intervention strategies [1].

The Intelligent Moving Manikin in Automotive applications (IMMA) has been developed as a user friendly, non-expert digital human modeling tool with a manikin motion generator, based on automatic path planning techniques, that finds a collision free path and ergonomic motion for a part and the human who is assembling the part, see as a system. IMMA can address populations of human operators by creating manikin families, i.e. a set of manikins that will represent the anthropomorphic diversity among the humans within the user group [2]. IMMA is mainly used for ergonomic assessment of assembly tasks in manufacturing but has recently also been applied to driver ergonomics [3]. In development versions of IMMA the user can program e.g. a driving sequence using a scripting language [4] and the motion planning is enhanced through dynamics and optimal control [5].

Aim

The aim of this master thesis is to investigate whether the IMMA manikin family can be applied to pre-crash vehicle maneuvers for industrial applications. The intention is to assess the possibility to leverage the virtual tool chain developed for driver ergonomics (IMMA) for knowledge on sitting postures and occupant kinematics in pre-crash maneuvers. At this stage, the aim is not to replace the existing pre-crash simulations and therefore detailed modeling of muscles, seat and seat belts are not considered.

Scope

- Review the current IMMA capabilities incl. dynamics enhancements under development
- Review state-of-the-art active human body models and their capabilities
- Establish model requirements and limitations for industrial applications
- Apply conceptual and recorded pre-crash vehicle maneuvers to IMMA model
- Study feasibility of modeling pre-crash restraint systems

Student Profile

- We are looking for students that are highly motivated and have a genuine interest in mechanics and mathematics
- Master's degree students in: Mathematics, Applied Mechanics, Systems, Control and Mechatronics or similar
- The student(s) preferably has a history with Matlab
- Communication skills are an important asset

Duration

- Period: 1 semester, 30 hp credits
- Starting date: January 2020
- Number of students: Suitable for 1-2 students

Application

- Attach your CV and cover letter stating your interest within the given area and your thoughts and credentials
- Please note the application deadline
- Selection process will be ongoing
- Send the application to the contact persons below

The thesis work will be carried out at Fraunhofer Chalmers Research Centre in collaboration with Volvo Cars Safety Centre.

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[2] Hanson, L., Högberg, D., Carlson, J.S., Bohlin, R., Brolin, E., Delfs, N., Mårdberg, P., Gustafsson, S., Keyvani, A. and Rhen, I-M., IMMA-Intelligent moving manikins in automotive applications, 2014.
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