Impact Biomechanics of a Computational Pregnant Occupant

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ABSTRACT

Background: *Motor vehicle collisions are the leading cause of accidental foetal death worldwide. In the United States, around 130,000 women in the second half of pregnancy are involved in car accidents each year, out of which around 30,000 pregnant women sustain treatable injuries, approximately 160 die, and among survivors, between 300-3800 sustain foetal loss.*

Objective: *The objective of this research is to investigate various impact situations that pregnant women may undergo through a computational model of the pregnant occupant.*

Method: *The three dimensional computational model 'Expecting' has been developed at the Research School of Informatics of Loughborough University, which embodies a detailed multi-body representation of a foetus comprising 15 rigid bodies and a finite element uterus at around 38 weeks gestation. Both foetus and uterus are incorporated within an existing 5th percentile female model in MADYMO version 6.2 of TNO Automotive. The model includes a 3-point seat belt as well as a driver's airbag and is designed to simulate any kind of dynamic loading conditions the pregnant occupant can be subjected to.*

Data: *This research involves impact simulations of several impact severities for frontal and oblique crash situations. Different crash pulses are applied to the model resulting in different crash speeds. Case studies include the effects of safety systems during the impact such as correctly or incorrectly worn seat belts and airbags with different firing timings are analysed. The global and local kinematics of the pregnant occupant and stresses and strains occurring on the womb will be presented for the aforementioned cases.*

Conclusions: *This research exhibits the general response of the pregnant occupant and un-born baby in differing accident situations not only to explore the biomechanical aspects of the impacts but also to raise awareness for the issues surrounding pregnant women as vehicle users.*

The response of the pregnant occupant model in a frontal impact case with airbag and no seat belt for 20 ms intervals