UNIVERSITI TEKNOLOGI MARA

HUMAN SKULL 3D MODEL DEVELOPMENT AND BIOMECHANICAL ANALYSIS IN FULL FRONTAL CRASH

SHAHRUL HISYAM BIN MARWAN

Thesis submitted in fulfillment
of the requirements for degree of
Master of Science

Faculty of Mechanical Engineering

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Univrsiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student	:	Shahrul Hisyam Bin Marwan
Student I.D. No.	:	2011242614
Programme	:	Master of Science (EM 780)
Faculty	:	Mechanical Engineering
Thesis Title	:	Human Skull 3D Model Development and Biomechanical Analysis in Full Frontal Crash
Signature of Student	:	.....
Date	:	July 2014

ABSTRACT

This thesis is basically divided into three main topics. The three main topics are reverse engineering approach, finite element analysis and accident reconstruction for a case study. The study aims to reconstruct an accident reconstruction which involves a full frontal crash. It starts with reverse engineering stage. This stage describes the process of a human skull model development using reverse engineering approach to obtain the CAD data. The human skull model of actual life size is developed through the Non Contact 3D Digitizer processes. This stage involves the step-by-step process of developing a human skull to obtain CAD data. The CAD data and finite element model development done at Computer Aided Design, Engineering and Manufacturing (CADEM) Center, Universiti Teknologi MARA, Malaysia. Then, the next stage is to do the finite element analysis from the CAD data in previous stage. In this stage, it presents the development of one degree of freedom of frontal human head impact test procedure using finite element simulation. This study is to compare the results between simulation and experimental result conducted by Delye et al., (2007) for validation purpose. To conduct this study, the process involve is to develop finite element modeling of human skull and to analyze the data analysis which investigating the impact conditions of human skull during a human head impact on the resulting total deformation and stress distribution. There were geometric preparations, selection of elements, selection of materials, application of loadings, and the specification of boundary conditions. The last stage is to reconstruct the accident reconstruction which involves a full frontal crash. In this stage, it describes a full frontal car crash is reconstructed using finite element method to predict skull fractures. Details from the traffic and collision reports are extracted to create the computational environment. The predicted value of maximum stress is 132.01 MPa which exceeds the yield strength of human skull material. From the simulation results, it shows that the fractures are predicted at the respective velocity and initiated at the impact contact area. In summary, this study hopes to give better understanding on how to develop the three dimensional human skull model from the life size of prototype human skull as well as to do finite element analysis with the respective human skull model. This study also will help the forensic to do the prediction on the real case of accident in term of the velocity involved during the accident.

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