ANALYSIS OF PEDESTRIAN KINEMATICS IN A VEHICLE ACCIDENT

By

ATUL PRAMOD RONGHE

Fall 2001

ABSTRACT

Each year thousands of pedestrians worldwide are killed or injured in road traffic accidents. The need to provide and improve pedestrian crash survival research programs in pedestrian collision environment is the subject of much interest and research. At present, the European Enhanced Vehicle-safety Committee (EEVC) test procedure for impacts of various pedestrian subsystems, which represent sections of the human body, provides a means of assessing and rating the impact sites on a vehicle. Development and evaluation of test procedures, like 'full-body analysis' with the aid of computer simulation for optimizing vehicles on computer for compliance with the testing and evaluation methods proposed by the EEVC, which assess the injury propensity of vehicle structures for pedestrians, is needed. The TNO Road Vehicles Research Institute has adopted a fully integrated approach of 'full-body analysis', which offers a significant advantage over the EEVC method that the entire body of the pedestrian can be considered, including interactions between the individual parts of the body.

The objective of this study is to reconstruct a pedestrian-vehicle accident case by MADYMO model simulation to provide a way to study the kinematics of pedestrian in any desired impact situation. It provides flexibility to manipulate model parameters to capture impact responses of the pedestrian impact speed, vehicle front shapes, stiffness of vehicle parts and pedestrian height are the key factors, which influence the pedestrian kinematics and injury severity in a pedestrian-vehicle impact. It is most important to evaluate head injury risks as it causes a serious threat to life. Pedestrian-vehicle crash simulations are studied at different impact speeds to replicate accidents involving adult and child pedestrians. These studies are done for the following vehicles with different front geometry: Passenger car, SUV and Minivan. The overall pedestrian behavior, head impact events to predict possible head impact location and injuries sustained by head, chest and pelvis are emphasized. There is a correlation between the pedestrian height and the head impact location, which can be perceived in collisions with all the three types of vehicles. The pedestrian height remaining same, the impact location varies with the vehicle profile. Impact speed also influences the overall pedestrian kinematics to a much extent. Head injuries are severe for the high speed crashes. The chest and pelvis injuries are not significant for the adult pedestrian in collisions with all three vehicles. The 6-year-old child is more liable to chest injury in impacts with all vehicles. The potential injury to chest and pelvis is more for the child pedestrians in Minivan accidents.

In general, the injuries sustained by head, chest and pelvis are severe for the high speed crashes since the resultant body velocities are high during post impact kinematics. The research also postulates a method for development of pedestrian compliant vehicle structure to minimize the potential injury risk.