Analysis of the Damage of Cyclists in Electric Bicycle - Sedan Angle Collision: Electric Bicycle - Sedan Angle Collision

Min Yuan, The Engineering & Technical College, Chengdu University of Technology, Chengdu, China
Linpeng Hou, The Engineering & Technical College, Chengdu University of Technology, Chengdu, China
Hui Jing, CThe Engineering & Technical College, Chengdu University of Technology, Chengdu, China

ABSTRACT

In order to study the vulnerable factors of the traffic accidents—the cyclist’s injury factor at the moment of the accident—the computer simulation analysis method is used to restore the information collected by a real accident combined with the scene. From the established multi-rigid kinematics model, the corresponding injury situation of a body structure of a traffic accident rider is obtained, which involves the collision speed, the collision angle, the acceleration of each part of the human body and the force. The data is compared with ECE R44, FMVSS 213 and Euro NCAP 2009 regulations to analyze and restore various factors of bicycle injury in the collision. The results show that when the car and the non-motor vehicle have a low-angle collision, the cyclist’s injury is mainly caused by the collision with the ground after the parabola movement, and the damage position of the human body depends on the order of contact with the ground.

KEYWORDS

Accident, Index, Injury, Reproduction, Simulation

1. BACKGROUND AND THE INTRODUCTION OF PC-CRASH SOFTWARE

1.1. Background

With the rapid development of road traffic, cars have become synonymous with freedom and convenience in people’s minds. According to statistics from the Ministry of Public Security, by the end of June 2018, the number of motor vehicles in the country reached 319 million. In contrast, the number of large and small traffic accidents has also been trending with the increase of vehicles. Taking 2012 and 2014 as examples, the total number of traffic accidents in 2012 was 204,196, and the number of traffic accidents in 2014 totaled 196812 (Park, Kim, & Ha, 2016). Therefore, the safety of vehicle collision has become the focus of research at home and abroad. According to the data of the US National Accident Sampling System, in the damage of various parts of the human body, 35.5% of head injuries, 27.6% of chest injuries, 18.2% of abdominal injuries, 5.1% of lower limb injuries, and 4.6% of neck injuries. Finally, the upper limbs and facial injuries (Caliendo, Guglielmo, & Guida, 2016). It has been found that most people who are killed or disabled in a car accident are neither passengers nor drivers, but vulnerable road users outside the car (Li & Li, 2015). In China’s traffic accidents, the ratio of the death of motor vehicle drivers to the traffic vulnerable (pedestrians, occupants, cyclists) is 1:3. In the developed countries of traffic, the opposite is true, which means that

DOI: 10.4018/IJACI.2020010106

Copyright © 2020, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.
the death rate of traffic vulnerable people in China is twice as high as that of drivers. According to statistics, 12% of traffic accident deaths in Europe are pedestrians, 11% in the United States and over 50% in China. Therefore, it is very necessary to study the domestic pedestrian collision protection and the formulation of relevant standards (Martínez, Páez, & Furones, 2016).

At present, the research on vehicle collision is mainly studied from two aspects: physical collision dummy and simulated collision dummy (Kim et al., 2015). This paper will use computer simulation analysis method to reconstruct and analyze traffic accidents based on Pc-crash software. According to the data collected by the accident site, the collision and the victim are studied at the two angles. Combined with theoretical knowledge, the respective trajectories and data links are analyzed between the two when the collision occurs and the end of the collision movement. In turn, the relevant human injury analysis is carried out for the vulnerable people in traffic accidents. With the continuous development of the global economy and the acceleration of urbanization, the global car ownership and road mileage are gradually increasing. The pollution caused by automobile exhaust, the shortage of land resources caused by road expansion and traffic accidents are becoming more and more serious. Because the traditional motor vehicles can not avoid the continuous expansion of such traffic problems, with the rise of intelligent vehicle technology such as vehicle networking and intelligent driving, people place these problems that traditional vehicles can not solve on intelligent driving technology. The American Association of Electrical and Electronic Engineers (IEEE) predicts that by the end of 2040, 75% of vehicles on the road will be equipped with automatic driving technology.

1.2. The Introduction of Pc-Crash Software

PC-Crash builds physics mathematical models based on kinematics and dynamics. It contains several different computational models, including impulsive momentum collision models, stiffness-based collision models, dynamic models for real trajectory simulation, and for time- A simple kinematic model of distance research. In order to reflect the relative movement state and internal relationship between the elements of the accident caused by the traffic accident, it is mainly used for the reconstruction of road traffic accidents. The human body model in the software uses a multi-rigid system, and all parts of the human body (head, torso, buttocks, etc.) are connected by a rotatable joint, as shown in Figure 1. For each part, there are different characteristics, such as geometric shape, quality, contact hardness, friction coefficient and so on.

2. ACCIDENT RECONSTRUCTION

2.1. Accident Description

In the process of normal traffic from east to west at the crossroads, a Ford sedan collided with an electric bicycle with a red light from south to north. And the collision contact point was on the zebra crossing. The electric bicycle does not have any braking measures before the accident, and the car has a slight braking trace. When the electric bicycle collides with the electric bicycle, the front is skewed to the right. Two people on the electric bicycle were injured, one slightly injured and another seriously injured. The front left bumper of the car was damaged, and the right side of the electric bicycle was damaged. The cyclist’s injury was a pulmonary contusion and a compression fracture of the lumbar vertebral body. Combined with the picture video data and the degree of damage of the rider, it is preliminarily identified that the rider is in contact with the left front bumper of the passenger car during the riding of a minor. The head, chest and abdomen or some position is in contact with the hood of the vehicle. Then the rider is bumped into a parabolic free fall and comes into contact with the ground, causing secondary damage to the buttocks or chest.

The scene of the accident was measured by scratching the ground on the zebra crossing after an electric bicycle hit the ground. The position of the left front wheel of the car was 5.1m away from the starting point of the scratch. The driver of the car started to brake and turn after the blind spot. It
Indirect Adaptive Fuzzy Control for a Class of Uncertain Nonlinear Systems with Unknown Control Direction
[www.igi-global.com/article/indirect-adaptive-fuzzy-control-class/60377?camid=4v1a](www.igi-global.com/article/indirect-adaptive-fuzzy-control-class/60377?camid=4v1a)

Complex Event Refinement by Statistical Augmentation Model
[www.igi-global.com/article/complex-event-refinement-by-statistical-augmentation-model/135906?camid=4v1a](www.igi-global.com/article/complex-event-refinement-by-statistical-augmentation-model/135906?camid=4v1a)