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The development of a new low cost accident database with the addition of an online feature to allow multi-centre input

Michel H. Woering[*], Jos Vander Sloten[#], Bart Depreitere[†]

[*]Faculty of Mechanical Engineering
KU Leuven University
Celestijnlaan 300C, 3001, Heverlee, Belgium
email: Michel.woering@kuleuven.be

[#] Faculty of Mechanical Engineering
KU Leuven University
Celestijnlaan 300C, 3001, Heverlee, Belgium
email: Jos.vandersloten@kuleuven.be

[†]Faculty of Medicine
Ku Leuven University
UZ Herestraat 49, 3000, Leuven, Belgium
email: Bart.depreitere@uzleuven.be

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1 INTRODUCTION

Head injuries are the most frequent injuries for bicyclists and pedestrians involved in accidents [1][2]. Therefore, it is important to understand these injuries and see how protection can be improved. Understanding the human head crash biomechanics is mostly done by means of cadaver or animal experiments. However, real life accidents are claiming a place between these two in the last few years [3]. To perform real life accident simulations of sufficient quality and relevance, there is a need for well documented real life accidents. And, in order to produce statistical relevant results, there should be enough cases of each type of accident.
Several big accident databases exist, like the GIDAS [4][5] and the IMPAIR [6] study in Germany, and the EDA of IFSTTAR [7] in France. These databases are based on accidents reported to the police in several cities. They gather a detailed description of the accident place, mostly combined with a smaller medical report. Databases like these have pushed the real life accident simulation scene in the right direction, and formed a basis for many safety features on cars to protect pedestrians and cyclist. However, these databases are costly due to the intensive work they need and they tend to gather predominantly cycle crashes in which a vehicle is involved [8], although 70% of the emergency visits of cyclist is due to singe crashes [9]. This shows that single sided bicycle accidents are also a big source of injuries. Yet, these accidents are hardly reported in literature [8][9][10]. Another downside of these databases is the fact that most cycling crashes that involved a vehicles resulted in a double impact on the head, which makes it harder to find the relation between cause and injury compared to one sided accidents.
To get a better view on the most common cycling accidents that result in TBI, another approach is needed. A search based on hospital admissions instead of traffic police callings is one possible solution. This will not only show the cycle to vehicle crashes, but also the single cycling accidents resulting in head injuries. Naturally the gathering of solely hospital data will not give the details needed for accident reconstructions. For this reason the hospital data is combined with a questionnaire send to eye witnesses and the victim. However, questionnaires have a certain amount of uncertainty, which has to be battled. This can be done by an increase of cases. Therefore, the questionnaire is carefully made to provide the necessary information, without taking too much time of the victim. Thereby efforts have been made to store all the information in a database that can be accessed by different hospitals and universities too. Good documentation and cooperation between multiple hospitals and universities will help to increase the number of cases, not only for car-VRU accidents, but especially for single VRU accidents. The main goal is to establish a scientific environment that enables multiple universities to do accident reconstructions without the high costs of a detailed crash research. This should increase the understanding of head injuries, by boosting the number of documented real life accidents and the number of simulated cases.

2 METHODS

Data gathering

Data of real life crashes can be acquired through the hospital. With ethical approval it is possible to store the medical data in a database. The medical data includes medical images and a detailed report of the injuries. Without crash kinematics, these reports are not suitable for accident reconstructions. Hence a lot of attention went into making a fitting questionnaire for the victims of the crash. A questionnaire should be useful to get insights in the accident environment and crash kinematics while they should also be easy to fill in for the user. This was reached by studying literature from multiple sources [11]–[14] and the help of medical doctors.

Database development

The digital age creates the opportunity to share data quick and easy through internet. For this purpose, work went into the making of a simple but effective database. The focus of this database is accident reconstructions. Hence, it is developed to capture the details needed for accident reconstruction, which is a combination of the crash description and medical records, but also the reconstruction results like velocity and acceleration profiles. Due to the cooperation with the HEADS network, a Horizon 2020 project focusing on head injuries and helmet standard improvement, the system will also be useable for equestrian and snow sports. The base of this project is a relational database with a clear interface build in Microsoft Access. Through a screen with 5 buttons users are guided to different forms. The first form is a to add basic personal data like the weight, height and age. The next form is made to submit general medical information. The general information is useful to quickly connect accident data with a simple overview of the medical conditions. After this, there is the opportunity to add specific injury data, mainly related to the head. Easy navigation is created through a submenu on the side, which contains forms for injuries such as ASDH, fractures and contusions. These forms are useful to create a detailed description of the different injuries. Finally, there is a form to add details about the accident, which is mainly based on the questionnaire. Every form has a relation with the other form. This means that one person can have multiple crashes, and one crash can result in multiple injuries. A simple reading form has been created, showing only the most important information for accident reconstructions. This includes a description of the persona that is needed to scale the person, accident information needed for the reconstruction and the location and description of the different injuries. Furthermore, there is an opportunity for statistical analysis and relational searches of different topics. One example is to relate gender or age with different injuries or reconstruction results, which might result in age or gender specific injury thresholds.

The last form is to submit reconstruction results with some additional information to check the background of the simulation in an efficient way. These details include the institute of the researcher, the type of simulation that was used and possible publication details.

The possibility to work together with other universities is created through a coupling with Microsoft Sharepoint. Users can be invited to work online in the interface, which allows the addition of new data and the reading of all other data. With this database it will become possible to cooperate with different institutes in a low cost way. A simple open source platform to create a wealth of accident reconstruction material.

3 INITIAL FINDINGS

The database was tested and altered based on data collected by our group in the past and new cases from UZ Leuven. Next to this, there was an opportunity to work together with KBC Insurances, a private insurance company, to get access to casefiles of work accidents. This means the files where organized and written for insurance purposes. The database helped to find the most important information in a fast way and made sure all the important details were covered. It showed that even without any prior knowledge, it is possible to work with the database and gather useful information.

4 DISCUSSION

Based on the findings so far, the database shows high potential for the gathering and saving of accident information. However, the crash information that is collected through a questionnaire has a lot more uncertainties compared to police file and juridical expert data, which might be a downside of this database. Managing uncertainties is an inherent challenge in this work and efforts should be done to keep uncertainties in the entry data as low as possible. Working together with the police, gathering police data, video data or GPS data will have a positive effect on the uncertainties, however, this will also increase the workload again. Another approach that might be explored is to categorize accidents on different accident types and outcomes, to create a statistical base with a bigger sample size. This will decrease the input uncertainties of individual cases and create a more general overview of the accidents. The end goal would be to find a correlation between input parameters and injury outcomes, to increase the knowledge of head crash biomechanics and create a basis for innovation in pedestrian and cyclist protection. A good correlation can only be established if the sample size of data is sufficient. This again, stresses the importance of an accident database with a considerable amount of cases.

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