A. Title Page

Development of an Automated CRUSH Profile Measuring System

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B. Restatement of problem researched, creative work, or professional enhancement opportunity

Traffic accidents have become a serious social problem that threatens people and their property. In the United States, motor vehicle accidents are the leading cause of death for college age people.[1] Globally, traffic accidents are the second leading cause of death for young people between the ages of 18-25.[2] As a result vehicle safety design has made great strides during the last 20 years. Crumple zones, air bags, anti-lock brakes, and safety data recorders were direct results of control crash test and real-world accident investigations.

One analysis technique involves calculating the amount of energy dissipated during a collision. This technique is known as Crush Energy Analysis and has led to several improvements in vehicle safety design, namely the inclusion of crumple zones in critical structural areas. To perform Crush calculations the investigator must take a series of evenly spaced damage measurements to establish the amount of deformation the car experienced during a collision. These measurements must be very precise because the energy calculated using this data is extremely sensitive to variations in the damage depth (Energy ~ Damage Depth Squared), consequently, small measurement inaccuracies will result in large errors in these calculated energies. An example of these types of measurements are shown in Figure 1.[4]

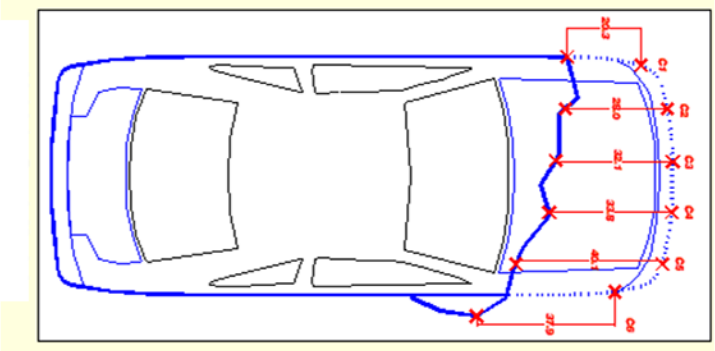

Figure 1 CRUSH measurements for a head-on collision

One major drawback with CRUSH analysis is the time it takes to perform the measurements. It can take an investigator several hours to setup and measure the vehicle because it is necessary to measure the entire vehicle in at least three separate planes of damage. Additionally it is necessary to reproduce the measurements on an exemplar undamaged vehicle in order to perform the calculations. Furthermore, in order to ensure the accuracy of the data it is often necessary to have a team of 2-3 investigators/engineers. What is needed is a simple, fast, and highly accurate method for collecting these measurements. In this proposal we request funds to design an automated system that would scan the front or side of a vehicle and record the damage profile in a matter of minutes instead of hours. Additionally the system should be portable and simple enough to be operated by only one user.

C. Brief review of the professional enhancement opportunity, creative work, or research procedure

Our design consisted of a laser range finder (LIDAR) mounted on a tripod. The LIDAR works by sweeping a laser over 240° with 0.36° angular resolution. As the laser scans it simultaneously detects reflected signals and calculates the distance as a function of angular position. This scan is completed in under a second and is accurate to within +/- 0.1 inch. The LIDAR system was then mounted on a lightweight aluminum tripod stand. This stand allows the investigator the ability to take scans at multiple heights in order to obtain a complete CRUSH depth profile.

D. Summary of findings, outcomes, or experiences had.

Unfortunately we were unable to complete this project because the instrumentation could not be delivered before the end of the fiscal year on July 1st. However this project was similar in scope to our professional development grant and we were able to obtain some results.

E. Conclusions and recommendations

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REFERENCES

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3. Center for Disease Control, "The Incidence and Economic Burden of Injury in the United States", http://www.cdc.gov/ncipc/factsheets/CostBook/Economic_Burden_of_Injury.htm
4. http://www.exhibit-a.net/vehicle/