I. Introduction

Traffic accidents can be a dangerous habit on Furman University’s college campus and endangering the lives of students, faculty, staff and community members. Over the past ten years Furman University has experienced anywhere from 40 to 60 traffic accidents on campus in a single year. While fatalities are rare, vehicle damage can be costly and property damage to the Furman University campus can be expensive. This research hopes to identify areas where higher incidences of traffic accidents occur so that precautions can be taken to make Furman University a safer college campus.

Traffic hotspot analysis was conducted using kernel density estimation techniques to highlight areas on Furman University campus. The maps produced display high accident areas or hotspots on campus.

II. Literature Review

Multiple analytics have been completed on urban areas and major highways around the world to determine dangerous areas in an urban area or on a section of highway (Shankar, V., et al., 1995; Jones, A.P., et al., 1996; Ng, K.S., et al., 2002; Khan, M.A., et al., 2004; Sabel, C.E., et al., 2005; Esrkine, S., et al., 2008; Jones, A.P., et al., 2008; Anderson, T.K., 2009; Durrance, S.R., 2010; Gunodlugu, B.L., 2010). Four different data analysis techniques have been used in different articles to determine traffic accident hotspots. The first step in all of these methods involve clustering the data before running the different methods listed below. The first step in a kernel density estimation method which identifies higher than normal traffic accidents and displays the hotspots as a continuous raster surface (Jones, A.P., et al., 1996; Sabel, C.E., et al., 2005, Anderson, T.K., 2009). The second method incorporates environmental data (climate, population, traffic, etc.) in the clustering analysis methodology to determine hotspots. This method was determined by the authors to be more accurate than kernel density estimation because of the added context for the accident data (Jones, A.P., 2008; Anderson, T.K., 2009). The added environmental data also allows one to not only gain greater hotspot accuracy, but also determine the cause or unique factors involved in the traffic accident. The third method is to determine the location of past accidents which will be used to determine linear sections of highway that are dangerous and needed to undergo improvement construction due to the higher traffic safety (Gunodlugu, B.L., 2010).

The fourth technique is a repeatable analysis method which determines hotspots based on a software technique called moving window analysis. The author claims that this technique is repeatable and can reduce data noise and achieve reliable hotspots than the kernel estimation method (Erdogdu, S., et al., 2008).

A portion of the research directly analyzes traffic accident hotspots to determine the cause in a given location – such as dangerous road geometries, hazardous weather, or social triggers. Shankar, V., et al. (1995) introduce the idea that certain road geometries and weather conditions cause an increase in a certain type of accident or style of accident.

There is literature that goes as far as to detect the hotspot and develop an accident prediction system that could identify where accidents would happen to happened in and what weather conditions those accidents will occur. Dobhram, S.S. (2010) proposes a decision making system that is supported by a support vector machine and artificial neural network to predict traffic accidents. However, this first research has to identify the hotspots with kernel estimation analysis before an accident prediction system could be created out of different algorithms and databases.

The research into traffic accident hotspot identification is rather vast. However one paper in the literature does exist. None of the research has been conducted on the small scale of a college campus alone a small library on a college campus. Most of the research focuses on large urban areas, city wide areas, major highways in Aljoun kingdom, major highways in New Zealand, and Northern England. Other research areas comprise of major highways in Afyonkarahisar, Turkey and Seattle, Washington. All of these research areas are large urban areas, very different from a college campus where the maximum posted speed limit is 25 miles per hour.

III. Methodology

Five years of traffic data gathered from Furman University Police Office (FUPO) were collected from their automated system and inputted into ArcGIS 10 in various maps marking the location, time, and date of the traffic accidents. A raster base map of Furman University’s campus was provided by the earth and Environmental Sciences laboratories. Once the data was inputted into ArcGIS 10 a kernel density estimation was selected as the method for determining accident hotspots on Furman University campus. The kernel density estimation was run eight times upon different selection of data events with a 500 feet radius (see resulting maps).

IV. Results and Discussion

The kernel density analysis on traffic data that runs a simulation multiple times from 2006-2010. The output of this analysis shows distinct hotspots that exist at Furman University. One hotspot exists in McClone parking lot (MC), while a smaller hotspot is located in the Upper Village parking lot (Dining Hall, DH). MCA and USoHo experience high activity because both of these lots are close to student parking. There is a high amount of activity in both of these parking lots from students leaving the DH parking lot, arriving at these lots at all hours of the day and night. Secondary hotspots appeared in North Village A (NV A), North Village B (NV B), North Village E (NV E), North Village K (NV K), Main Entrance Circle (ME), Dining Hall parking lot (DH), Dining Hall Loading Dock (DL), and Timmons Arena (TIM). All of these secondary hotspot areas are parking lots on campus. The kernel density data analysis on all the data from 2006-2010 marks parking lots as the most dangerous areas on campus, due to the amount of traffic accidents in these areas.

Analysis of traffic accidents for each individual year in the five-year analysis period reveals minor changes in primary hotspots. Different secondary hotspots in each year appeared on the secondary hotspot list. For the highest intensity hotspot (2009 and 2007) to a medium intensity hotspot (2010, 2008, 2006) from 2006 through 2010. The secondary hotspots in 2006 are NV B, NV K, Main Entrance Circle Center parking lot (UC), and South Housing parking lot (USoHo). The secondary hotspot in 2007 shifts entirely to USoHo, USoHo, and Hayrwood parking lot (HL). The secondary hotspots in 2008 are located in NV K, DL, and HL. This interesting to note is that the hotspot that existed in 2007 become a secondary hotspot in 2008. In 2009 the secondary hotspots are NV E, ME, DL, ME, USoHo, SCL, and TIM. 2010 displays the secondary hotspots are USoHo, and USoHo. Both in 2009 and 2010 (USoHo) becomes a secondary hotspot instead of a primary hotspot. Almost all of the primary and secondary accident locations from 2006 through 2010 are parking lots on Furman University campus. Additionally, from the kernel density estimation of the individual years of data, a rotation between different parking lots during different times on the campus appears; however, one of the main hotspot locations remains a primary hotspot on campus from 2005 through to 2010.

Kernel density estimation was run on all five years of data separating out the weekday accidents vs. weekend accidents. Analysis showed that out of the 226 of total data points 179 of those traffic accidents happen during the week, more than the 47 that run a simulation multiple times on the weekends. The weekend small concentrated primary hotspot occurs at MCA, Me and USoHo. During the weekend the primary hotspot location is scattered on MCA, DH, LD, and USoHo. Once the semester is over, the everyday primary accident hotspots occur mostly in student parking lots (MCA and USoHo).

This chart reiterates accidents occurring more commonly on the weekend with a plateau of traffic accidents in the middle of the week.

V. Recommendations / Future Research

Without FPU collecting the latitude and longitude data of traffic accidents and past general locations (in south Campus, north Campus, etc.) a user could make an accurate assessment of potential traffic accidents and occurrence of traffic accidents in those locations. A user would be able to determine if the geometry of roads, parking lots design, configuration, trees, bushes are causally traffic accidents on the campus. An update of the Furman University accident reporting system is necessary to record accurate traffic accidents on campus. sideline devices with GPS locations capabilities could be used to fill out an accident report and record the exact location of traffic accidents occurring on the campus. A system to automatic recognize of traffic accidents on the basis of a GIS platform, accident report filling out system to automatic recognize of traffic accidents on the basis of a GIS platform is necessary. An additional, this project could be expanded identifying traffic problem areas and solutions to improve these dangerous sections of Furman University campus.

VI. Conclusion

Accidents on Furman University campus are common. Most traffic accidents consist of two main student parking lots, MCA and USoHo. Parking lot traffic accidents occur due to traffic congestion in North Village parking lots and high traffic areas such as student parking lot (MCA), Upper Village parking lot (USoHo) and the Main Entrance of Furman University.


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