Traffic Incidents on Furman University Campus

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I. Introduction

Traffic accidents can be a dangerous hazard on a college campus, endangering the lives of student, 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. Hotspot analysis was conducted using kernel density estimation to locate high incident areas on Furman University campus. The maps produced display high accident areas or hotspots on campus.

II. Literature Review

Multiple hotspot analyses 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; Erdogan, S., et al., 2008; Jones, A.P., et al., 2008; Anderson, T.K., 2009; Durduran, S.S., 2010; Gundogdu, I.B., 2010). Four different data analysis techniques have been used in different articles to determine traffic accident hotspots. The first step of all of these methods involve clustering the data before running the different methods listed below. The first is a kernel density estimation method which identify 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, weather, etc.) in with 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 hotspot accuracy, but also determine the cause or unique factors involved in the traffic accident. The third method is a linear analysis technique to determine linear sections of highway that are deemed dangerous and needed to undergo improvement construction to make those areas of highway safer (Gundogdu, I.B., 2010).

The fourth technique is a repeatability analysis method which determines hotspots based on a software algorithm that runs a simulation multiple times. The author claims that this technique determines a greater number of reliable hotspots than the kernel estimation method (Erdogan, 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 (rain, snow, or ice) see an increase of a certain type of accident or style of accident.

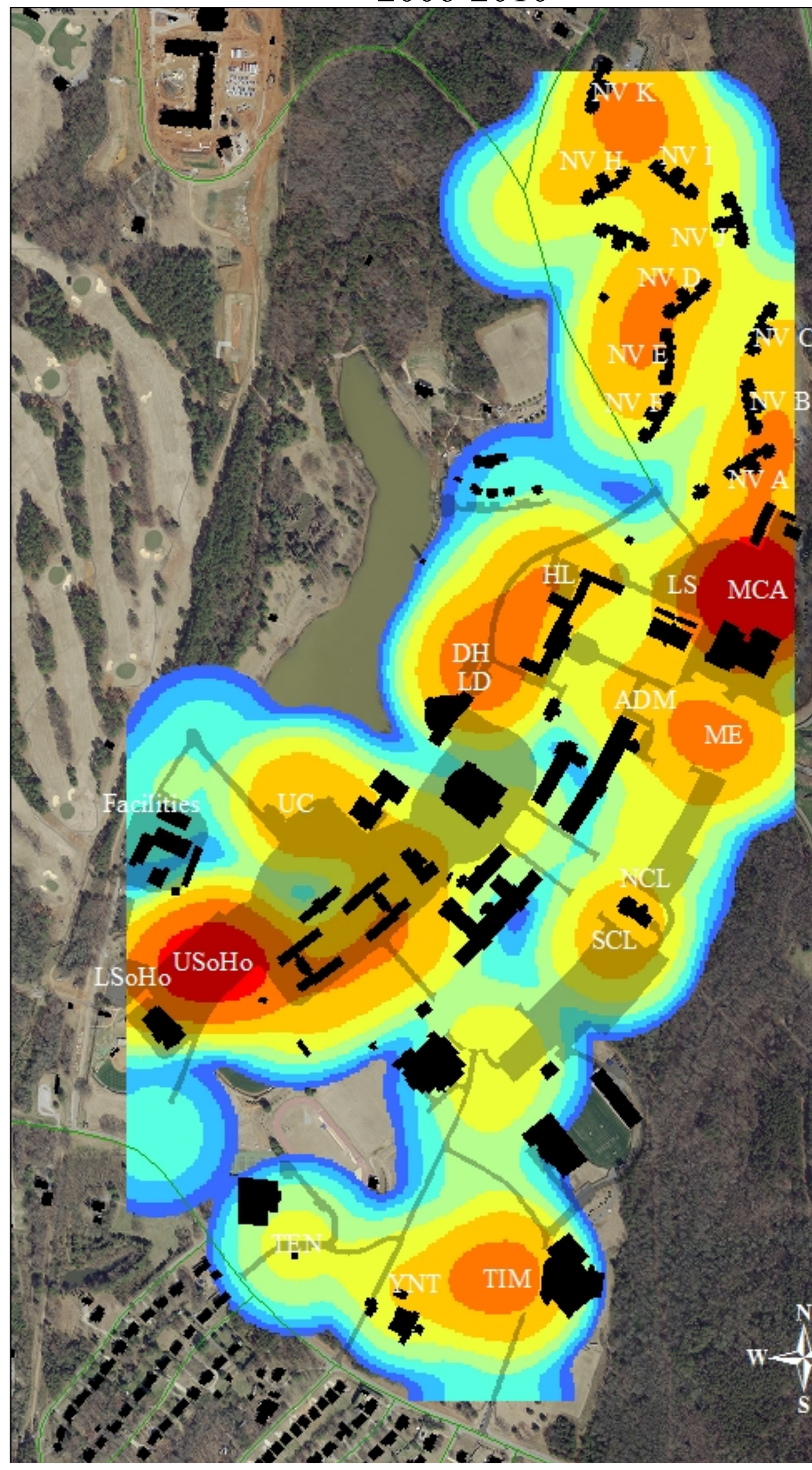
There is literature that goes as far as to gather the hotspot data and develop an accident prediction system that could identify where accidents are going to happen and in what weather conditions those accidents will occur. Durhuran, S.S. (2010) proposes a decision making system that is supported by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

The research into traffic accident hotspot identification is rather vast. However one gap in the literature does exist. None of the research has been conducted on the small scale of a college campus let alone a small liberal arts college campus. Most of the research focuses on large urban areas such as Hong Kong, China, Konya, Turkey, Christchurch, New Zealand, and Norfolk, 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.

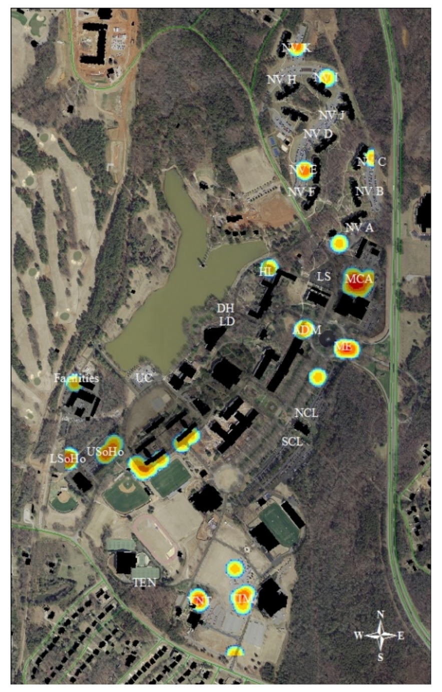
III. Methodology

Five years of traffic data gathered from Furman University Police Office (FUPO) was collected from their automated system and inputted into ArcGIS 10 as data points marking the location, time, and date of the traffic accidents. A raster base map of Greenville in 2008 was provided by the Earth and Environmental Sciences department. Kernel density estimation was selected as the method for determining accident hotspots on Furman University campus. Kernel density estimation was run eight times upon different selections of data and with a 500 foot radius (see resulting maps).

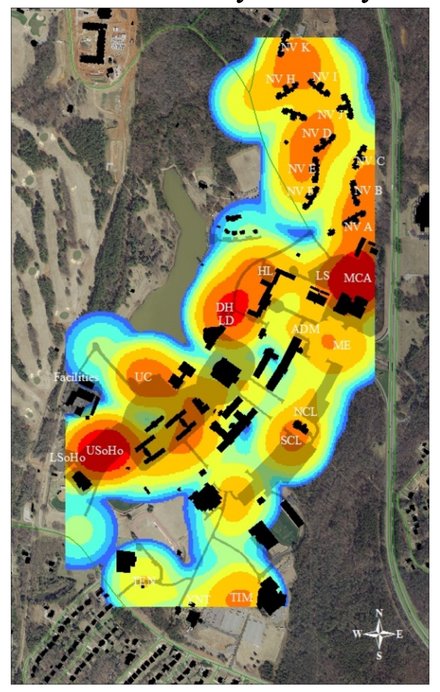
Kernel Density Estimation of Furman University (FU) 2006-2010



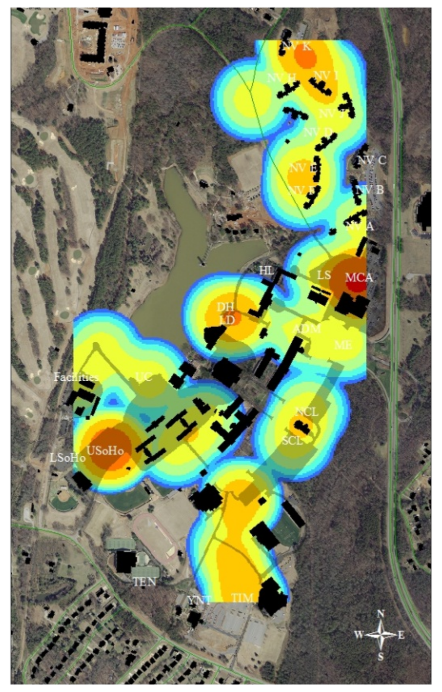
Kernel Density Estimation of FU Saturday and Sunday



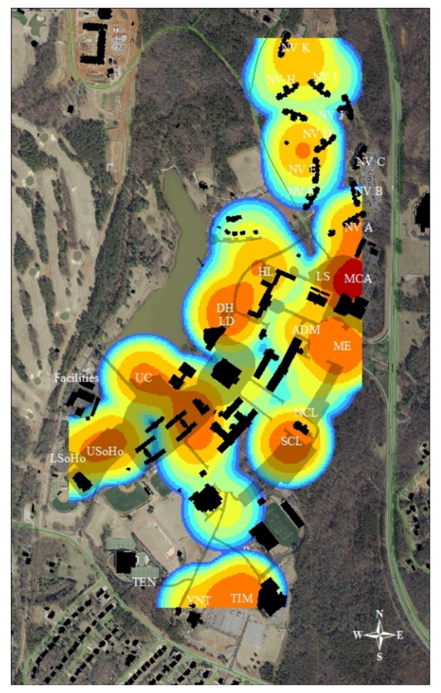
Kernel Density Estimation of FU Monday – Friday



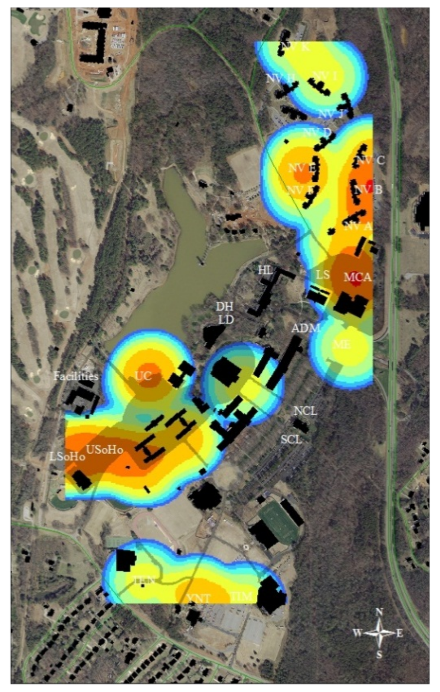
Kernel Density Estimation of FU 2010



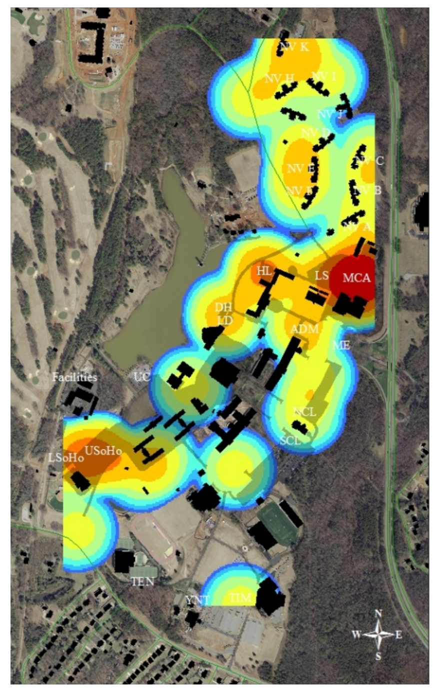
Kernel Density Estimation of FU 2009



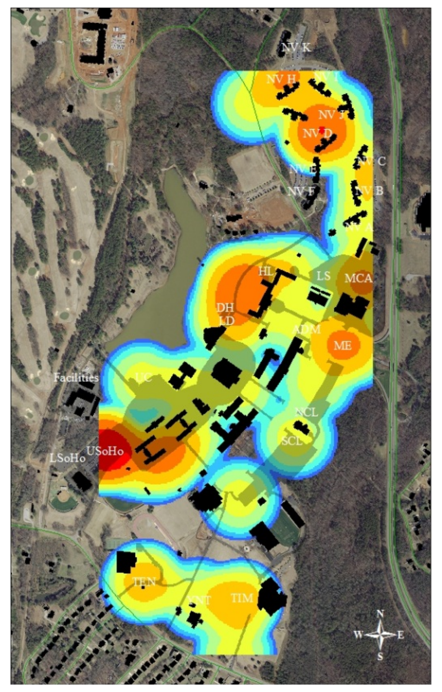
Kernel Density Estimation of FU 2006



Kernel Density Estimation of FU 2007



Kernel Density Estimation of FU 2008



Legend

= High Intensity Traffic Accidents = Medium Intensity Traffic Accidents = Low Intensity Traffic Accidents

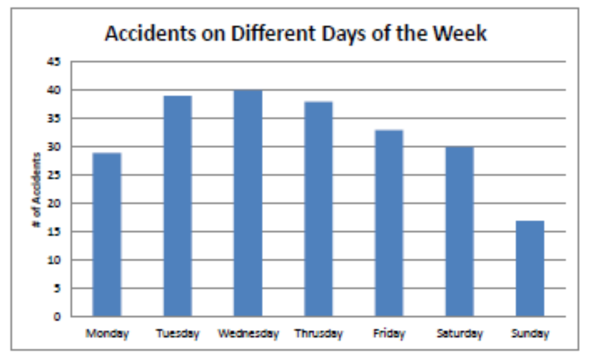
NV A = North Village A parking lot
NV B = North Village B parking lot
NV C = North Village C parking lot
NV D = North Village D parking lot
NV E = North Village E parking lot
NV F = North Village F parking lot
NV H = North Village H parking lot
NV I = North Village I parking lot
NV J = North Village J parking lot
HL = Haynesworth parking lot
LS = Lakeside parking lot
MCA = McAlister parking lot
ME = Main Entrance Circle
ADM = Administration parking lot
DH = Dining Hall parking lot
LD = Dinning Hall Loading Dock
NCL = North Chapel parking lot
SCL = South Chapel parking lot
UC = University Center parking lot
Facilities = Facility Services
USoHo = Upper South Housing parking
LSoHo = Lower South Housing parking
TIM = Timmons Arena
YNT = Younts Conference Center
TEN = Mickel Tennis Complex

IV. Results and Discussion

The kernel density analysis on traffic data from 2006-2010 revealed that two distinct hotspots exist at Furman University. One hotspot exists in McAlister parking lot (MCA) and the other hotspot is located in the Upper South Housing parking lot (USoHo). MCA and USoHo experience high activity because both of these lots are student parking. There is a high amount of activity in both of these parking lots from students leaving and arriving at these lots at all hours of the day and night. Secondary hotspots appeared in North Village A (NV A), North Village D (NV D), North Village E (NV E), North Village K (NV K), Main Entrance Circle (ME), Dining Hall parking lot (DH) / Dining Hall Loading Dock (LD), and Timmons Arena (TIM). All of these secondary hotspot areas are parking lots on campus. This 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 on campus.

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 appear. The MCA hotspot shifts from high intensity hotspot (2009 and 2007) to a medium intensity hotspot (2010, 2008, and 2006) from 2006 through 2010. The secondary hotspots in 2006 are NV B, NV C, NV E, University Center parking lot (UC), and South Housing upper and lower parking lot. The secondary hotspots in 2007 shifts entirely to USoHo, LSoHo, and Haynesworth parking lot (HL). The secondary hotspots in 2008 are located in NV D, NV H, NV J, MCA, ME, DH, LD, and HL. Interesting to note is that MCA, one of the primary hotspots, became a secondary hotspot in 2008. In 2009 the secondary hotspots are NV E, DH, LD, ME, UC, USoHo, SCL, and TIM. 2010 displays the secondary hotspots of NV K, LD, and USoHo. In both 2009 and 2010 USoHo becomes a secondary hotspot instead of a primary hotspot. Almost all of the primary and secondary accident locations for 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 on campus appears; however, one of the main student parking lots is always the primary hotspot on campus from 2006 through to 2010.

Kernel density estimation was run on all five years of data separating out 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, far more than the 47 of traffic accidents that occurred on the weekend between the years 2006-2010. On the weekend small concentrated primary hotspots occur at MCA, ME, and USoHo. During the weekday primary hotspots are located at MCA, DH, LD, and USoHo. Once again, not surprisingly primary accident hotspots occur mostly in student parking lots (MCA and USoHo).



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

V. Recommendations / Future Research

Without FUPO collecting the latitude and longitude of traffic accidents and just general locations (ie. South Chapel Lot or NV A) it is difficult to make an accurate assessment of possible causes for traffic accidents in certain locations on campus. With the accurate GPS location of an accident one would be able to determine if the geometry of roads, parking lot isles configuration, trees, bushes are inadvertently causing traffic accidents on campus. An update of the Furman University accident recording system is necessary to record accurate locations of traffic accidents on campus. Handheld devices with GPS location capabilities could be used to fill out an accident report and record the exact location of traffic accidents providing a much more efficient and helpful system. With the suggested update of technology for FUPO an additional, more precise research project could be completed identifying problem areas and solutions to improve these dangerous sections of Furman University campus.

VI. Conclusion

Accidents on Furman University campus occur most prominently in the two main student parking lots, McAlister parking lot and Upper South Housing parking lot. Secondary traffic accident locations are also found in student parking lots in North Village parking lots and high traffic areas such as the University Center parking lot and the Main Entrance of Furman University.

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Acknowledgements

A special thank you to Dr. Amelie Davis and Mike Winiski for their support and assistance on this project, this research was made possible by these two people.