GEOG 6204

Summer 2021

GIS based Research Proposal

Which Intersections are the Most Dangerous on GWU's Foggy Bottom Campus?

Author: Lydia Teinfalt

Last Updated: 06/27/2021

Table of Contents

Introduction

Koren A. Bedeau, Senior Associate Provost for Special Projects, announced in an email that George Washington University (GWU) will "transition into the in-person fall semester." This marks an exciting return towards normal operations in a post-pandemic world for the GWU community where many students, friends and colleagues have not seen each other in person for a year or more. We should moderate this excitement by being aware about the dangers of traffic accidents that continues to be a threat post-pandemic. For the first six months of 2021, there were a total of 2,491 people injured in traffic crashes in D.C. On 3/1/2021, a car struck a pedestrian around the block of 2400 Virginia Avenue, NW nearby to Shenkman Hall, a GWU dormitory. The pedestrian died from injuries sustained. Could spatial analysis show the most dangerous intersections for the community inhabiting GWU's Foggy Bottom campus?

The National Highway Traffic Safety Administration (NHTSA) reported while American drove less in 2020 because of the pandemic, it is estimated 38,680 casualties resulted from motor vehicle crashes. GWU moved to online learning in 2020 to keep us safe from the spread of Covid-19 and now vaccines are helping us stay healthy, but vaccines will not prevent dangers of the road. Association for Safe International Road Travel (ASIRT) maintains that road crashes can be predicted and preventable and preventing them is a shared responsibility amongst organizations and individuals. Spatial analysis will be conducted on geographical crash data in DC with a focus to the Foggy Bottom campus to enable members of our GWU community make informed road safety decisions.

This research proposal will rely on D.C.'s Open Data website to find crash data that pinpoint the locations of crashes. Secondly, find geographical data defining the area and boundaries GWU's Foggy Bottom campus with attributed street information. Then overlay the GWU's Foggy Bottom campus outline with the DC crash data and integrate the two layers to form a new layer informing location and number of people injured in the crashes. Density analysis can be conducted to understand magnitude per unit area within intersections located in the Foggy Bottom campus that have the most concentration of traffic accidents. Figure 1 is a map rendered using ArcGIS map viewer available from Open Data DC's website; each red dot in Figure 1 represents a crash location from the Crashes dataset for Foggy Bottom since 2017. If multiple crashes occurred in the exact same location, the dots can overlay on top of each other so may not visually convey the number of crashes accurately.

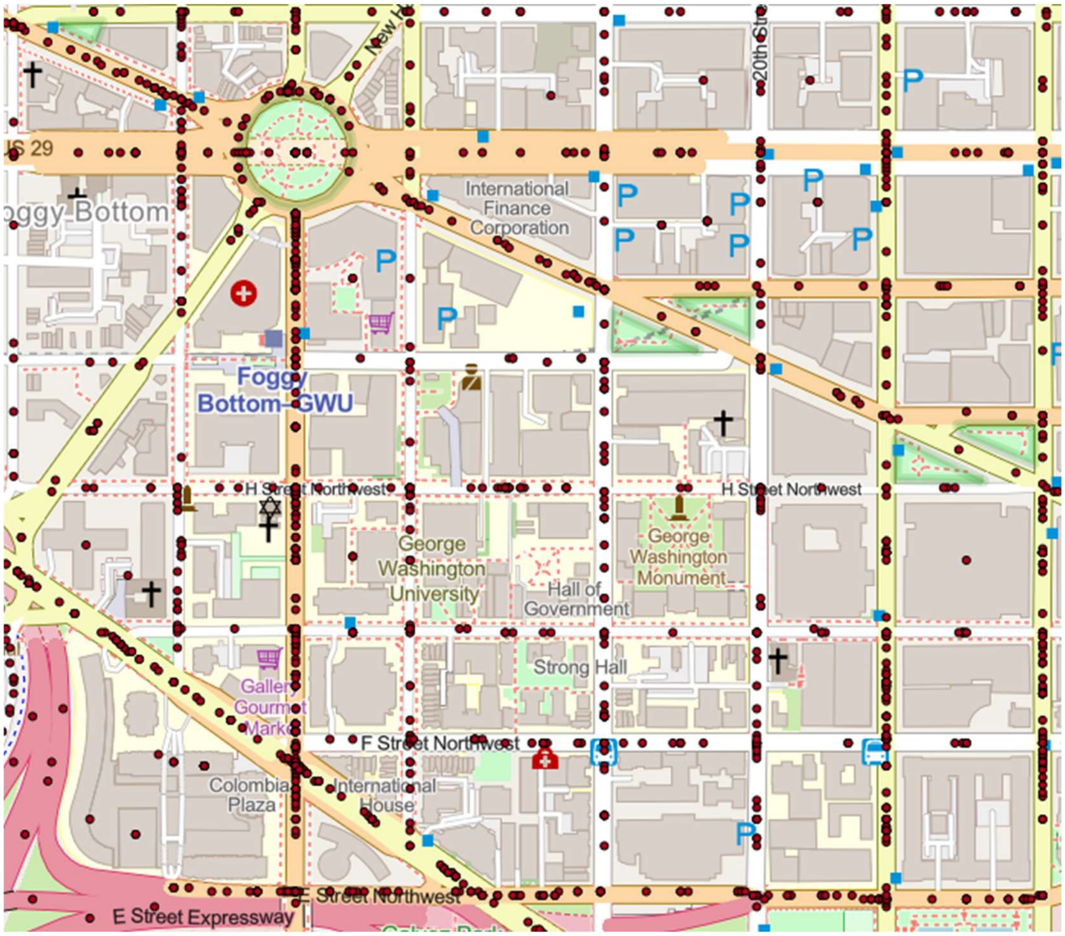


Figure 1: Spatial distribution of traffic crashes in the Foggy Bottom area of Washington, D.C. (2015-2021)

Literature Review

Article 1: Enhancing the Documentation Process of Traffic Accidents Registry in Gaza City Using GIS

This excellent paper written by Maher A. El-Hallaq was published in March of 2021 in the Journal of Engineering Research and Technology on the necessary transformation of a current ineffective paper system used being used to track traffic accidents in Gaza City. El-Hallaq outlines the transition into a modern GIS system for collecting, organizing, and modeling crashes. The paper provides a brief history of Gaza city being the largest city in the Gaza strip and include maps showing the geography of the city, its neighborhoods, population density, and the roads. Since Gaza City relies solely on roads for transportation, there is an urgency to build a new GIS system in order keep the public safe. With a new desktop application implemented armed with geographical data, El-Hallaq was able to identify that three specific neighborhoods Al-Nasr, Northern and Southern Remal exposed to most of the traffic accidents. In addition to using spatial data to identify hot spots, El-Hallaq could use aspatial data to characterize hot hours, hot months, categorize injury seriousness, and mode of transportation. This paper is not directly relevant to my research but an informative read nevertheless in that it provided a comprehensive picture of how one would start from scratch an online GIS for collecting, organizing, and analyzing traffic accidents and the problems and solutions that would present. Fortunately for this research proposal, the DC crash data is already available online and can be accessed using D.C.'s Open Data website and maintained by the District Department of Transportation (DDOT) and the Metropolitan Police Department (MPD).

Article 2: New methods to identify and rank high pedestrian crash zones: An illustration

This research paper authored by Srinivas S. Pulugurtha, Vanjeeswaran K. Krishnakumar, Shashi S. Nambisan published in Accident Analysis and Prevention 39 in December 2009 presents GIS methodologies for identifying high pedestrian crash zones and evaluates methods for ranking these zones in Last Vegas. The first part of the paper focuses on the geoprocessing steps to identify crash zones where pedestrians were involved. Each step feeds into the next step of analysis:

1. Geocode pedestrian crash data by using address match functionality available from commercial GIS software.
2. Create crash concentration map by using spatial clustering. Simple Method versus Kernel Method to calculate density was discussed and Kernel Method produced smoother density surface.
3. Identify zones, shapes, and sizes. Along the streets, linear shapes are identified. At intersections, circular shapes were used.
4. Measurement of risk and ranking of zones identified.
    a. The existing methods for measuring crash risk in the zones identified: crash frequency is count of crashes involving pedestrians, crash density is number of crashes per length if shape is a line and area if the shape is a circle. The crash rate is number of crashes per total vehicular or pedestrian volumes.
    b. Sum-of-the-ranks (SR) method is a new method that combines the selected individual methods listed above in the calculation of a single rank value for each zone and generates a crash score.

The second half of the paper focuses on applying the theory using crash data maintained by Nevada Department of Transportation from 1998-2002 and discuss the results. The paper is directly relevant to the research I would like to conduct in the Foggy Bottom campus of GWU.

Methodology

For this research proposal, the following steps will be taken to analyze DC crash data to determine which intersections are the most dangerous in GWU's Foggy Bottom's campus:

CRASH DATA

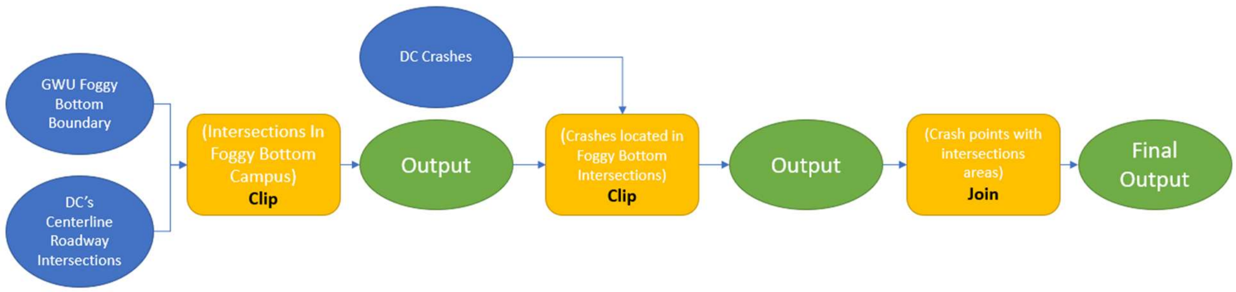
1. Limit the report date (REPORTDATE) field to be within last 5 years of Crashes in D.C. data set from D.C.'s Open Data website. This will filter out any data that has "bad" data like missing report dates. Report date is going to be used instead of the From/To date fields. The report date is when the analyst entered the data into the system and can be later than the actual date of the crash but the quality of data makes it a more reliable choice for date. Since the research will not be focusing on temporal aspect of the spatial analysis, this compromise is acceptable.
2. Download the shape file with filtered for report dates with years from 2016-2021 using Crashes in D.C.
3. Build file geodatabase by importing shape file. This will inform coordinate information.
4. Create a layer from X, Y coordinates from the data.

GWU FOGGY BOTTOM SHAPEFILE and DC's ROADWAY CENTERLINE

5. From D.C.'s Open Data website, download the Campus Areas Zoning shapefile which shows the official zoned campus boundaries for all of DC's colleges and universities.
6. Filter data based on Campus_Name being equal to George Washington University which defaults to Foggy Bottom campus. The Mount Vernon campus will be excluded from this analysis.
7. Import this shape file into geodatabase to use it isolate a boundary for the study area. Confirm coordinate system is the same as Crashes in DC shape file.
8. The GWU Foggy Bottom shapefile will not contain road intersections for us to answer research question.
9. Download the DC's Roadway Centerline using the Roadway Intersection approach and import it into the geodatabase. Confirm coordinate system is same as above two shape files. Import shapefiles from DC's Roadway Centerline, GWU Foggy Bottom and Crash into a map.
10. Clip the DC's Roadway Centerline shape using GWU's Foggy Bottom shapefile and the output layer should contain intersection information.
11. Clip DC Crashes shape using GWU's Foggy Bottom Shapefile resulting in a layer with crash data for GWU's Foggy Bottom. This

12. Spatially join the two layers where the crash points fall within the areas defined by each intersection. Count the number of points (crashes) within intersections of Foggy Bottom campus.
13. Map the intersection based on the counts from high to lower counts.

Flowchart of Methodology



Geospatial Layer

All data should be available from D.C.'s Open Data website.

- GWU's Foggy Bottom
  - Name: Campus Areas Zoning
  - Type: Shapefile (28.3 KB)
  - Cost: Free
  - Source: Available from D.C.'s Open Data website Campus Areas Zoning
  - Date/Year: Created January 2009 and last updated June 2021.
  - Zip file is downloaded containing the following files: XML document, CPG file, DBF file, PRJ File, SHP File, SHX File
- DC's Roadway Centerline
  - Name: Roadway Intersection approach
  - Type: Shapefile (13.9 MB)
  - Cost: Free
  - Source: Available from D.C.'s Open Data website Roadway Intersection approach
  - Date/Year: Created November 2020 and last updated May 2021.
  - Zip file is downloaded containing the following files: XML document, CPG file, DBF file, PRJ File, SHP File, SHX File
- Crashes in DC
  - Name: Crashes in DC
  - Type: Shapefile (~48.5 MB)
  - Cost: Free
  - Source: Available from D.C.'s Open Data website Crashes in DC
  - Date/Year: Published May 2021
  - Zip file is downloaded containing the following files: XML document, CPG file, DBF file, PRJ File, SHP File, SHX File

Bibliography

ASIRT. (2002-2016). Annual United States Road Crash Statistics. Association for Safe International Road Travel. Accessed 6/22/2021.

NHTSA. (2020). 2020 Fatality Data Show Increased Traffic Fatalities During Pandemic. Accessed 06/24/2021.

El-Hallaq, Maher A. (March 2021). Enhancing the Documentation Process of Traffic Accidents Registry in Gaza City using GIS. Journal of Engineering Research and Technology, Volume 8, No1. Accessed 6/25/2021.

Pulugurtha, Srinivas S., Krishnakumar, Vanjeeswaran K., Nambisan, Shashi S. (December 2009). New methods to identify and rank high pedestrian crash zones: An illustration. Accident Analysis & Prevention, Volume 39, Issue 4, July 2007, Pages 800-811. Accessed 6/26/2021.