A Geospatial Analysis to Identify and Rank High Pedestrian Serious Casualty Areas across Victoria

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Abstract

Identifying and ranking high pedestrian serious casualty (PSC) areas enable practitioners to develop more targeted and efficient pedestrian safety programs. We employed the Kernel Density method to study the spatial distribution pattern of PSC's and formulated PSC density criteria to rank the identified areas. We used police-reported injury data for the 8 year period to 2013, where the reported injury levels were validated using the TAC hospitalisation data. We produced concentration maps, identified numerous high PSC concentration areas across Victoria, and ranked them using the land area and estimated traffic volumes of each area. We introduced the top 87 areas for pedestrian safety program development under the Safe System Road Infrastructure Program (SSRIP).

Background:

Pedestrians are among the most vulnerable road users and the Safe System Approach mandates the provision of specifically-designed road environments to ensure their safety. Pedestrian serious casualties (PSC) are usually concentrated across dense urban environments. However, considering the expanse of the Melbourne Metro and the regional urban areas in Victoria and the limited pedestrian safety funds, it is necessary to identify and rank high PSC areas. Such knowledge is vital to guide the investments under the Safe System Road Infrastructure Program (SSRIP) to develop more efficient and targeted pedestrian safety programs.

Data and method:

Police-reported crash data for the 8 year period to 2013, where the reported injury levels were validated using the TAC hospitalisation data, indicate that more than 12,000 pedestrian injuries occurred in Victoria, almost half of which (5,388) were classified as fatal or serious injuries. This represents 1,500 pedestrian injuries each year, of which approximately 670 will be fatal or serious injury. Whilst pedestrian fatal and serious injury numbers are reducing, serious injuries as a proportion of all other road user serious injuries have increased, indicating that the pedestrian safety issue is not reducing in line with other road users.

PSC's are scattered across a road network of 150,000 km roads. Geo-spatial mapping has become a valuable technique for visualising the geographic incidence of socio-economic data and therefore is well suited to studying the spatial distribution of PSC's (Pulugurtha, Krishnakumar, & Nambisan, 2007). One of the most widely used techniques for generating heat maps is kernel density estimation (KDE) combined with Geographical Information Systems (GIS) (Pulugurtha, & Sambhara, 2011). The geo-spatial mapping concept is based on the evident spatial interaction existing between contiguous PSC locations, and KDE is a non-parametric way to estimate the probability density function of a random variable (Pulugurtha, & Repaka, 2008).

The geospatial analysis process involved four steps:

Step 1 - Identify pedestrian serious casualty data: The source of data was taken from VicRoads Road Crash Information System and cross checked against TAC claims information to verify crash severity.

Step 2 – Geo-code pedestrian serious casualty data: The TAC Validated data was coded into a GIS data set and plotted onto a map of Victoria. This task allows the creation of PSC concentration maps. The user can view serious casualties across Victoria and has the ability to zoom into individual crash locations (Figure 1). However whilst geo-coded crashes show the degree of spatial clustering and dispersion, it does not clearly identify the level of concentration.

Figure 1. Pedestrian serious casualties in the Melbourne CBD

Step 3 - Create a crash concentration map (heatmap).

GIS mapping software was used to map the crash density, i.e. the magnitude of serious casualties per area unit, with the application of KDE. Using KDE, we calculated a density value for each area. These values are represented with colour (Figure 2).

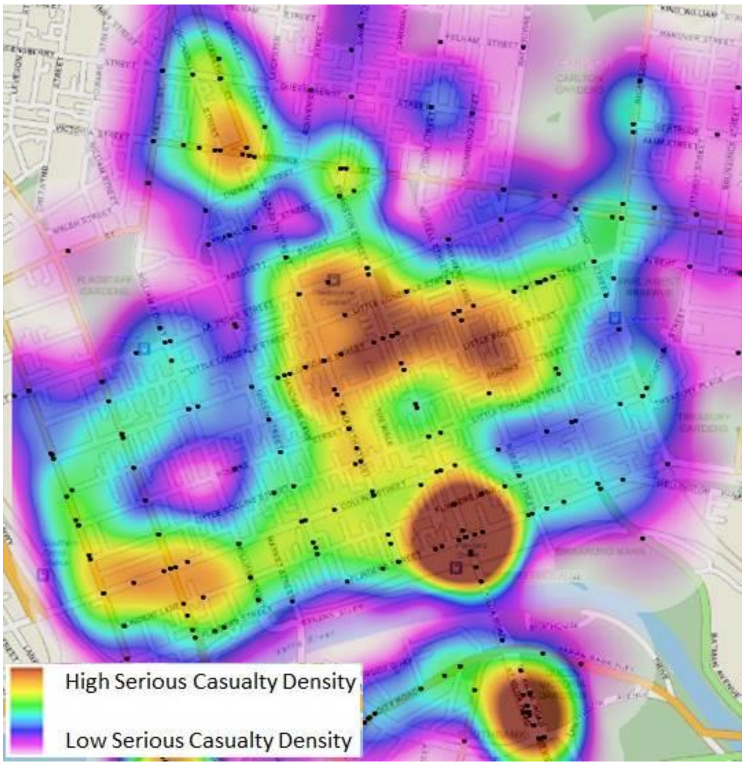

Figure 2. Concentration of pedestrian serious casualties in the Melbourne CBD

Step 4 - Identify areas, their shapes and sizes.

Once having created the heatmap the user can objectively focus on the high density locations. The heatmaps may indicate that the area is circular or linear. VicRoads Spatial Services team examined all the high density areas in heatmaps across Victoria, and identified and ranked highly concentrated areas. This has resulted in a list of 87 high PSC areas across Victoria.

Conclusions:

We studied the spatial distribution of pedestrian serious casualties across Victoria. Using an 8-year worth police-reported pedestrian injury data, validated against TAC hospitalization data, we employed geospatial methods combined with Kernel Density Estimation technique to identify and rank high pedestrian serious casualty areas in Victoria. We identified a total of 87 top priority areas to be funded under the Safe System Road Infrastructure Program. We believe targeting these areas will yield significantly higher road safety gains for pedestrians as well as increasing the efficiency of the program.

References

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