Crash Type Clustering and Transportation Safety Strategies

tech transfer summary

Understanding the clustering behavior of motor vehicle crashes is important for developing effective transportation safety strategies.

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RESEARCH PROJECT TITLE
Spatial Scale of Clustering of Motor Vehicle Crash Types and Appropriate Countermeasures

SPONSORS
Midwest Transportation Consortium (MTC Project 2007-10)
Iowa Department of Transportation (Iowa DOT Project TS-UNI 0701)

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The Midwest Transportation Consortium (MTC) is part of the Institute for Transportation (InTrans) at Iowa State University. The MTC is the University Transportation Centers Program regional center for Iowa, Kansas, Missouri, and Nebraska.

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Objectives

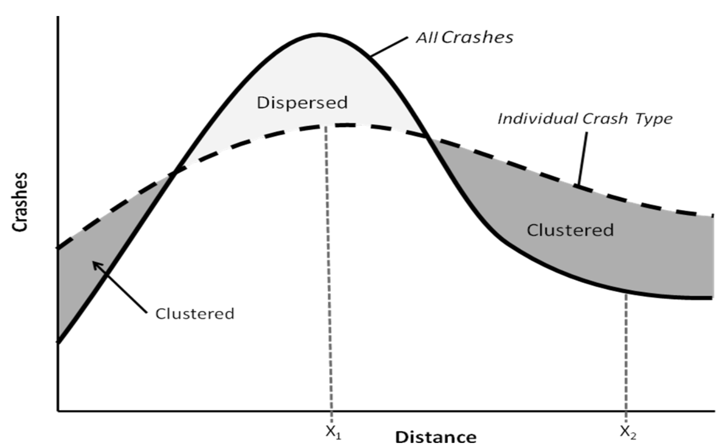
- Analyze the characteristics and spatial distributions of several types of motor vehicle crashes to evaluate the degree and scale of their spatial clustering
- Explore the implications of clustering for developing and selecting appropriate countermeasures

Problem Statement

Crashes occur for a variety of reasons and can be attributed to human, environmental (roadway/roadside), and vehicular factors. Some crash types may be causally linked to hazardous locations, while other crash types have a more random spatial distribution. Distinguishing between spatially clustered crashes and spatially random crashes is a crucial element in analyzing crash distributions and selecting effective countermeasures.

Research Description

In this project, the degree and spatial scale of clustering were analyzed for 10 crash types within the counties of the Iowa Northland Regional Council of Governments (INRCOG). Crash types included distracted driver, older driver, younger driver, local roads, lane departure, impaired driver, failure to yield right of way, fatal and major injury, ran signal, and speeding crashes. The research used five years of data from the Iowa Department of Transportation (Iowa DOT) crash database, geographic information systems, and a spatial statistical function called Ripley's K function. Using this function, the amount of clustering for each crash type was calculated at different scales of distance, and high-crash "hot spot" areas were identified. The crashes that appeared to be clustered were distinguished from the crashes that appeared spatially random.



Conceptual overview, showing use of comparative K functions to determine the distances at which a given crash type clusters relative to all crashes. These distances are used to identify hot spots at the appropriate scales.

Key Findings

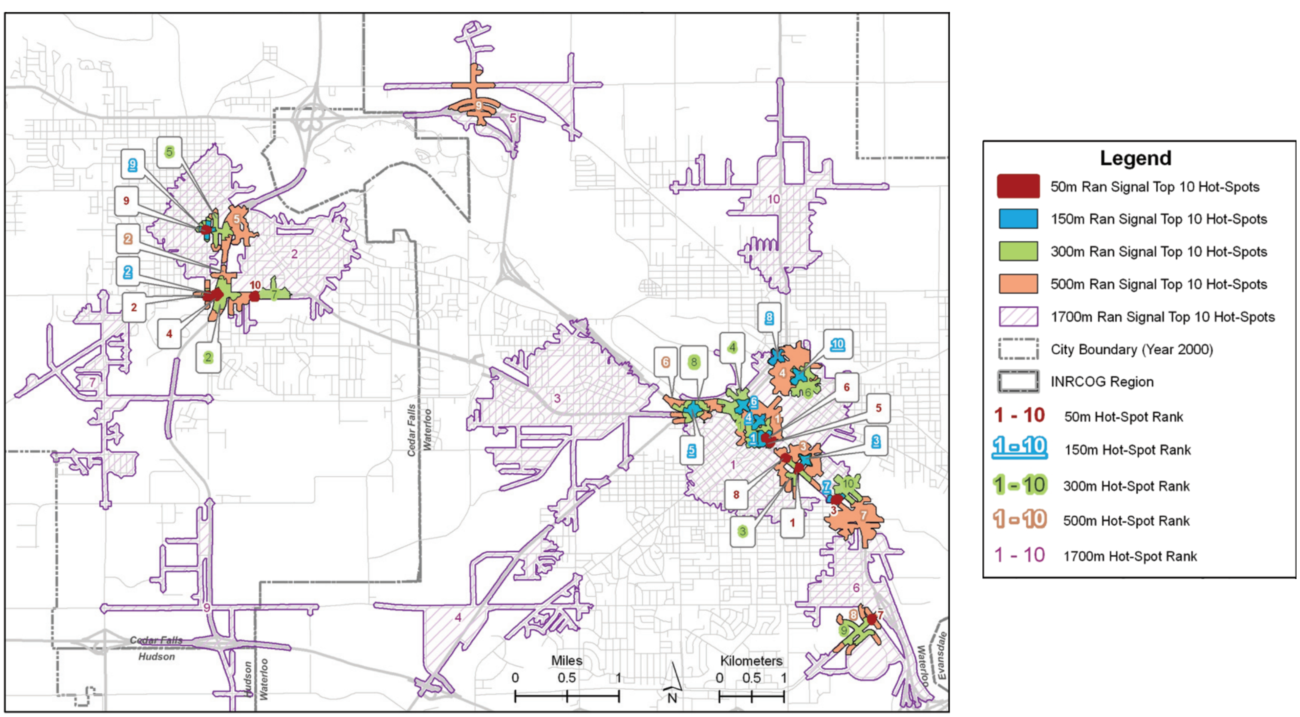
- The results of the K-function analysis indicate the usefulness of the procedure for identifying the degree and scale at which crashes cluster or do not cluster relative to each other.
- For many individual crash types, different patterns and processes and potentially different countermeasures seem to appear at different scales of analysis. This fact highlights the importance of scale considerations in problem identification and countermeasure formulation.
- Crashes related to signal running were found to cluster the most, while fatal crashes tended to be the most dispersed.
- Calculating the K function for each crash type is very computationally intensive, especially on a fairly dense road network. A database size of about 600 crashes was the maximum for running the K function successfully and with acceptable processing times.
- Some crash types, such as fatal crashes, lacked enough crash points to produce reliable results. Fatal crashes were therefore combined with major injury crashes.
- In a few cases, a crash occurring along a roadway was spatially referenced far enough from the road network to keep it from falling within a hot spot, which was confined to the shape of the road network. This limitation was observed in about 1% of the hot spots generated.
- The hot spots identified in the analysis sometimes included side streets and other roads not truly involved in the high-crash hot spot.

Benefits

Crash clustering information can help improve transportation safety by helping safety engineers select focused countermeasures that are closely linked to crash causes and the spatial extent of identified problem locations. Additionally, less location-based crash types better suited to non-spatial countermeasures can be identified.

Recommendations and Further Developments

- Based on trial runs and other experiments for this study, the effect of methodological limitations on the overall results and conclusions is thought to be small.
- For crash types that do not exhibit clustering, attention could be paid to the types of locations that appear problematic rather than the specific locations. For example, the clustering of non-spatial attributes may help identify groups of homogeneous crash types and characteristics in statistical space.
- Recent methodological research has focused on the development of methods to better identify cluster sizes and cluster locations through modified K function methods. Such research may help improve the identification and application of the appropriate scale of analysis.
- To make the procedure more computationally efficient, computer programming could be used to automate the database management procedures. Work is continuing in these areas.



Sample map of ran signal crash hot spots identified at 50, 150, 300, 500, and 1,700 m. Several 1,700 m hot spots indicate area-wide or corridor issues, even if they do not contain hot spots at smaller distances. This map illustrates the usefulness of analyzing crash clustering at several spatial scales.