Engineering Safer Roads: A Clustering Analysis of Road Accident Data in Canada

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Research Overview & Methodology

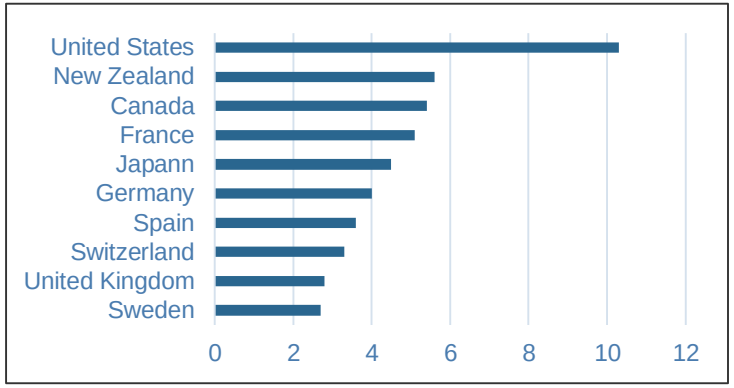

Figure 1: Motor Vehicle Crash Death in 10 High-Income Countries (WHO, 2015)
The value indicates deaths per 100,000 people in 2013.

- **Every day, almost 3,700 people are killed globally in car accidents (WHO, 2018)**
- **Significant possibilities that engineering can mitigate the risk of car accidents**
  - e.g., road conditions, driver-support system
- **I aim to investigate car accidents in Canada from 1999 to 2014 to identify trends and inform effective engineering perspective intervention to reduce the number of car accidents**
- **Simply looking at the mode value of the variable does not provide insightful information**
- **Use principal component analysis (PCA) and k-means clustering to analyze 10,000 incidents selected from a dataset of over 3.8 million collisions**
- **Variables:**
  - Collision hour, collision configuration, roadway configuration, weather conditions, road surface, road alignment, traffic control, vehicle type, vehicle model year, driver sex, and driver age.

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Results

- **Analysis Process:**
  - PCA to decrease dimension to 2 dimensions
  - 4 clusters are used after checking the silhouette score
- **Clusters 0 & 1: rear-end collision on sunny days at peak hour**
- **Cluster 2: rear-end collision on snowy conditions at peak hour**
- **Cluster 3: rear-end collision on rainy conditions at the end of peak hour**

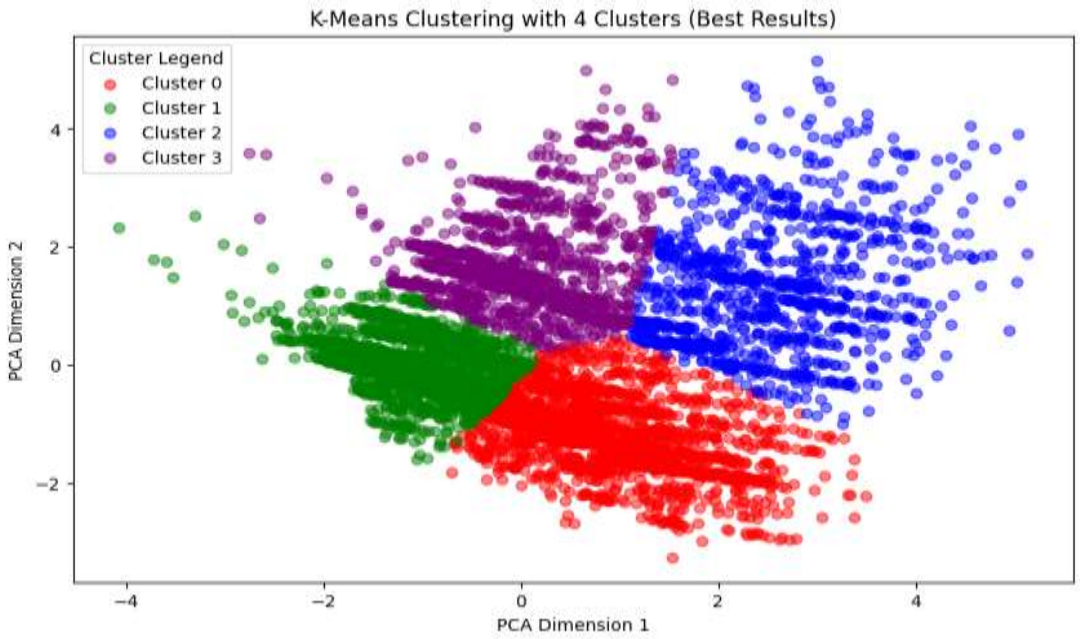

Figure 2: Clustering Results

Table 1: Most Frequent Value in each Clusters

Cluster	Hour	Collision Configuration	Road Configuration	Weather	Road Surface	Road Alignment	Traffic Control	Vehicle Type	Vehicle Year	Driver Sex	Driver Age
0	16	Rear-end Collision	Non-intersection	Clear & Sunny	Dry Normal	Straight & Level	No Controlled Traffic	Light Duty Vehicle	2002	Female	18
1	16	Rear-end Collision	Intersection	Clear & Sunny	Dry Normal	Straight & Level	Traffic Signal	Light Duty Vehicle	2002	Female	17
2	16	Rear-end Collision	Non-intersection	Snowing	Wet	Straight & Level	No Controlled Traffic	Light Duty Vehicle	2000	Female	19
3	17	Rear-end Collision	Intersection	Raining	Wet	Straight & Level	Traffic Signal	Light Duty Vehicle	2000	Male	18

Discussion & Conclusion

- **Technologies to reduce the risk of rear-end collision must be a priority**
  - Recent technologies have shown the potential to mitigate the risk of rear-end collision
  - A potential issue is their workability in severe weather conditions
- **Prevent slips and provide better visuals in severe weather conditions**
  - Camera & sensor technology
  - Advanced road surface material
  - Improvement in tire technology
- **Out of engineering scope…**
  - It is not true that females drive worse than males
  - Young drivers (17 – 19 years old) are the most dangerous drivers

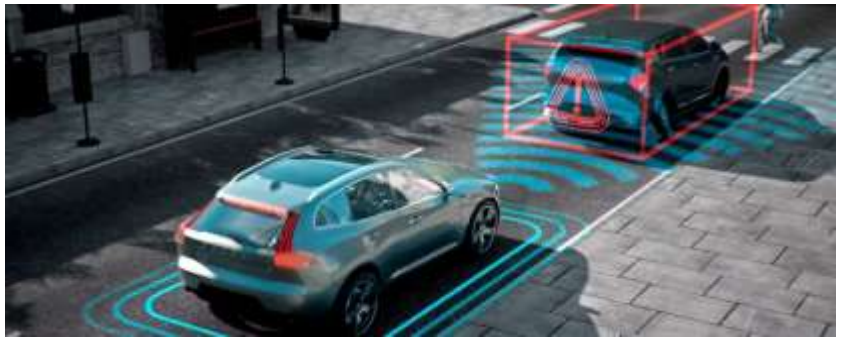

Figure 3: Rear Collision Warming System
source: https://www.autonationvolvocarssanjose.com/research/rear-collision-warning.htm

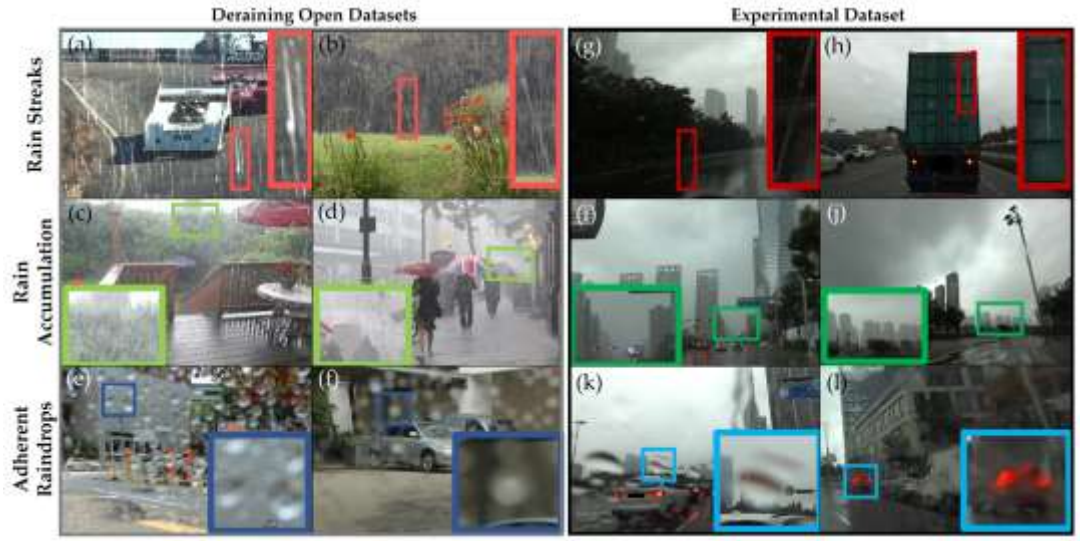

Figure 4: Camera Technology in Rainy Condition
source: Jhung and Kim 2021