Scientific analysis of road accidents in India by Self Organizing Map

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I. INTRODUCTION

In 2015, more than 1.2 million people lost their lives in road accidents worldwide, with middle income countries accounting for 74% of those traffic deaths [1]. India is a middle income country, and it accounted for more than 140,000 traffic deaths in 2015 [2]. As per Brasilia Declaration on Road Safety, it has committed to reduce traffic accidents and fatalities by 50% by 2020 [2]. Many Indian accident-specific research studies have been carried out in the past. Some of their key findings include: Increase in heavy vehicle traffic can increase accident probability [3], increase in road side shoulder width can reduce accident probability [4], fatality rate per km for the expressway is 1.8 per year and 0.58 per year for national highway [5]. The Self Organizing Map (SOM) can be a useful tool, to study accident data [6]. This study uses RASSI (Road Accident Sampling System India) data, to identify the main influencing parameters in Indian accidents.

II. METHODS

This study examines 1,779 RASSI accident cases collected between April 2011 and March 2016. Present study uses 31 variables, as shown in Fig. 1 (b) and transformed the same into 123 binary attributes. This study uses Self Organizing Map (SOM) based clustering technique to identify the influential parameters in Indian accidents. Self-Organizing Maps works based on neural network concept. It reduces the high dimension data into two dimension space. Data with similarity will be organized closer and without similarity will be placed far. SOM's working procedure is as follows (i) Neurons will be organized in two dimensional space (ii) Each neuron will be assigned with some random weights (iii) Neuron whose weight vector has smallest distance from an input data vector will be classified as Best Matching Neuron and its weight vector will be updated based on input data vector & neighboring neurons (iv) Similarly weight factors for every neuron will be updated (v) After each cycle, weight factors for every neuron continue to update (vi) the process continues till the results are converged (i.e. no appreciable changes in neuron weights). (vii) Finally data with topological similarity will be grouped in 2D space to form clusters. A commercial software called Viscovery was used to build the SOM and identify clusters. Dominant attributes within each cluster were identified through the deviation method.

$$\left(\text{Deviation} = \frac{\text{Mean}_{\text{cluster}} - \text{Mean}_{\text{input data}}}{\text{Standard deviation}_{\text{input data}}}\right)_{\text{Attribute}}$$

III. INITIAL FINDINGS

Using SOM method, 1779 accident cases were grouped under 7 clusters (Figure 1–a). For better understanding, clusters were named based on dominant crash type. Attributes were ordered within each cluster based on the deviation (≥0.3) and the results are shown in Figures A1 – A3. Characteristics of individual clusters are as follows:

Cluster 1: Head-on & side-swipe accidents occur mainly on undivided roads due to improper overtaking (driver behaviour).

Cluster 2: Rollover accidents happen due to over speeding, loss of control and mainly occur on roads without road side barriers (along roll-over prone zones).

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Cluster 3: Rear-impact accidents happen due to parked/ stopped vehicles and driving too closely with the vehicle in front, i.e. tailgating

Cluster 4: Side-impact occurs mainly at intersection and median gaps without traffic signals. It can also results from improper turning (driver behaviour).

Cluster 5: Object impact occurs due to un-deformable objects near roadways (trees, barriers, flower pots, etc.) and driver drowsiness during night-time.

Cluster 6: Pedestrian accidents result from poor pedestrian infrastructure (lack of foot-path alongside of the road and visible pedestrian crossing zone).

Cluster 7: Run-over accidents - number of cases are less to draw any conclusion.

(a)

Accident	Occupant & vehicle
• Accident time	• Road condition (wet/dry)
• Severe crash event	• Profile uphill/downhill
• Number of events	• Ejection status
• Critical pre-crash event	• Injury severity
• Kind of accident	• Alcohol involved
• Weather	• Avoidance maneuver
• Lighting condition	• Human error
• Day/Night	• Vehicle body type
• Region(urban/rural)	• Contribution of vehicle
Infrastructure	• Stability
• Type of road(NH, SH, EX)	• Rollover
• Crash location	• Helmet use
• Road structure (I.N, U.T, etc.)	• Number of vehicle involved
• No. of lanes	• Distracted
• Infrastructure-error	• Override
• Vision obstruction	• Underride

(b)

Fig. 1. Analysis of 1779 accidents: (a) Clusters identified; (b) Variables considered for study.

IV. CONCLUSION

Head-on and side-swipe accidents may occur in similar conditions, i.e. undivided roadway, improper overtaking, etc. Pedestrian crashes appear to be more severe impact type. Due to limited number of data and sampling locations, proper precaution is necessary to draw any conclusion nationwide.

V. REFERENCES

[1] Global Status Report on Road Safety, 2015.
[2] Road Accidents in India, 2015.
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[4] A.K.Sharma et al, Pedestrian Accident Prediction Model for Rural Road, IJSAT-2012
[5] Road safety in India status report – 2015, IIT Delhi.
[6] Chinmoy pal et al, Clustering Analysis of Indian Road Accidents, AAAM – 2016

VI. APPENDIX

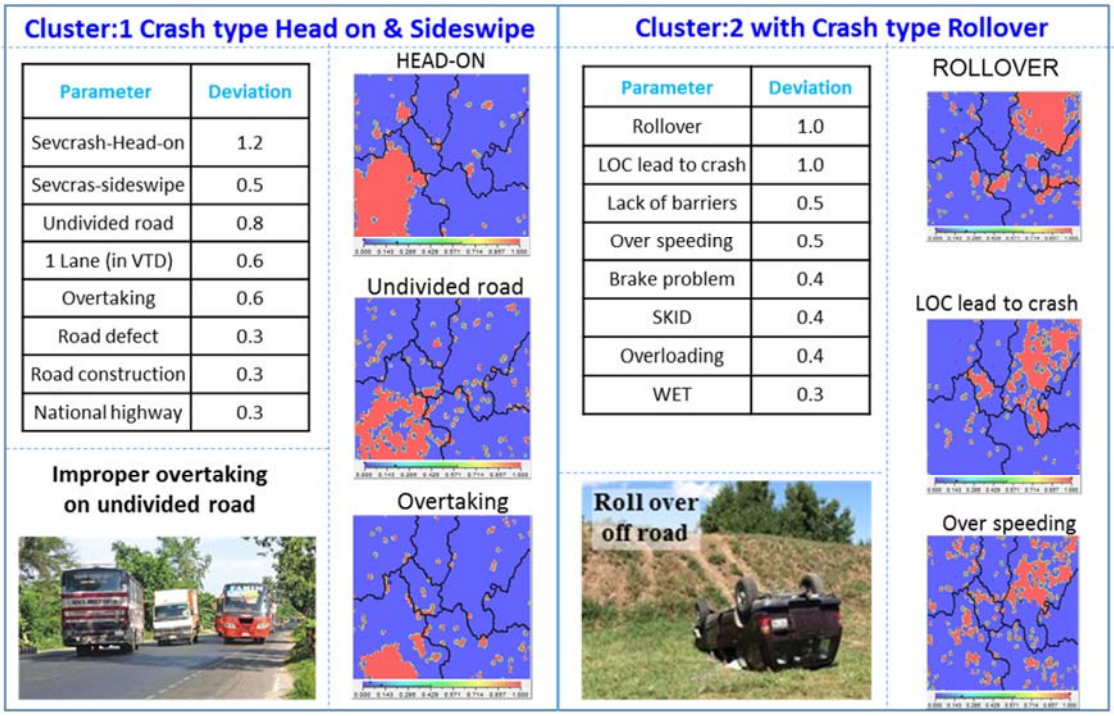

Fig. A1. Characteristics of clusters 1 and 2.

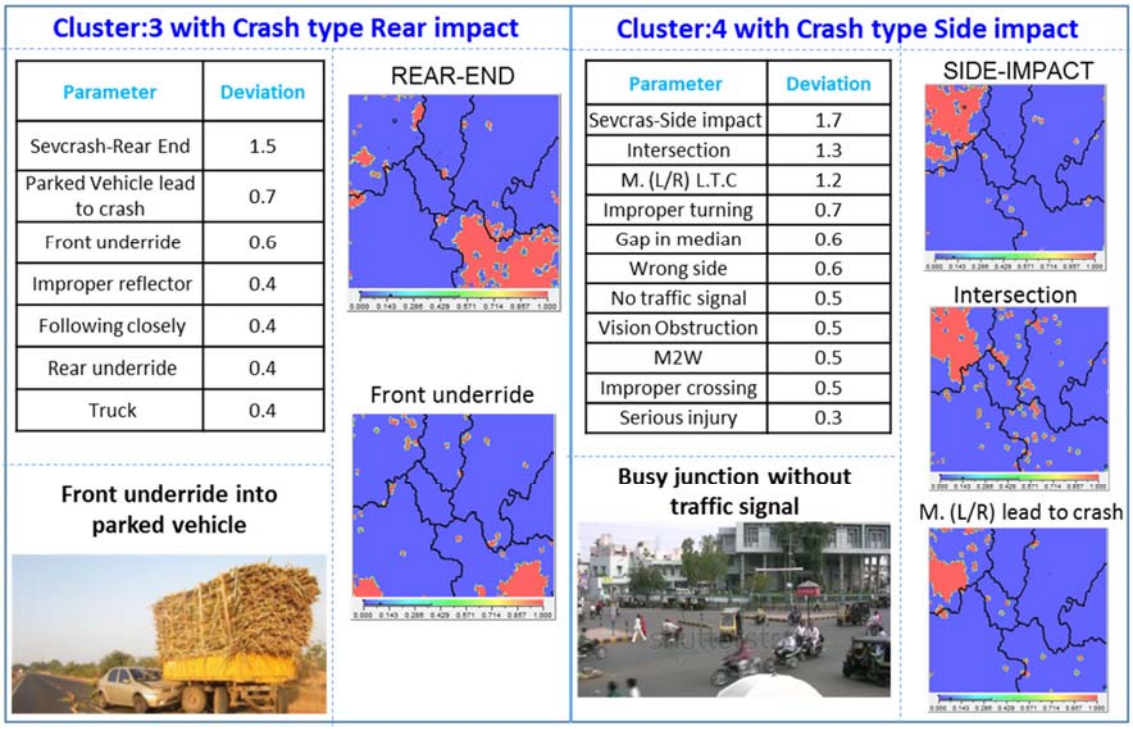

Fig. A2. Characteristics of clusters 3 and 4.

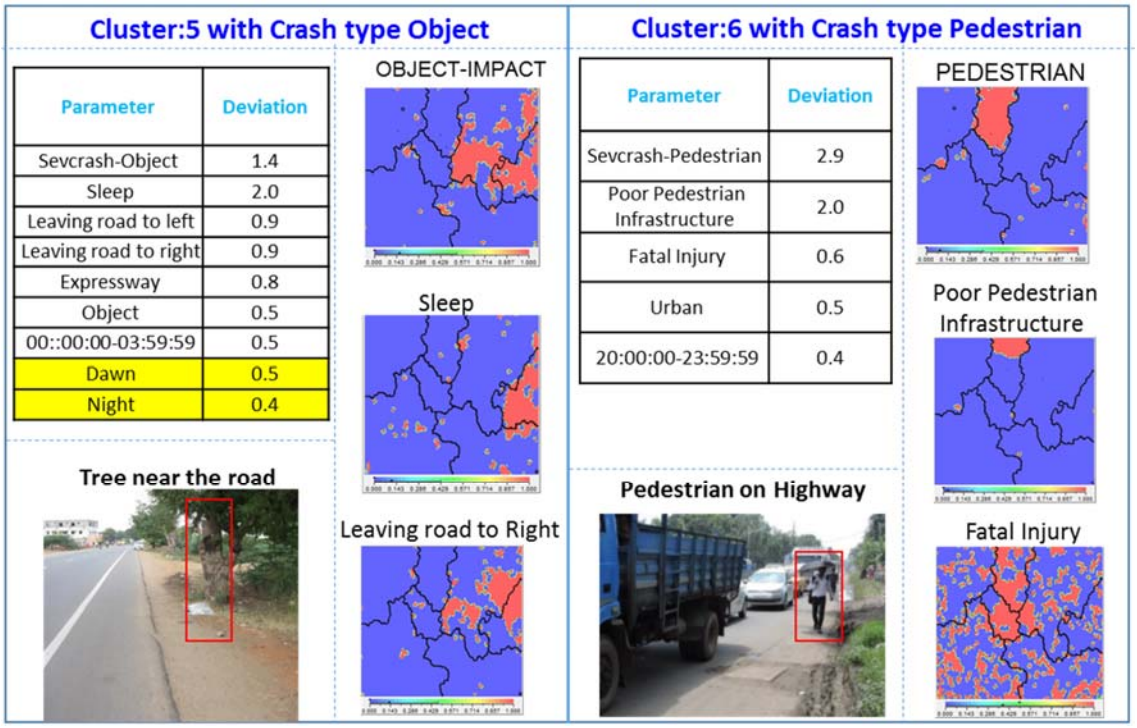

Fig. A3. Characteristics of clusters 5 and 6