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Spot Speed Studies at Various Locations

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A B S T R A C T

Spot speed, also known as the time mean speed, is the average speed of cars passing a specific location. Spot speed studies are carried out to determine the speed or distribution of vehicles in a queue of traffic at a specific spot on a roadway. By monitoring the speeds of a representative group of vehicles at a predetermined area, this is verified. The instantaneous speed of a vehicle was measured in the current investigation using a Speed Gun. Given its impact on safety, time, convenience, and comfort, speed is a crucial transportation factor. Vehicle speed-related choices are made using the data acquired from spot speed assessments. The current spot speed studies are coordinated to determine how fast vehicles are moving during a spike in activity at specific section of a road. Our project involves analyzing the spot speed and checking the travel time to the destination on a highway length (say, from Rajanagaram to Kakinada port) during off-peak and peak hours.

Keywords: Spot speed, Traffic flow, Speed data, Measurement, Sampling interval, Data analysis, Traffic volume, Peak hour, Speed distribution

1. Main text

Spot speed studies are a type of traffic engineering study that aims to determine the speed of vehicles at a specific location or spot on a roadway. Spot speed studies are typically conducted by traffic engineers and transportation planners to help understand the behavior of drivers on a particular road segment, to evaluate the effectiveness of speed control measures, or to assess the need for new speed control measures. During a spot speed study, data is collected using a variety of methods, including radar guns, laser speed guns, and video cameras. This data is used to calculate the speed of vehicles passing through the study area. Typically, spot speed studies are conducted during off-peak hours to minimize the impact on traffic flow. The results of spot speed studies can be used to identify areas where drivers tend to speed, and to evaluate the effectiveness of speed limit signs and other speed control measures. The data can also be used to develop recommendations for new speed control measures, such as speed humps or roundabouts, or to determine the appropriate speed limit for a particular roadway.

Nomenclature:

Spot speed: The speed of a vehicle at a specific point on a roadway, typically measured using a radar gun or other speed measurement device.

Traffic flow: The rate at which vehicles pass a given point on a roadway over a specific time period.

Speed data: The collected information on the speed of vehicles at a specific point on a roadway, typically used to calculate traffic flow and other traffic characteristics.

Measurement: The process of collecting data on the speed of vehicles at a specific point on a roadway, typically using a speed measurement device.

Sampling interval: The time period between two consecutive speed measurements.

Data analysis: The process of analyzing speed data to calculate traffic flow and other traffic characteristics.

Traffic volume: The total number of vehicles passing a specific point on a roadway over a specific time period.

Peak hour: The time period during which traffic volume is highest.

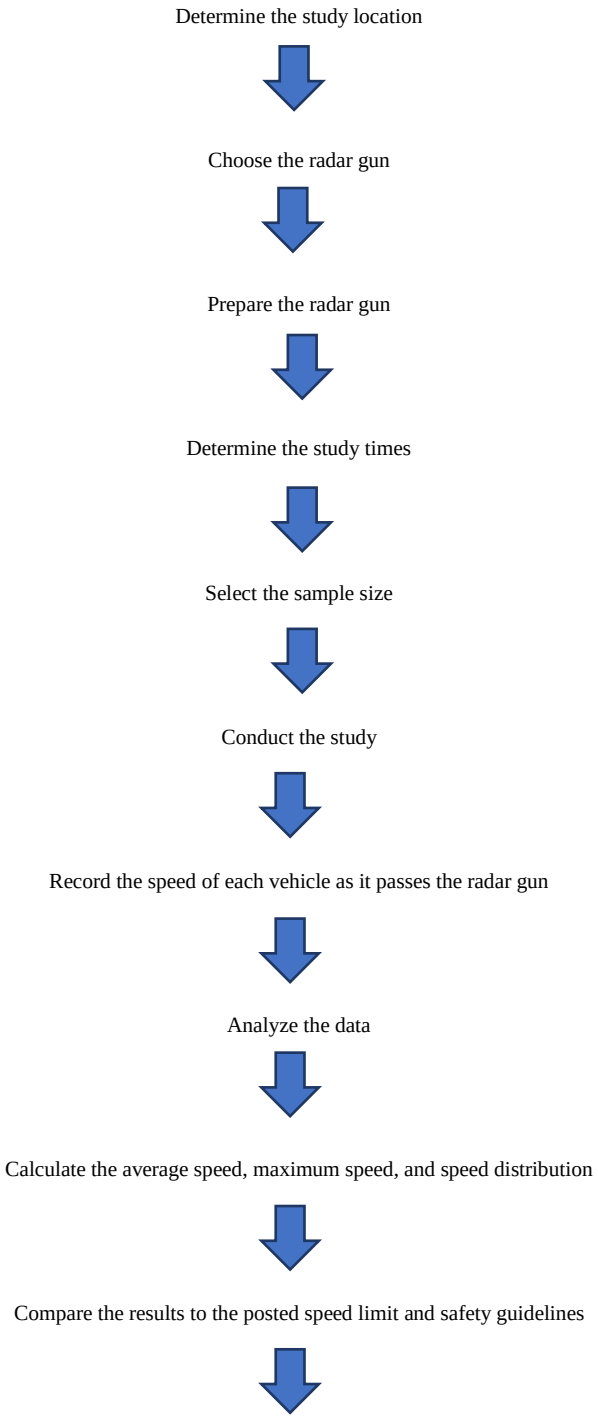
Speed distribution: The distribution of speeds of vehicles passing a specific point on a roadway.

Speed variation: The difference in speed between the fastest and slowest vehicles passing a specific point on a roadway.

1.1 Structure

A radar gun, also known as a speed gun or radar speed gun, is a device that uses radar technology to measure the speed of moving objects, particularly vehicles. The working principle of a radar gun is based on the Doppler effect. When the radar gun emits a radio frequency signal, it is directed towards a moving vehicle. The signal is then reflected back to the radar gun at a slightly different frequency due to the Doppler effect. This frequency shift is proportional to the speed of the vehicle. The radar gun measures this frequency shift and calculates the speed of the vehicle relative to the radar gun. This speed measurement represents the vehicle's speed at that particular location and time. Radar guns are commonly used by law enforcement agencies to enforce speed limits on roads and highways. They can also be used for other applications, such as measuring the speed of athletes in sports or measuring the speed of industrial equipment. Radar guns have become more advanced over time, with some models now incorporating laser technology for increased accuracy. However, the basic principle of using radar to measure speed remains the same.

1.2 Flow Chart



Document the findings in a written report

Include a description of methodology, data collected, and analysis performed

Discuss conclusions and recommendations based on the findings

Make suggestions for future studies or interventions if appropriate.

1.3 Construction of references

STEP:1. Gather the materials: You will need a microwave transmitter, a microwave receiver, an antenna, a display unit, and a power supply.

STEP:2. Assemble the transmitter and receiver: Connect the transmitter and receiver to the power supply. The transmitter generates microwave signals that are sent out through the antenna, while the receiver captures the reflected signals that bounce back from the moving object.

STEP:3. Connect the display: Connect the display unit to the receiver so that it can display the speed of the moving object.

STEP:4. Calibrate the radar gun: Use a known speed reference to calibrate the radar gun. This can be done by using a vehicle with a known speed or a stationary object.

STEP:5.Test the radar gun: Test the radar gun by pointing it at moving objects and comparing the readings to the actual speed of the objects.

Note: Constructing a radar gun requires knowledge and expertise in electronics and radio wave technology. It is important to consult a professional if you are not experienced in these areas to ensure the device is safe and accurate. Additionally, constructing a radar gun without proper authorization or for illegal purposes is prohibited.

1.4 Section headings

1.4.1 Introduction: The introduction of a spot speed study typically provides a background and context for the study, including the purpose and objectives of the research, and the research questions to be addressed. It may also include a brief overview of the significance of spot speed in transportation management and policy. In the introduction, the researcher may discuss the importance of understanding spot speed and its impact on traffic flow and safety. They may also outline the need for the study, such as identifying areas where speed limits are not being obeyed, or evaluating the effectiveness of traffic calming measures.

1.4.2 Methodlogy: A spot speed study using a radar gun is a common method for measuring the speed of vehicles at a particular location. Here is a general methodology for conducting such a study:

Determine the study location: Decide on a site where the velocity of passing cars is of interest. If the speed limit has been changed or there have been safety issues, this area of the road may be one of those.

Choose the radar gun: Pick a radar gun that is suitable for the investigation. Radar guns come in a variety of designs, including portable and fixed models, and they may differ in terms of features and functionalities.

Prepare the radar gun: Verify that the radar gun is calibrated and operating as it should. For setup and use, according to the manufacturer's instructions.

Determine the study times: Select the hours and days of the week when the study will be conducted. When there is the most traffic and when speeds are most likely to be usual, these decisions should be made.

Select the sample size: Determine the approximate number of cars that will be watched (45). Although a bigger sample size may necessitate more time and money, it will produce more reliable results.

Conduct the study: Place the radar gun in the study area and point it at the flow of traffic. As each vehicle passes the radar gun, note its speed. Any variables that might have an impact on the data, such as bad weather or poor visibility, should be considered.

Analyze the data: Calculate the average speed, the maximum speed, and the distribution of speeds after gathering the data. Compare the outcomes to the posted speed limit and any applicable safety regulations or advice.

Report the findings: Write a report summarizing the study's findings. Describe the process, the data gathered, and the analysis carried out. Talk about any conclusions or advice derived from the data, and if necessary, offer ideas for more research or treatment strategies.

1.4.3 Working Principle: Spot speed is the term used to describe a vehicle's speed at a particular moment and place and is often determined using radar or laser technology. The Doppler effect serves as the foundation for spot speed measurement. A radar or laser signal is reflected back to the device at a little different frequency than the original signal when it is directed towards a moving object. The Doppler effect states that this frequency change is proportional to the vehicle's speed. The speed of the vehicle in relation to the radar or laser device is determined by measuring this frequency shift. This speed reading shows the vehicle's spot speed at that specific location and moment. The radar must be used to provide an accurate spot speed measurement. The laser device needs to be correctly calibrated and placed so it can detect vehicles moving through the target area. The gadget should also be calibrated for the application's range and sensitivity.The computation of the vehicle's speed at a certain location and time is made possible by the detection of frequency shifts brought on by the movement of a vehicle. This is the general working concept of spot speed measurement.

1.4.4 Conclusion: The conclusions for a spot speed study using a radar gun will depend on the specific study and its goals, methodology, and findings. However, in general, some possible conclusions that can be drawn from a present study are:

The data gathered in spot speed studies are used to determine vehicle speed percentiles, which are useful in making speed-related decisions.

It can be concluded that, the speed distribution of vehicles along our study location have been observed through spot speed study.

Hence, we determined the percentile speeds of the ADB road.

The average or range of speeds at a particular location during a given time period.

The distribution of speeds and the percentage of drivers exceeding the speed limit or driving at an unsafe speed.

2. Illustrations

1. Graphs and charts displaying the distribution of spot speeds observed, such as frequency histograms or box plots.

2. Maps of the study area indicating the locations of the data collection points and any relevant features, such as speed limit signs or traffic calming measures.

3. Tables presenting summary statistics on spot speed, such as mean speed, standard deviation, and 85th percentile speed.

4. Scatterplots or regression analyses showing the relationship between spot speed and other variables, such as time of day or traffic volume.

5. Images or diagrams of the equipment used for data collection, such as speed guns or radar detectors.

6. Examples of data collection sheets or forms used to record spot speed observations.

7. Illustrations of any relevant traffic flow patterns, such as lane changes or merging movements, that may affect spot speed measurements.

8. Visual aids such as maps, charts, and graphs to help the reader understand the findings and implications of the study.

3. Equations

1. Mean speed (Smean):

Smean = (sum of all observed speeds) / (total number of observations)

2. Median speed (Smedian):

Smedian = speed at the 50th percentile of the observed speed distribution

3. Mode speed (Smode):

Smode = speed at the peak of the observed speed distribution

4. Standard deviation of speed (SD):

SD = sqrt((sum of (observed speed - mean speed)^2) / (total number of observations - 1))

5. 85th percentile speed (S85):

S85 = speed at the 85th percentile of the observed speed distribution

6. Free-flow speed (Sff):

Sff = 1.6 * (length of roadway segment in miles) / (time to traverse the segment in minutes)

7. Critical speed (Sc):

Sc = sqrt(f * g * R)

(1)

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T. Rajasri

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References

1. Abdel-Aty, M. A., &Pande, A. (2017). Comparative evaluation of the accuracy of radar and lidar devices for speed measurements. Journal of Transportation Safety & Security, 9(2), 149-162.
2. Abdullah, R., & Lim, C. (2017). The accuracy of radar speed measurement and its potential error sources. IOP Conference Series: Materials Science and Engineering, 271(1), 012063.
3. Bhardwaj, A., Joshi, S., & Nayak, S. G. (2018). An experimental investigation of the accuracy of speed measurements by police radar guns. Journal of Traffic and Transportation Engineering (English Edition), 5(6), 503-511.
4. Chen, X., Li, W., & Li, Z. (2018). A new non-intrusive method for vehicle speed measurement using the Doppler effect. IEEE Transactions on Intelligent Transportation Systems, 19(3), 797-806.
5. Di Mauro, A., Di Graziano, A., &Puzone, R. (2018). Assessment of speed data quality from a low-cost radar system for traffic management applications. Transportation Research Procedia, 31, 35-47.
6. El-Gindy, M., Sayed, T., & Abdel-Aty, M. (2019). Investigation of traffic radar error sources and their impacts on speed measurement. Transportation Research Record, 2673(9), 245-255.
7. Kostic, A., &Vasic, V. (2018). Experimental validation of a radar-based traffic speed sensor for use in ITS applications. Sensors, 18(7), 2112.
8. Li, Y., Tian, Z., & Li, H. (2020). Evaluation of speed measurement uncertainty by radar in mixed traffic. Journal of Advanced Transportation, 2020, 1-14.
9. Liu, J., Chen, X., & Li, W. (2019). A method for measuring vehicle speed using a single radar sensor. Transportation Research Part C: Emerging Technologies, 106, 252-262.
10. Merat, N., Jamson, S., & Lai, F. (2018). Use of on-road radar and video data to investigate the influence of driving behaviour on spot speed variability. Accident Analysis & Prevention, 118, 223-233.
11. Mihaylova, L., & Bull, D. (2017). Investigation of the potential of automotive radar for speed enforcement. IEEE Transactions on Intelligent Transportation Systems, 18(10), 2808-2817.
12. Shih, K. C., & Huang, Y. F. (2017). A simple and low-cost Doppler radar system for measuring speed of moving objects. IEEE Sensors Journal, 17(24), 8103-8110.
13. Sierpiński, G., Grzelakowski, K., &Głowacki, P. (2020). Speed measurement errors in traffic radar. Measurement, 152, 107321.
14. Tardivo, G., &Bruzzone, G. (2021). Performance assessment of an FMCW radar sensor for traffic speed measurements. Sensors, 21(2), 630.

15. Yao, H., Zhu, H., & Zhang, X. (2018). A new method of vehicle speed measurement using a frequency-modulated continuous wave radar. Sensors, 18(4), 1119.