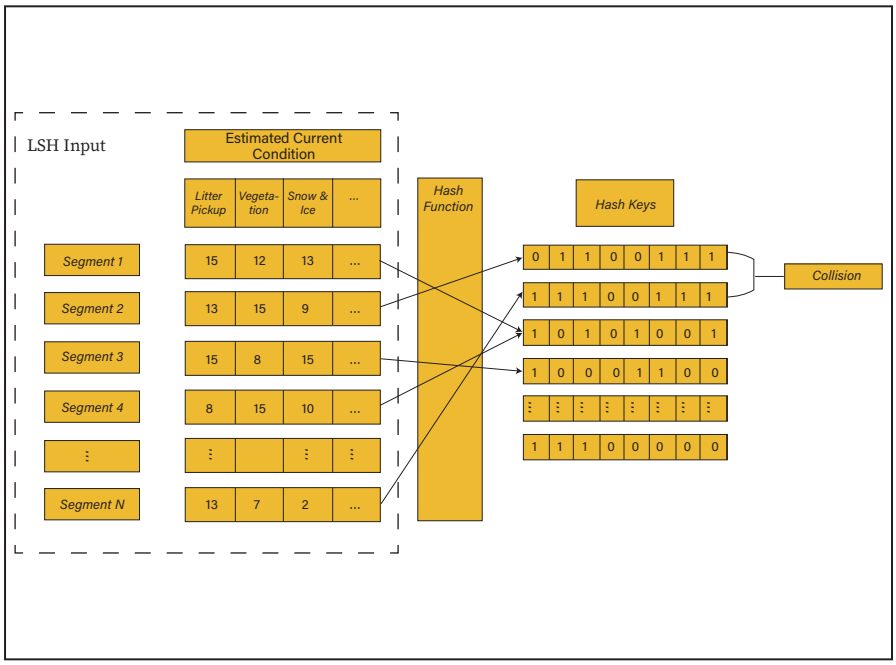
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-392 (project 528) | July 2019

Hotspot and Sampling Analysis for Effective Maintenance Management and Performance Monitoring



the ISSUE

The decision-making process to allocate resources for roadway asset preservation includes three major components: inspection, maintenance and rehabilitation. Agencies evaluate the condition of roadway assets via inspection to inform decisions on the prioritization of maintenance and rehabilitation. Inspections are a labor- and time-intensive process, so agencies often inspect only a sample of assets. An improved sampling method is needed that maximizes accuracy and minimizes costs.

the RESEARCH

Researchers developed a sampling method utilizing machine learning techniques to suggest the location and frequency of sampling roadway assets. The method strives to choose proper highway segments where the conditions of sampled assets can represent the maintenance performance of the full inventory within the network. To this end, the researchers present a high-dimensional clustering-based stratified sampling (HDCSS) method for roadway asset inspection. The method allows transportation agencies to adjust parameters, such as sample size, inspection frequency, and assets of interest. The HDCSS method integrates asset deterioration prediction, high-dimensional clustering, and locality-sensitive hashing (LSH). The sampling method can also incorporate various features of the asset network, such as asset condition, geographic information, traffic condition, and geometric design, as the information upon which samples can be selected. The method is adaptable to any asset changes, as the sampling process is constantly updated with previous inspection results and maintenance records.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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Project Title

Hotspot and Sampling Analysis for Effective Maintenance Management and Performance Monitoring

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the **FINDINGS**

Using the inspection records from the State of Utah, the researchers verified that the high-dimensional clustering-based stratified sampling method outperforms the simple random sampling method used by many DOTs, especially where level of maintenance varies greatly within assets. For the assets with little level of maintenance variation across segments, both the new and existing sampling methods yield low errors. However, the proposed method requires relatively smaller sample sizes, leading to potential reductions in inspection costs, especially for large-scale road networks.

the **IMPACT**

By using the HDCSS method, road management agencies can reduce the resources required for asset inspection. The method can be further applied to any high-dimensional sampling process, e.g., in selecting corridor segments, intersections, or traffic assets where multiple types of features, such as traffic condition, geometric design, or assets, need to be considered.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=955

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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