HIGHLIGHTER

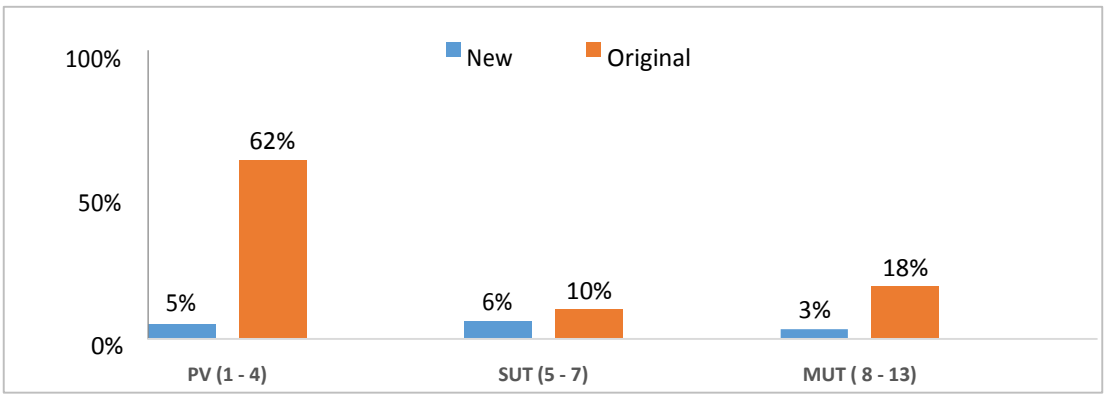
VEHICLE CLASSIFICATION EQUIPMENT: SOLUTIONS TO IMPROVE ACCURACY IN OKLAHOMA

December 2015

OVERVIEW The accuracy of vehicle counting and classification data is vital for appropriate future highway and road design, including determining pavement characteristics, eliminating traffic jams, and improving safety. Organizations relying on vehicle classifiers for data collection should be aware that systems can be affected by hardware and sensor malfunction, as well as the equipment's implementation of classification scheme (i.e., algorithm). This project provided outcomes from an extensive statewide examination of vehicle misclassification at Oklahoma Department of Transportation (ODOT) AVC stations employing the PEEK Traffic 'FHWA-USA' classification algorithm. A novel method for an improved classification algorithm designed to reduce the number of classification errors was presented.

RESULTS Axle-based AVC classifiers reporting errors due to axle-spacing overlap between different classes were found to cause misclassification relative to spacing values programmed into the classification algorithm for each device. To alleviate this problem and decrease errors caused by overlap, a novel approach was proposed for constructing distribution databases that reflect actual ground-truth axle-spacing for vehicles currently traveling on Oklahoma roadways. Classifications obtained from video recordings and PEEK Traffic axle spacing measurements for a sample of 20,000 vehicles were recorded and analyzed to obtain 13 good-fit Gaussian distributions that correspond with each vehicle class. An optimization algorithm was then implemented to develop axle spacing thresholds. The new scheme was then implemented in the PEEK Traffic automatic data record equipment and experimentally evaluated for accuracy.

Results, as shown in the figure, illustrate differences between the original FHWA-USA algorithm output that is currently utilized in ODOT systems and the output from the new algorithm.



Consolidated system error grouped by vehicle type

PROJECT TITLE
THE STUDY OF VEHICLE CLASSIFICATION EQUIPMENT WITH SOLUTIONS TO IMPROVE ACCURACY IN OKLAHOMA

FINAL REPORT ~
FHWA-OK-14-17
ODOT SP&R 2250
December 2014

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Consolidated system error reported a 15% reduction in misclassified MUTs classes 8 to 13 (mainly due to classification improvements in class 8). Additionally, a 4% reduction was observed for SUTs in classes 5 to 7. A 57% error reduction was achieved for PVs, classes 1 to 4.

The following table shows field test result (ground-truth) values compared to FHWA-USA algorithm values, presented as errors. When applying the newly-developed algorithm, a 43% reduction in errors for class 8 was observed, which is the most problematic class of all 13 FHWA classes. This improvement was primarily attributed to a reduction in the number of false-detections that occurred when class 3 or class 5 vehicles with trailers were traveling over the ADR sensors. Adding just a few entries to the decision tree and using optimal thresholds found via axle spacing distribution analyses resulted in significant improvement for class 8 error ratio.

Misdetection and False detection error result comparison between the old and new algorithm.

Class	Ground-truth video count (New)	Total counted by ADR (New)	Correctly classified by ADR (New)	Misdetection error		False-detection error	
				Old Alg.	New Alg.	Old Alg.	New Alg.
Class 1	50	30	24	55%	52%	24%	20%
Class 2	3101	2994	2825	1%	9%	43%	6%
Class 3	2205	2349	2007	54%	9%	4%	15%
Class 4	13	6	3	33%	77%	96%	50%
Class 5	254	241	181	42%	29%	46%	25%
Class 6	102	110	102	21%	0%	12%	7%
Class 7	25	22	22	36%	12%	0%	0%
Class 8	19	25	18	7%	5%	71%	28%
Class 9	384	376	376	3%	2%	2%	0%
Class 10	11	11	11	14%	0%	0%	0%
Class 11	4	4	4	0%	0%	0%	0%
Class 12	0	0	0	0%	0%	0%	0%
Class 13	1	1	1	0%	0%	50%	0%
Class 15	0	0	0	0%	0%	50%	0%

In addition, the new approach resulted in substantial improvements in classes 5, 6, 2, and 3. The threshold separating class 2 and class 3 reflects actual wheelbase spacing distribution of vehicles currently traveling on the roadways. Despite the fact that some agencies combine classes and are not much concerned with accuracy, following the aforementioned practice would eliminate error altogether. This alone makes the new approach valid for decreasing similar errors for class 2 and class 3.

Class 5 exhibited a noticeable decrease in errors mainly due to the reduction of false detection errors when large class 3 trucks were inadvertently classified as class 5 vehicles. Class 6 also experienced a decrease in misdetections relative to class 4 buses.

Class 7 and class 10 errors were also reduced by adding entries not present in the original FWHA-USA algorithm that is currently utilized in ODOT systems.

BENEFITS Results demonstrated the proposed algorithm's effectiveness in improving vehicle classifications and reducing persistent overall system errors characteristic of the 'FHWA-USA' Scheme. The resultant analysis methodology detailed in the final report will benefit organizations interested in improving vehicle classification and overall system accuracy.