TECH BRIEF

NCRST
NATIONAL CONSORTIUM ON REMOTE SENSING IN TRANSPORTATION
INFRASTRUCTURE

Roadway Feature Inventory
USING REMOTELY SENSED IMAGES

Many different methods of inventory data collection are used by transportation agencies in the United States, but are often time consuming and labor intensive. With data requirements for transportation agencies increasing, there is a need for more efficient methods of data collection. A pilot study was conducted to evaluate the use of remotely sensed images for the collection of roadway inventory features. Images at 2-inch, 6-inch, 24-inch, and 1 meter resolutions were evaluated and compared for the study area. Images were tested for positional accuracy, the number of inventory features that could consistently be identified, distance measurements, and variation among users in correctly positioning feature location. In particular, the use of remote sensing for the extraction of data elements required by the statewide linear referencing system (LRS) that is being developed by the Iowa Department of Transportation (DOT) is discussed.

THE IOWA DOT'S LINEAR REFERENCING SYSTEM (LRS)

The Iowa DOT is implementing a statewide linear referencing system that will allow the DOT to integrate disparate data with linear reference method (LRM) locations as the common link. Transportation inventory features (signs, drainage structures, bridges) as well events (crashes, traffic collection sections) are located in relation to their position along a transportation feature (GeoAnalytics et al, 2000). One of the key elements of the LRS is creation of a datum that will provide structure to the LRS. Several methods are being considered for creation of the datum including videoLogging and remote sensing. Specifications for the datum are:

- Anchor points: ± 1.0 meter RMS
- Anchor sections: ± 2.1 meter RMS
- Business data (inventory features): ± 10.0 meters

Remote sensing was used to develop the datum elements and this was evaluated using several performance measures, which are presented in the following sections.

POSTIONAL ACCURACY

A root mean square (RMS) test was used to evaluate the positional accuracy of the 4 datasets using kinematic GPS points (cm accuracy) for comparison. Results are given in Table 1. The 2, 6, and 24-inch datasets met the accuracy requirements for anchor points according to the Iowa DOT LRS specifications of ± 1.0 meter RMS. The 1-meter dataset had a RMS of 1.9 and exceeded the specifications.

FEATURE RECOGNITION

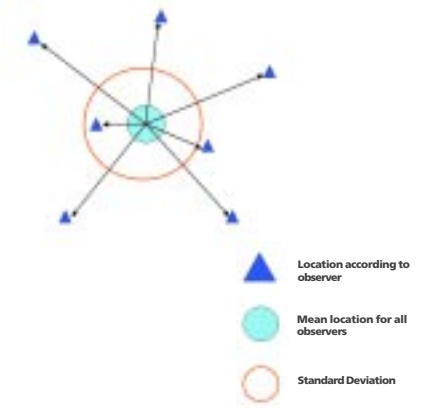
Manual feature location is often the most feasible method to locate inventory features. In order to manually locate a feature on an image, the feature must first be identified and located by an observer. Even if standard procedures are provided for the identification of a feature and selection of its location, there can be differences among observers in locating the same point. If there is significant variation between where different observers locate a feature, and if a number of observers are involved in interpreting data, significant variations in locating features will result, regardless of the accuracy of the data collection method.

Eight different features (signals, utility poles, drainage structures, medians, pedestrian crossings, intersection centers, railroad crossings, bridges, and driveways) with a sample size of 5 or 6 elements were randomly selected in a pilot

Table 1: Positional accuracy values for each dataset

Dataset	Error (meter)				
	Mean	STD	RMS	CMAS (90%)	NSSDA (95%)
2-inch	0.2	0.2	0.3	0.4	0.5
6-inch	0.7	0.1	0.7	1.0	1.2
24-inch	0.8	0.4	0.9	1.4	1.6
1-meter	0.5	0.3	1.9	2.9	3.3

U.S. DEPARTMENT OF TRANSPORTATION
Research and Special Programs Administration



study area. Seven observers familiar with ArcView were selected to identify and locate each set of features in each dataset. Only 3 features could visually be identified in the 24-inch and 1-meter images

- Railroad crossings: mean variation and std < 0.49 m for the 2-inch, 6-inch, and 1-meter datasets and 1.34 m and 1.1 m for the 24-inch dataset
- Bridges: mean variation and std < 1.49 meters for the 2-inch, 6-inch, and 1-meter datasets and > 4.8 m for mean and std for the 24-inch dataset
- Intersections: mean variation and std < 1.34 meters for all datasets

The other five features were identified in the 2-inch and 6-inch datasets and the mean and standard deviation for variation was less than or equal to 0.52 meters and 0.82 meters respectively for all five features.

FEATURE IDENTIFICATION

Feature recognition is a measure of whether a particular feature can be identified at all and whether it can be identified consistently. Identification Percentage (IP), was the measure of effectiveness used to evaluate the recognizability of features using:

$IP\ (\%) = (F_a/F_g) * 100$

where:

IP = percent of features identified

F_a = # of features identified in data set

F_g = # of features present in the field

A total of 21 features were tested in the 4 datasets. Results are:

2-inch: 100% identified consistently

6-inch: > 80% identified consistently

24-inch: < 50% consistently identified, 6 features not identified at all

1-meter: < 25% consistently identified, 8 features not identified at all.

LINEAR MEASUREMENTS

The use of imagery for creation of anchor sections was evaluated for all but the 2-inch imagery. Distance measurements were compared with videolog van DMI measurements for 7 locations. The RMS and std for the difference between the imagery and DMI measurements for the 6-inch imagery was 5.05 and 5.36 m; for the 24-inch, 5.35 and 5.61 m; and 7.13 and 7.41 for the 1-meter dataset. None met the rather stringent requirements for anchor sections in the Iowa DOT LRS. However, financial constraints may require that standards be lowered.

RECOMMENDATIONS

Although the use of lower resolution images would be more cost-effective,

they are limited by the ability to actually see and identify inventory features. A significant number of features could either not be identified or could not be regularly identified in the 1-meter and 24-meter datasets.

Because the ability to consistently identify features decreases with resolution, images with at least 6-inch resolution would be necessary for most inventorying purposes. For collection of data elements for the LRS datum 2-inch or 6-inch would be feasible if datum accuracy standards are relaxed slightly.

REFERENCES

GeoAnalytics, TransDecisions, Oracle Corporation, and Iowa DOT. "A System Pilot Plan for the State of Iowa Department of Transportation's Linear Referencing System." July 2000.

Contacts: Iowa State University,
Reg Souleyrette, *reg@iastate.edu*
Shauna Hallmark, *shallmar@iastate.edu*