NCRST

NATIONAL CONSORTIUM ON REMOTE SENSING IN TRANSPORTATION

INFRASTRUCTURE

BridgeView

Updating Bridge Location for NBI Compliance

cookbook

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

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THE PROBLEM

Many state DOTs maintain accurate information on the condition and structural nature of bridges. However, the locations of bridges are often recorded by a variety of methods that vary considerably in their accuracy (e.g., field inventory, rough scaling from small scale maps, literal descriptions). The Wisconsin DOT maintains two separate databases that include locations for a total of 13,000 bridges, 4800 of which are on the state trunk network. In addition, the State has a mandate from the FHWA to provide bridge locations as part of the National Bridge Inventory. One of the databases is associated with field inventory and locates bridges by linear offsets from route reference points. The linear referencing system is in turn associated with a spatial database originally derived from 1:100,000 scale mapping. Bridge locations in this first database are expected to be fairly accurate. The database is known however to have bridges missing and also to include information that is irrelevant to bridge managers (e.g., culverts). The second database is maintained by the bridge management section. Bridge sequences and locations along routes are expected to be correct, yet there are often errors in this database.

THE SOLUTION

The remote sensing approach in solving this problem lies in observing differences between the DOT's bridge spatial database, and bridges extracted from aerial and satellite imagery. The goal is to assist the user in locating bridges accurately and efficiently. The functional requirements of this approach are summarized in Table 1.

- Load and manipulate imagery
- Load and manipulate vector (shape files of highways and bridge locations)
- Move, edit and locate highways and bridges to accurate positions based on the orthoimage
- Add new bridges in vector data (shape files)
- Open associated tables and add new attribute data for new bridges

Table 1. *Functional requirements of Bridge Updating based on Remote Sensing Imagery*

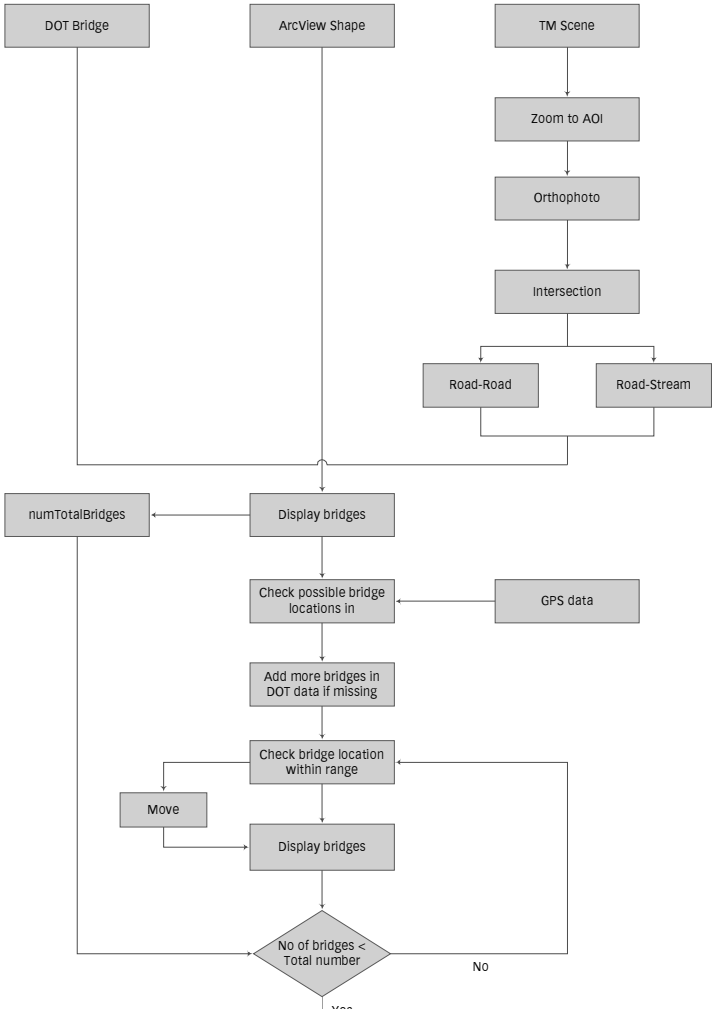


Figure 1. *Flow Diagram for* BridgeView *Procedures*

To implement this approach, the *BridgeView* toolset has been developed to locate new, and revise existing, roads and bridges using remote sensing data sources. *BridgeView* was developed using ESRI's *Avenue*™ programming language as an ArcView™ extension. It runs on a PC with Windows 98, Windows NT or Windows 2000 operating system.

The primary data source in *BridgeView* is orthophoto imagery with appropriate accuracy and resolution. This data source is generated from scanned aerial photography or from high-resolution satellite imagery. The user can correct positions of roads and bridges if their locations are deemed inaccurate by visual interpretation of the orthophoto or satellite images. The accuracy of the corrected position is within one to two meters but also

depends on the source data and image resolution. The user can also add new bridges to the spatial database by pointing and clicking on new features from the orthophoto imagery.

Accurate locations of the bridges are derived from higher resolution digital orthophotos, as shown in Figure 2. The spatial database is updated accordingly. As shown in Figure 3, the conceptual data sources for this tool consist of orthoimagery, highway network and table of bridge locations.

System Requirements and Installation Procedures

BridgeView requires sufficient memory and speed for extensive image exploitation within the *ArcGIS* environment. In addition, significant storage is required to accommodate imagery, databases of roads and bridges, GIS layers, and derived datasets. *BridgeView* requires low and high resolution imagery, either panchromatic or multispectral. All images as well as roads and bridge locations must be accurately oriented using the same

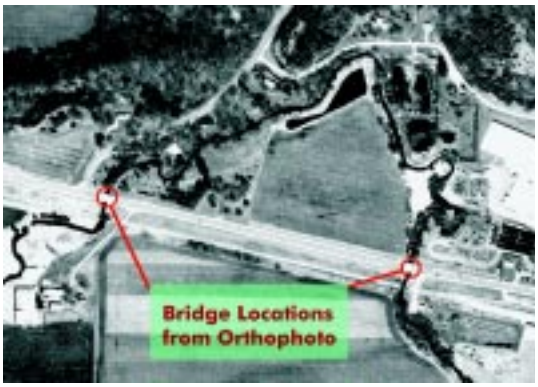
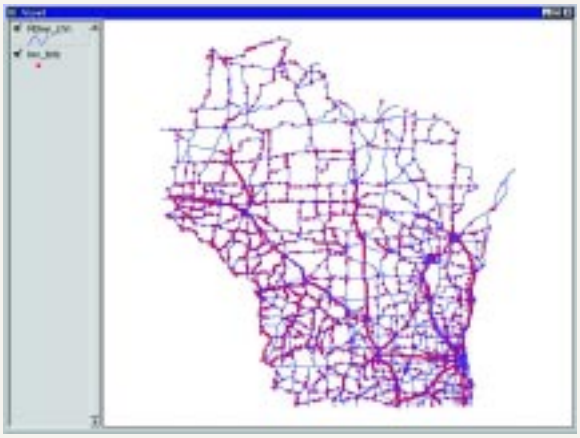


Figure 2. *The utility of Orthophoto in showing Bridge Location*



Bridge ID	Address	Feature Intersected
B-22-0097	1.2M N JCT STH 11 TO E	BADGER RD
B-22-0098	2.0M N JCT STH 11 TO E	SANDY HOOK RD
B-22-0122	4.6M N JCT STH 11 TO E	CTH HHH
B-22-0124	5.1M N JCT STH 11 TO E	CTH H
B-22-0144	3.0M N JCT USH 151 TO N	PLATTE RIVER
B-22-0828	5.0M N JCT CTH N	GRANT RIVER
...	...	...

Figure 3. *Data Components for Verification and Updating of Bridge Locations.*

base datum. There is no constraint on the coordinate system.

Since *BridgeView* is an *ArcView* extension, files must be copied to appropriate directories. Source code is supplied in a CD medium. Extension files are to be copied from the CD to the proper *ArcView* extension directory.

Description of the Main Graphical User Interface

The main interface consists of controls and functions. As shown in Figure 4, the user can add imagery to cover or extend a specific area of coverage. Table 2 describes the controls.

BridgeView includes an imagery-handling component that consists of several capabilities, as shown in Table 3. The medium resolution imagery is a Landsat Thematic Mapper (TM) scene displayed as an overview. The fine resolution imagery is a set of digital orthophoto images that are spatially registered to the coarser resolution imagery, the TM scene.

The mode of operation of this component can be summarized as follows: The operator loads the overview image, in this case a TM scene. The operator selects an area of interest (AOI) and clicks on a potential feature for zooming. The software keeps track of the display scale. Once the scale exceeds a specific threshold, a higher resolution image, or set of images, is automatically loaded. If the operator zooms out, thereby exceeding the threshold in the other direction, the coarser resolution image is displayed. Figure 5 shows an example of the two images at the threshold resolution. Throughout this process, the software maintains spatial registration between the two images.

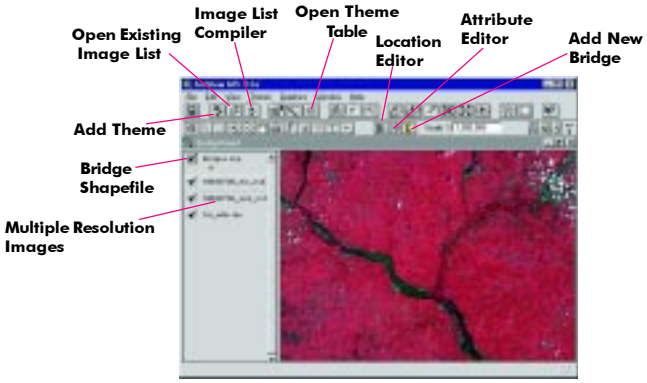


Figure 4. *Main Graphical User Interface for* BridgeView ™

Function	Description
Add Theme	Adds themes for road and bridges in active window
Open Existing Image List	Opens existing image list generated in previous session
Image List Compiler	Adds all necessary images then generates an image list
Open Theme Table	Opens a table of active theme
Location Editor	Modifies bridge location
Attribute Editor	Displays a dialog box to modify bridge information
Add New Bridge	Appends new bridges and adds attribute information

Table 2. *Description of Controls from Main GUI of* BridgeView ™

Image Display
Point and Click
Zoom In/Out
Scale Change
Spatial Registration
Scale-Based Image Flip

Table 3. BridgeView *Imagery Handling Capabilities*

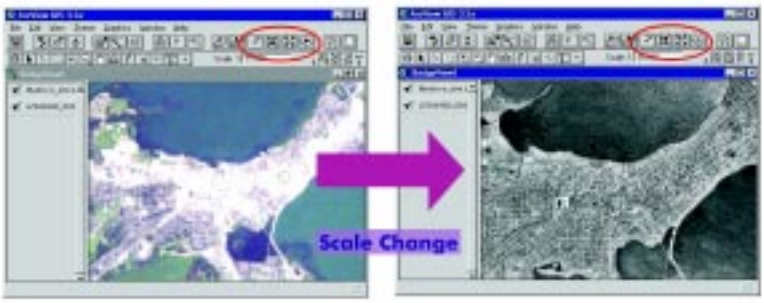


Fig 5. *Replacement of Imagery based on Zooming Threshold*
The left screen capture shows the view above the zooming threshold and the right screen shows the same location below the zooming threshold, note the change in display scale.

The image handling capability enables the operator to display the imagery precisely in the AOI. Overlaying the road coverage shape file and bridge locations from the DOT Log File, the operator can verify the locations of existing, and detect new, bridges. *BridgeView* enables editing of the location of bridges in question, and adding new bridges to the shape file. The operator can verify the bridge number and update other attributes in the shape file. Once this process is completed, a report can be generated in *ArcView* for new listings of bridges and attributes. Figure 5 depicts erroneous bridge locations in a shape file before and after verification and update.

A Word of Wisdom

One problem we encountered in our implementation was the inconsistency in projections between the shape file in WTM27, and the imagery in UTM. The remedy was to use WTM83 for all images and shape files, thereby ensuring consistent projects. It is essential to verify in advance that projections of all data sets are consistent.

Additional Information on *BridgeView*

The *BridgeView* toolset and Operational Manual are available free of charge from the NCRST-Infrastructure website *http://www.ncgia.ucsb.edu/ncrst* or on CD-ROM from the University of Wisconsin-Madison. To acquire this toolset please contact:

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