Basemap and Vector Migration
R&D Program for NASA/ICREST Studies
Project Report 09/16/01

Program Objectives:

1. Solve the local government problem of vector and image mis-registration when the vector data are of worse positional accuracy than the imagery.

2. Maintain and store the corrective 'shifting' applied as an index to the positional accuracy of the original vector data bases.

3. Provide visualization tools for the positional accuracy of the vector migration.

4. Create a pathway by which other data bases built on the same original vector base can be migrated to the same relative positional accuracy as the new image registration.

Progress Summary:

Local governments use map or spatial data for decision-making frequently, but many of these data are often inaccurate and outdated. That may have negative influence on decision-making. Remote sensing can provide timely, accurate, and cost effective data. However, one major bottleneck to the integration of remotely sensed imagery into existing geographic information system is the issue of positional accuracy of the existing line-work within the vector database which make it cannot match the imagery. This research presents an innovative approach to improve the positional accuracy of digital vector data by integrating geographic information system and remote sensing technologies. This method is based on piecewise transformation. The road intersections are chosen as control points and links are created from their locations in vector database and corresponding positions in the imagery. These links are used to create Triangulated Irregular Networks for rubber sheeting the vector data. The test results show that this approach can improve the accuracy of vector data significantly. It's a very cost-effective method and has great potential to save both time and money for local governments as they move to upgrade their inaccurate vector data.

This research presents an innovative approach to improve the positional accuracy of existing digital vector data. It utilizes available imagery such as air photograph, USGS DOQ (Digital Orthophoto Quadrangle), or high-resolution satellite imagery such as 1 meter IKONOS. The only manual procedure is to digitize the point location of road intersection in the imagery. All other processes are automatic. Therefore, it is very cost-effective.

We tested the piecewise transformation method using real world data. The city of Springfield, Missouri already had a digitized parcel map. Also aerial photography with 0.25 meters resolution was obtained. The geo-referenced and ortho-rectified aerial photograph has much better positional accuracy than the parcel map and provided a good test of both the methodology and the cookbook developed to produce this migration.

When the parcel data are overlaid on digital aerial photograph (Figure 1), it does not line up with the more accurate aerial photography. Many parcel lines cut through houses, and some parcel lines even fall into other blocks. All the road intersections are used as control points. The road centerline and parcel layers are displayed on top of aerial photograph (Figure 2). They act as reference for locating the corresponding road intersection points on imagery. A human operator collects these points manually and saves it to a points file. The corresponding point pairs (from, to) are obtained by finding the nearest distance between to-point and from-point layers. Therefore, the x, y coordinate attribute of from points can be transferred to the to-point layer. The to-point layer is used to create two TINs whose vertex are to-points location and Z values are x, y coordinate of from-points respectively. Figure 3 show the x coordinate shift distribution between from and to control points and Figure 4 show the coordinate shift in y coordinate. It can be clearly seen that the coordinate shift varies over space and there is no clear trend. Also the shifts in x & y direction have no correlation. That verifies the piecewise transformation is the most appropriate method that deals with the positional accuracy problem of parcel data. The results after piecewise transformation are showed in Figure 5. The parcel lines are within the block and most lines are line up with imagery very well. There is no clear problem of cutting through houses. The test results are very satisfactory visually.

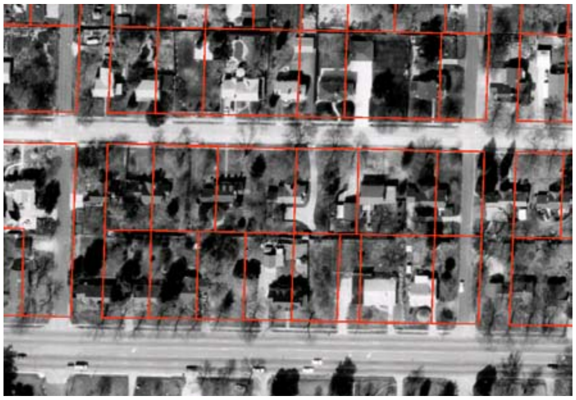

Figure 1. Overlaying original parcel lines on aerial photograph (part of test area).

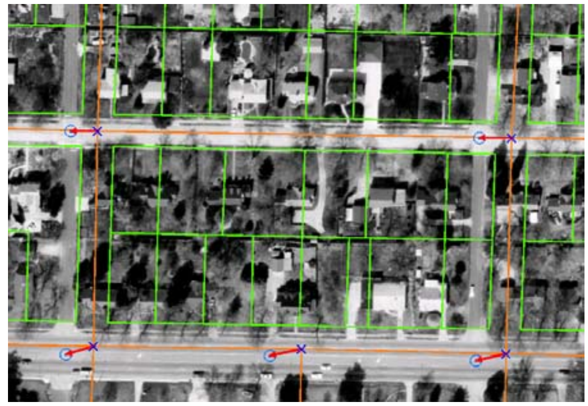

Figure 2. Finding the road intersection pairs: x symbol is location in vector database, and circle symbol is where it should be in imagery.

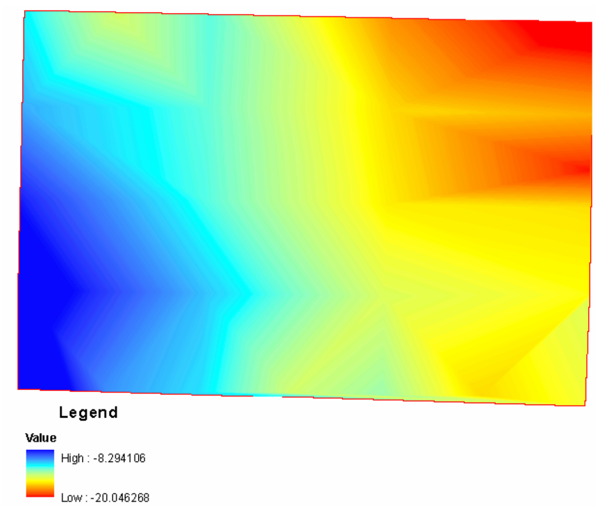

Figure 3. The coordinate shift in x direction.

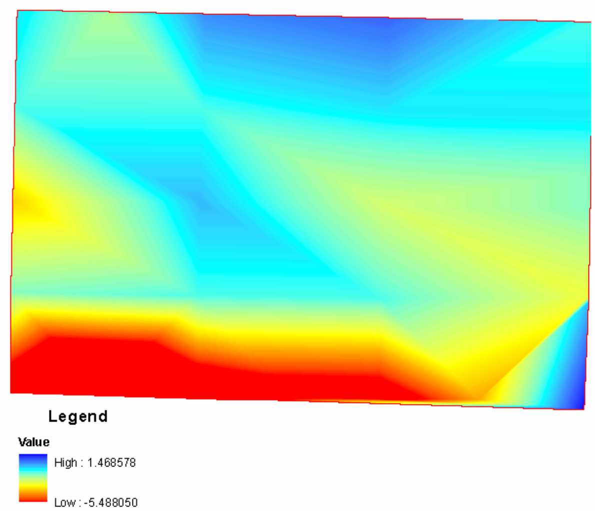

Figure 4. The coordinate shift in y direction.

Figure 5. The parcel data after piecewise transformation.

Ongoing Activities:

The methodology has been presented to the local government consortium in Springfield Missouri and the GRC is in the process of transferring the methodology for their implementation of this process for the correction of their base maps existing in the City, County, and within their public utilities. Metrics concerning this implementation will be gathered as the project nears completion in November.

Vector Migration / Basemap Product Generation/Validation/Error Modeling Team

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