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An Accuracy Adjustment of Uncertain GIS Positional Data by Data Fusion Method

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ABSTRACT: *the accuracy of an uncertain bridge database was adjusted by intersections of rivers and roads of officially used data that has clear accuracy information. The distance between each bridge point and intersection of road and river were calculated. If the distance shorter than the bridge length, it was assumed that the bridge has enough accuracy to be adjusted. This adjustment method can be called GIS data fusion. By GIS data fusion, the accuracy of 63% of bridges was adjusted and clear accuracy was obtained. Then the positional accuracy-adjusted bridges were classified by their attribute of road. After that the accuracy characteristics of each classified bridges were investigated. It was possible to assess adjusted accuracy of bridges GIS data by their attribute data. In classified bridge category, 69% of maximum adjustment could be achieved.*

Introduction and Objectives

The department of construction in Kochi prefecture JAPAN established and shared bridge database that has crossing object information, positional coordinates, road type, structure type, address and such like as attribute data. When the data overlaid with officially used data, some positional errors are appeared. To use the data with officially used data, positional accuracy adjustment and assessment are needed. To adjust the accuracy of the bridge database, data fusion method could be used; data fusion is the seamless integration of data from disparate sources (NOAA national data centers; Data fusion, What is it?, 1997). In this case study, the possibility of accuracy adjustment of the bridge database by GIS data fusion, and the possibility of assessment of accuracy adjustment result with attribute data were investigated.

Methods

The bridge database has 711bridges. 355 of them exist on rivers (figure3). Bridges on river consist of national road bridges, prefecture government road bridges and local government road bridges. As disparate source in data fusion, the National Land Digital Information (N.L.D.I) was used; it has clear information of road and river and based on 1:25000 scale map. So the positional accuracy of N.L.D.I. is 12.5m (Shunji Murai, GIS WORK BOOk, p35). In accuracy adjustment, distances between the nearest bridge points in the bridge database and intersection of each road and river of N.L.D.I. (figure1) were calculated. Each distance was evaluated by length of each bridge with positional accuracy of N.L.D.I. (12.5m) to be divided into adjustable bridges and not adjustable bridges. And the condition of evaluation is whether the distance between a bridge and the nearest intersection is longer than its bridge length with positional accuracy of NLDI or not. If bridges could not satisfy in the condition of the evaluation, they were eliminated. On the other hand, if bridges satisfy in the condition, their attribute combined with coordinate of the intersections. Finally their positional accuracy could be adjusted (figure2). Although interlinked, separate treatment of positional error and attribute error are often generated from naturally difference processes, and that different error modeling techniques are required (Chrisman 1989). To investigate more detail result of positional accuracy adjustment, the adjusted bridges were classified by their attribute of road. The result of positional accuracy adjustment of each classified bridge category was assessed and compared.

Results

When all bridges were used for accuracy adjustment, 43% of them were adjusted. However when bridges on river were used in accuracy adjustment, 63% of them were adjusted (figure3). The adjusted bridges on river were classified according to their road type. Each result of accuracy adjustments is different in each category (figure4). In classified bridge category, 69% of prefecture government road bridges were adjusted (figure4). Figure5 and 6 shows that the relationship between slope and result of accuracy adjustment. The adjusted bridges have a tendency to decrease with slope inclination in Figure5. And there are many bridges on national road category exist on steep slope area in figure6.

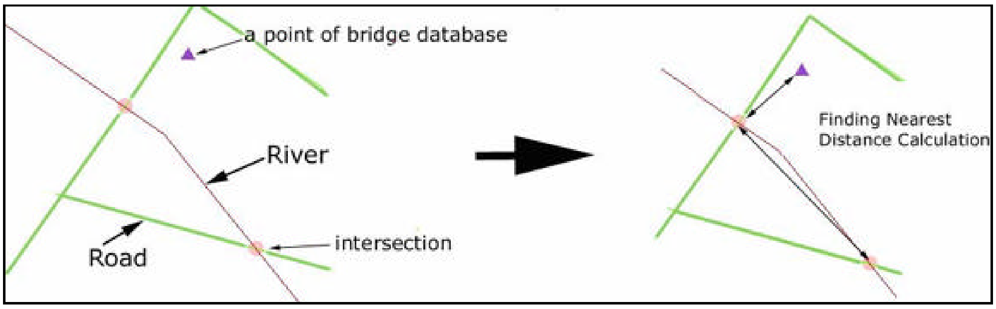

Figure 1. Process of adjustment; the nearest bridge point from intersection were selected

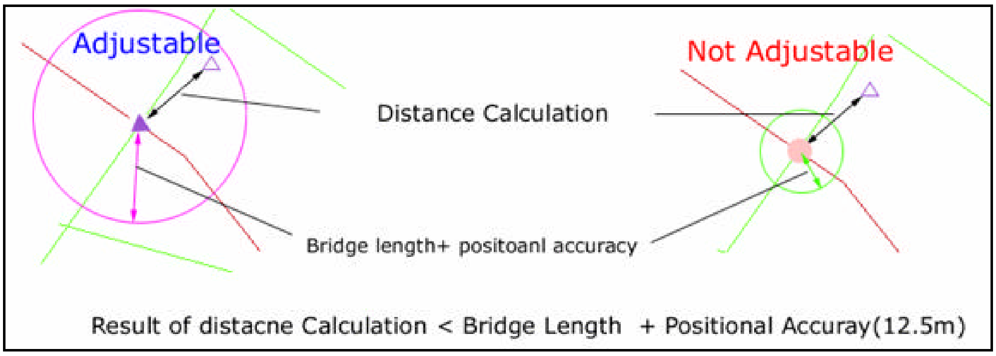

Figure 2. Evaluation of Distance Calculation Result

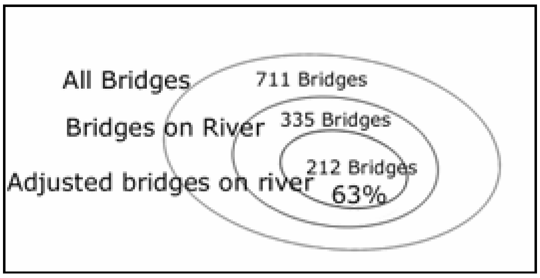

Figure 3. Data Consistence of Bridge database

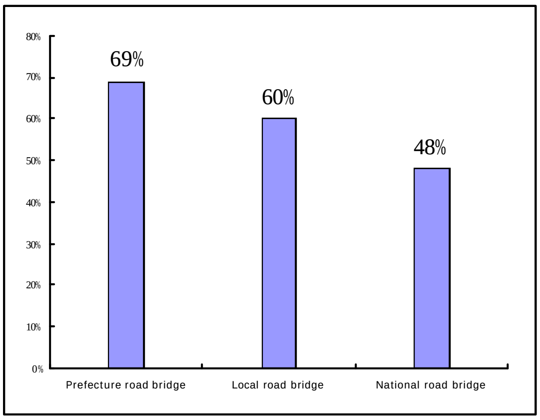

Figure 4. Result of accuracy adjustment

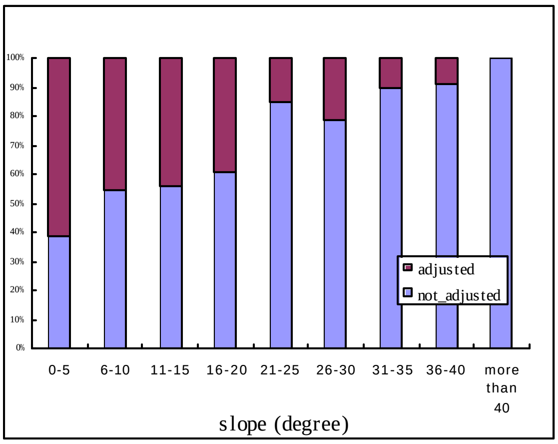

Figure 5. Result of positional accuracy assessment of bridges on river

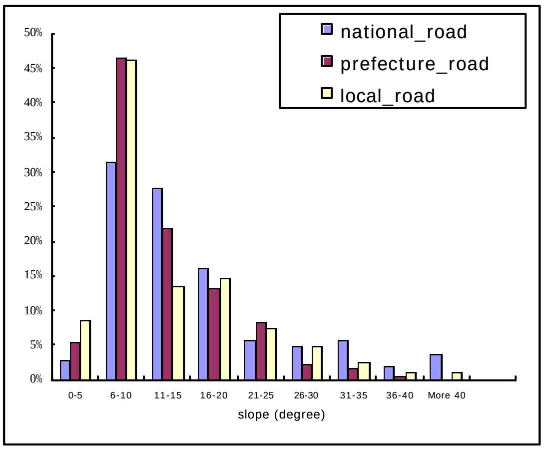

Figure 6. Accuracy adjustment result in slope

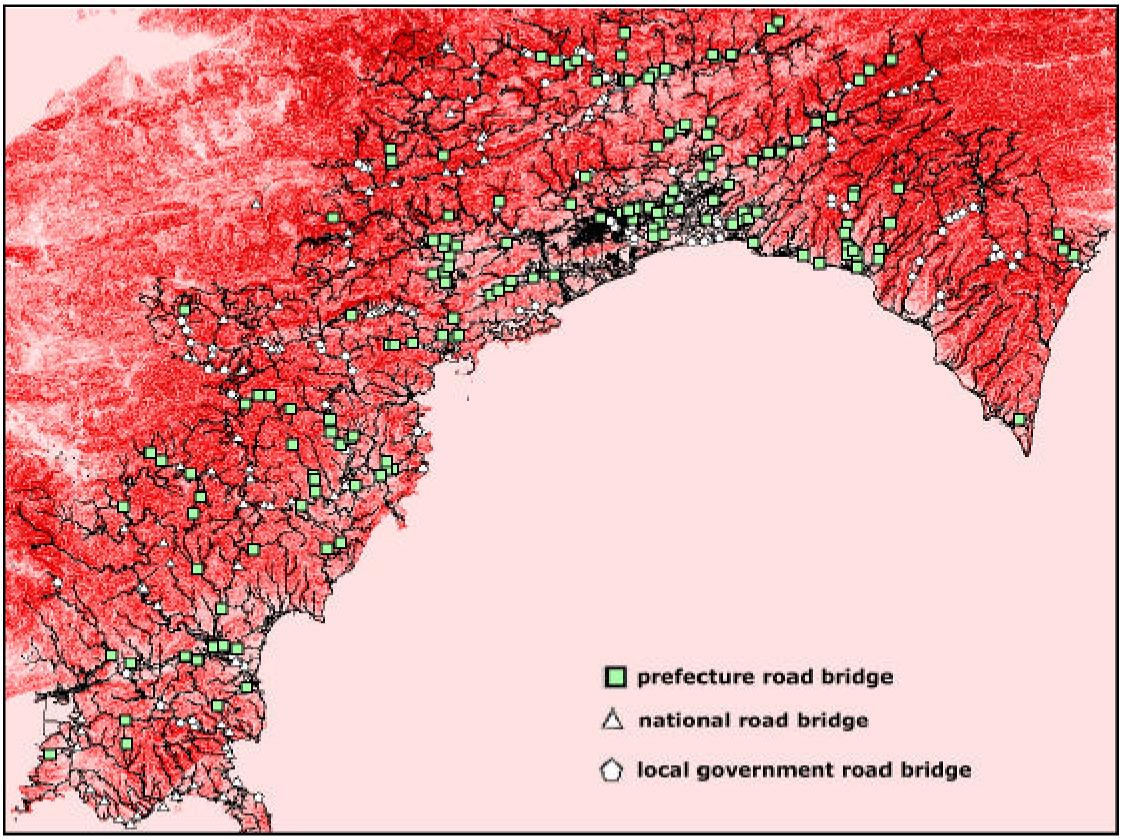

Figure 7. Classified accuracy-adjusted bridges overlaid with slope model of kochi prefecture in japan

Conclusions

The 64% percent of positional accuracy of bridges on river in the bridge database was adjusted by GIS data fusion method. In accuracy adjusted bridge categories that were classified by road attribute, at most 69% of maximum accuracy adjustment could be achieved. Those results explain that GIS data fusion is reliable method for accuracy adjustment. National road bridges obtained less adjustment result than others (figure6). Because it has many bridges exist on steep slope area that obtained low accuracy adjustment (figure5). In figure7, dark areas mean steep slope and bright areas mean gentle slope. There are many national road bridges exists on steep slope. National roads connect usually intercity. National roads were constructed on mountainous areas. Those areas have many small valleys and branches were not described on N.L.D.I. Because of the reason, a few intersections of rivers and roads were generated on mountainous area of N.L.D.I. Therefore, the result showed national road had lowest accuracy. In this study, bridge database, road data, river data were used each other as GIS data fusion. For the fusion, matching key words are needed to link each other. Though the bridge database has attribute data of road and river. But, it was very difficult to match or link records with records in another GIS database, because the attribute data were described as text. Therefore, numeric code is required for the easy matching or linking database. Currently many kinds of GIS data can be used. When every attribute of GIS data is coded under same structure, the GIS data will be efficiently used and easily cooperated for many purposes.

Further study

High-resolution IKONOS data and hyper-spectral OrbView image will be useful for accuracy adjustment, therefore, the possibility of accuracy adjustment with high-resolution data and spectral remotely sensed data will be investigated. Also the reusability of accuracy-adjusted data will be investigated.

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