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

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ABSTRACT: the accuracy of a shared bridge database was adjusted by intersections of rivers and roads data of officially used GIS data, which has clear accuracy information. Then distances between bridges and intersection of road and river, if bridge length is shorter than accuracy adjusted distance, it was assumed that the bridge does not have enough accuracy to be adjusted. By GIS data fusion, the accuracy of 63% of bridges was adjusted and obtained clear accuracy. Then the positional accuracy-adjusted bridges were classified by their road attribute, after that accuracy characteristics of each classified bridges were investigated. It was possible to assess adjusted accuracy of bridges GIS data by road attribute data.

Introduction and Objectives

Construction department of Kochi prefecture in JAPAN established and shared bridge database that has crossing object information, positional coordinates, ID numbers, structure type, address and such like, when the data overlaid with officially used data, some positional errors appeared. To use the data with officially used data, positional accuracy adjustment is needed. To adjust the accuracy of the bridge database, data fusion method was used; data fusion is the seamless integration of data from disparate sources1), as disparate source, the National Land Digital Information (N.L.D.I) was used; it has clear road and river information and based on 1to 25000 scale map, so the positional accuracy of it is 12.5m. 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 by attribute data were investigated.

Methods

At first distances between the nearest bridge points in the bridge database and intersections of road and river of N.L.D.I. (figure1.), next, the distances were evaluated by bridge length with positional accuracy of NL.D.I. (12.5m) to divide positional accuracy adjustable bridges and not adjustable bridges. The condition of evaluation is whether the distance between a bridge and nearest intersection is longer than its length with positional accuracy of NLDI or not. If bridges could not satisfy the condition of evaluation, they were eliminated, on the other hand, if bridges satisfy the condition, their attribute were combined with coordinate of intersections, then finally their positional accuracy 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, positional accuracy adjusted bridges were classified by their road attribute then the result of Positional accuracy adjustment of each classified bridge category was assessed and compared. It was assumed that short length bridges and bridges on high slope area or valley have lower accuracy, because of the reason, the accuracy of classified bridges was evaluated characteristic of adjusted positional accuracy of classified bridges, their existence frequency in slope, (bridge) length and accuracy adjusted distance were calculated and compared.

Results

Bridge database has 711 bridges, 335 of exist on river, bridges on river that has 82 bridges of local government road, 105 bridges of national road and 168 bridges of prefecture government road (figure3.). The accuracy of 47% of bridges in N.L.D.I. was adjusted, and the accuracy of 63% of bridge on river was adjusted (figure4.); this result shows that data fusion is reliable method in accuracy adjustment. Result of accuracy adjustment of bridges on river was classified, although they are in a database, their accuracy adjustments are different each other, so the reason was investigated, figure2 shows that the number of satisfied bridges is decreasing according to slope increasing, so there is a relation ship between slop and accuracy adjustment was found

Figure 3 shows the large difference between result of positional accuracy adjustment of national road bridge and others. The proportion of bridge of bridge existence above 11degree slope (figure5) is bigger than bridges of local government road (figure4) and bridges of prefecture road (figure6), it means that many bridges of national road are on high slope area, and according to graph2, national bridge has more low accuracy bridge than others. That short length bridge has low accuracy was assumed but figure 7, 8 and 9 show that bridge length is not so important factor in accuracy adjustment, because the accuracy of many bridges which has short length, were adjusted in all dataset.

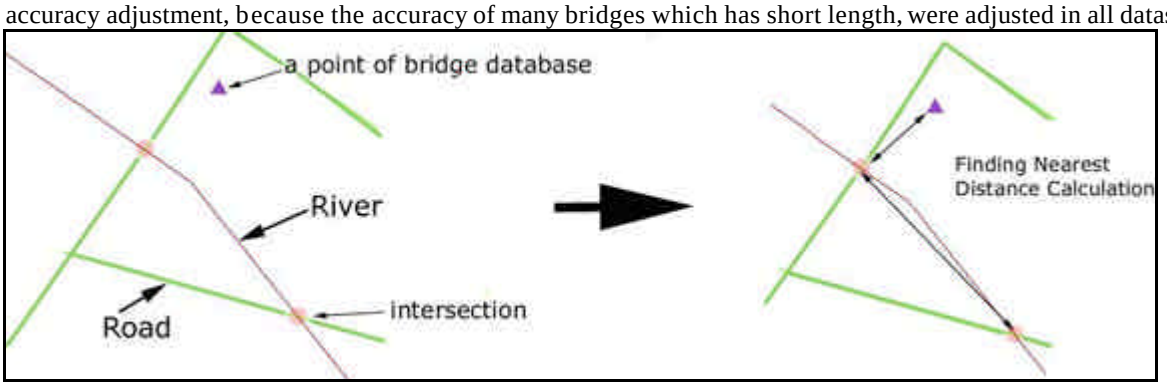

Figure1. Process of adjustment; the nearest bridge point from intersection were selected

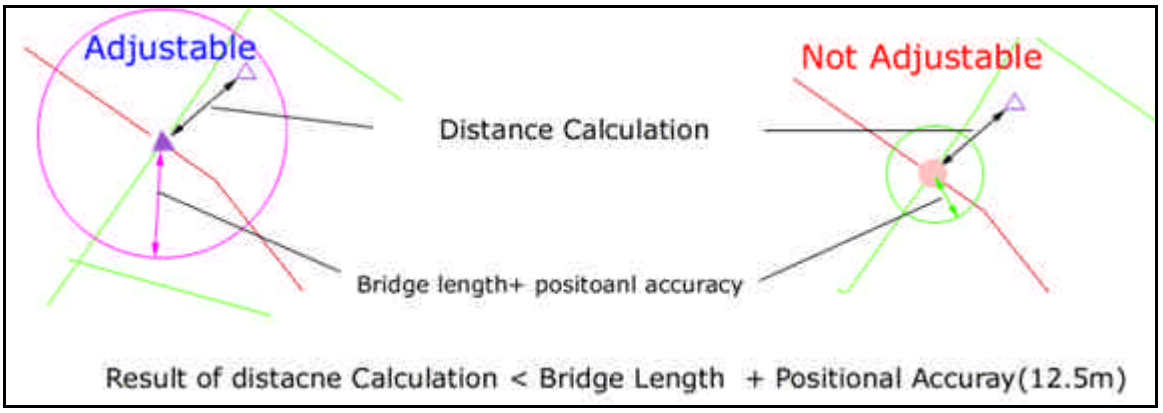

Figure2. Evaluation of Distance Calculation Result

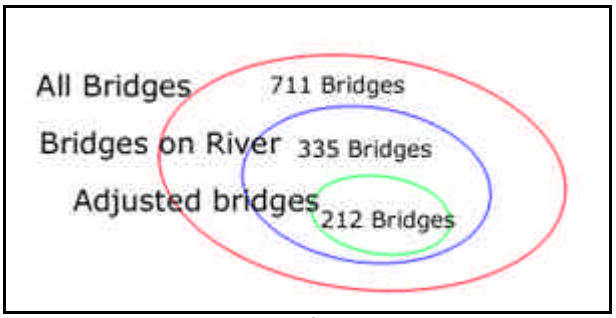

Figure3. Data Consistence of Bridge database

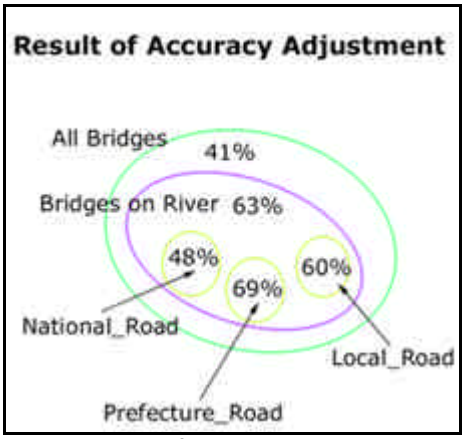

Figure4. Result of accuracy adjustment

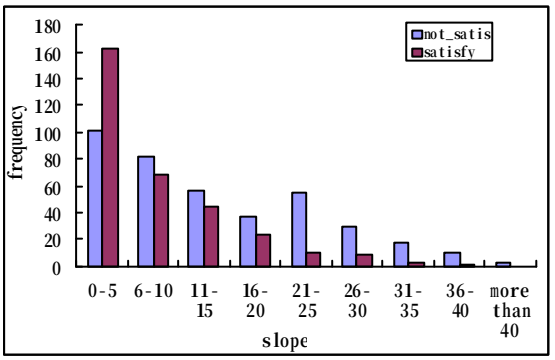

Figure2. Result of positional accuracy assessment of bridges on river

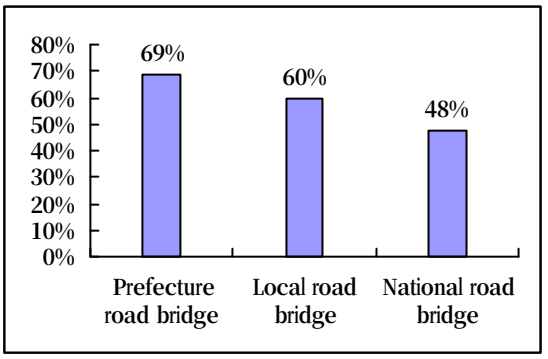

Figure3. Result of positional accuracy adjustment of classified bridge group by road attribute

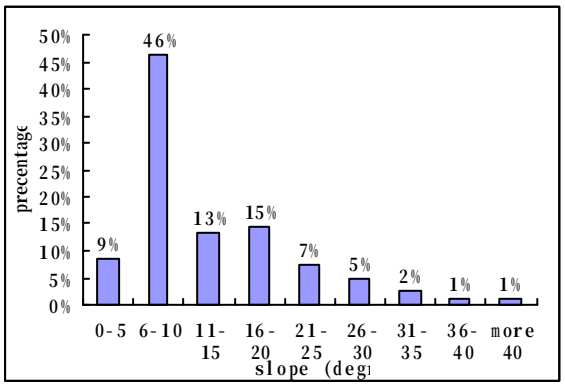

Figure4. Frequency of local road bridge in slope

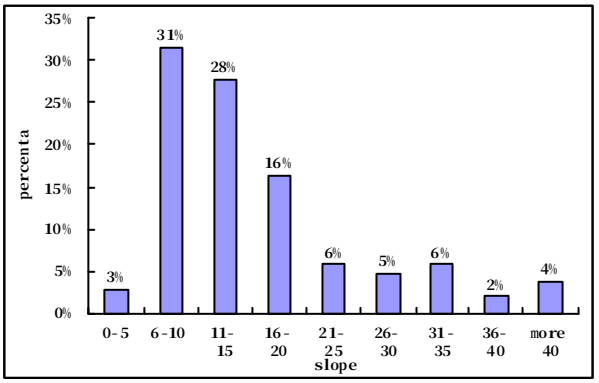

Figure5. Frequency of national road bridge in slope

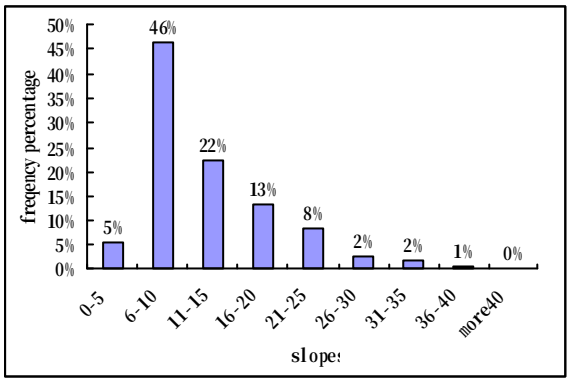

Figure6.Frequency of prefecture road bridge in slope

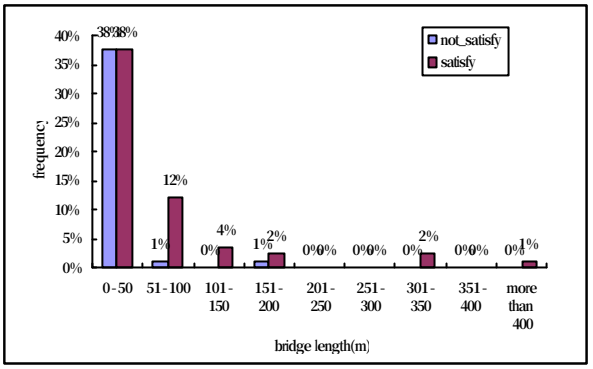

Figure7. Frequency of local road bridge in bridge length

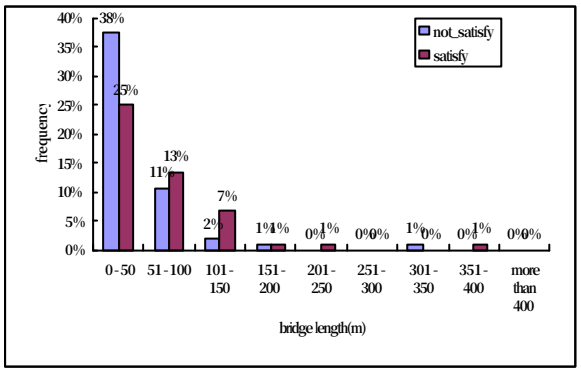

Figure8. Frequency of national road bridge in bridge length

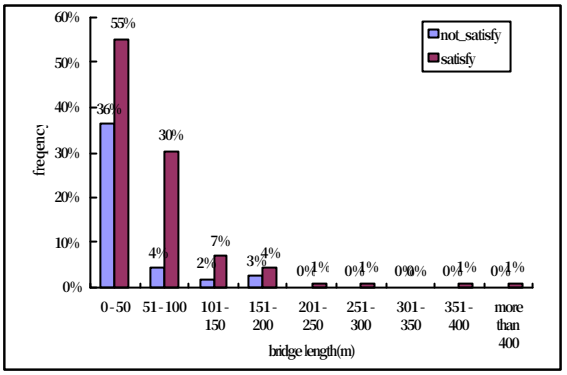

Figure9. Frequency of prefecture road bridge in bridge length

Discussion

National road bridge show two different characteristic from other road bridge in this case study, one is that many bridges exist on high slope area, the other is that many bridges are far from intersection of N.L.D.I. Those two differences explain that national road bridge, local road bridge and prefecture road bridge have different accuracy even though they are in a GIS database, from the result, that it is possible to assess result of positional accuracy adjustment by attribute was proved.

Conclusion

The 63% percent of positional accuracy of bridges in the bridge database was adjusted by GIS data fusion method, and GIS data fusion is reliable method in accuracy adjustment. It is possible that assessment of positional accuracy by attribute data, and the result of accuracy adjustment by GIS data fusion need to be assessed by its attribute data.

Reference

1. Data Fusion, What is it?: NOAA national data centers 1997 [Online],Available: http://www.ngdc.noaa.gov/seg/tools/gis/fusion.shtml
2. Shunji Murai, 1997 GIS Work Book. Japan Association of Surveyors pp.35
3. Chrisman, N,R.,1989, Modeling error in overlaid categorical maps. pp.21-34,in Accuracy of Spatial Databases, edited by M. F. Goodchild and S. Gopal, Taylor & Francis, London.