

Historical Geographic Network archived in Tongdian(通典)

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ABSTRACT

This paper proposes a way of constructing modern concept of geographic network by interpreting historical geography recorded in old archives such as the Tongdian(通典, Comprehensive Manual) which is one of the important materials in studying old concept of Chinese administrative geography. It is proposed a way of producing geographic network by constructing base network, and by combining and adjusting the constructed networks. The proposed way of construction has been applied for generating a geographic network around Bohai gulf and Shandong peninsula, by using descriptions recorded in the administrative division(州郡典) of the Tongdian.

Keywords : Historical geography, Geographic network, Tongdian

1. Introduction

The synchronic and diachronic geographic information is one of the important infrastructures in doing historical researches because almost of the historical event has occurred on the basis of certain geographic extents. Therefore it is necessary to convert geographic information recorded in historical documents into meaningful and objective descriptions such as event maps, tables of administrative names, electric databases etc.

Nowadays, by virtue of the development of Geographic Information System (GIS) technologies, it become possible to electrically merge and arrange various historical geographic informations scattered in diverse historical documents. One of the interesting researches in the field of historical GIS can be the China Historical GIS project (CHGIS)[1]. The purposes of CHGIS is in establishing a database of historical administrative units for different periods in Chinese History, and also in providing a base GIS platform for researchers to use for spatial analysis, temporal statistical modeling, and representation of selected historical units as digital maps [1][2][3].

Although the purposes of CHGIS can be one of the important researches in historical GIS, the author believes that there exists another interesting research in

historical GIS on the concept of proposing another way of understanding historical geography. The purposes of this paper is in constructing administrative road network of the Tang dynasty (唐, 618-907) using records of the administrative division (州郡典) of the encyclopedia Tongdian (通典)[4], which means a comprehensive statutes or a comprehensive manual, written by Du Yu(杜佑, 734-812) at A.D. 801. The Tongdian is a 200 fascicles(卷) of comprehensive history of various Chinese organizations and systems. It is composed of eight sections such as the food and money (食貨典), the offices (職官典), the governmental examination and promotion (選舉典), the rites (禮典), the music (樂典), the military (兵典), the penal law (刑法典), the administrative division (州郡典), and the geographical encyclopedias outside of china (邊防典). Among eight sections, the administrative division (州郡典) includes the followings:

- 1) Composition and changes of administrative districts until the Tang dynasty,
- 2) Names of administrative division such as superior prefecture (府), protectorate (都護府), prefecture(州), commandery (郡), and district (縣),
- 3) Populations of each administrative unit and road network connecting neighboring units. Especially, description about the road network constitutes a typical form of description, which is composed of

name and distance to the neighboring units existing along eight directions, distances to the west capital (西京), that is Changan (長安, modern Xian), and to the east capital (東京), that is Luoyang (洛陽).

In this paper, the author will propose a trial and discussion relating to converting human geographic information into natural geographic information and constructing road network of the Tang dynasty using historical records of the Tongdian. For the analysis of road network, the author used a electric collections of Chinese history [5].

Section 2 discusses a way of constructing small network by merging unit network, and Section 3 discusses a way of merging and adjusting small network for producing large network. Finally, Section 5 concludes this paper.

2. Construction of small network

2.1 Converting descriptions into table

The administrative division of Tongdian includes descriptions about history and changes of Chinese administrative units before the late Tang dynasty, administrative geography of each unit such as names of districts (縣) included in each prefecture (州) and commandery (郡), typical one about road network of each unit along eight directions and to the east and west capital, and populations of each unit.

For example, descriptions about the network of Liucheng commandery (柳城郡) and Beiping commandery (北平郡), which are nowadays located in Hebei province (河北省) and at north-east locations of Beijing (北京), is as follows:

"柳城郡東至遼河四百八十里。南至海二百六十里。西至北平郡七百里。北至契丹界五十里。東南到安東府二百七十里。西南到北平郡七百里。西北到契丹界七十里。東北到契丹界九十里,契丹衙帳四百里。去西京五千里, 去東京四千一百里。戶八百七十四, 口三千。"

"北平郡東至柳城郡七百里。南至海二百里。西至漁陽郡三百里。北至上谷口八十里。東南到臨榆關一百八十里。西南到馬城縣一百八十里。西北到石城縣一

	A	B	C	D	E	F	G	H	I	J	K
1	地名	東至	南至	西至	北至	東南至	西南至	西北至	東北至	去西京	戶
2	code	地名/聖地名/聖地名/聖地名/聖地名/聖地名/聖地名/聖地名/聖地名/聖地名/聖地名/聖地名								去東京	口
3											
4	柳城郡	遼河	海	北平郡	契丹	安東府	北平郡	契丹	契丹	5000	874
5		480	260	700	50	270	700	70	90	4110	3000
6	北平郡	柳城郡	海	漁陽郡	上谷口	臨榆關	馬城縣	石城縣	柳城郡	4320	3031
7		700	200	300	80	180	180	140	700	3520	13775

Fig. 1: Converted table of the given texts

百四十里。東北到柳城郡七百里。去西京四千三百二十里, 去東京三千五百二十里。戶三千三十一, 口一萬三千七百七十五。"

It can be translated as follows:

"Liaohe (遼河) is 480 miles (里) away from Liucheng commandery (柳城郡) to the west, a sea (海) is 260 miles to the north, Beiping commandery (北平郡) is 700 miles to the east, the border of Qiedan (契丹界) is 50 miles to the south, Andong protectorate (安東府) is 270 miles to the north-west, Beiping commandery (北平郡) is 700 miles to the north-east, the border of Qiedan (契丹界) is 70 miles to the south-east and 90 miles to the south-west, and the king's tent of Qiedan (契丹衙帳) is 400 miles to the south-west. The west capital (西京) is 5000 miles, and the east capital (東京) is 4110 miles away from Liucheng commandery, respectively. There are 874 houses (戶) and 3000 persons within the commandery."

"Liucheng commandery (柳城郡) is 700 miles (里) away from Beiping commandery (北平郡) to the west, a sea (海) is 200 miles to the north, Yuyang commandery (漁陽郡) is 300 miles to the east, Shangqiakou (上谷口) is 80 miles to the south, Linyuguan (臨榆關) is 180 miles to the north-west, Macheng district (馬城縣) is 180 miles to the north-east, Shicheng district (石城縣) is 110 miles to the south-east, and Liucheng commandery (柳城郡) is 700 miles to the south-west. The west capital is 4320 miles, and the east capital is 3520 miles away from Beiping commandery, respectively. There are 3031 houses (戶) and 13775 persons within the commandery." Since these are typical texts including names and distances to the neighboring administrative units along eight directions, it is possible to encode the texts into a meaningful geographic table, as is shown in figure 1.

2.2 Construction of base network

Although this table includes meaningful geographic information, it can't be spatial information until now because of lack of information about the geographic coordinate and substantial shape of the road. There it is necessary to establish a model required in converting the non-spatial information into a spatial one.

Firstly, for encoding spatial information into the table, there will be introduced the following assumptions:

- ① substantial distance = recorded distance + α ,
- ② substantial angle = recorded angle + β .

Assumption ① means that the substantial distance between two administrative units can be different from the distance recorded in the administrative division of Tongdian. This is necessary to compensate aberration of

distance when assuming the road between two units is straight line. Assumption ② means that the substantial angle going from one unit to neighboring one can be different from 45 degree unit even when the road is assumed to be straight.

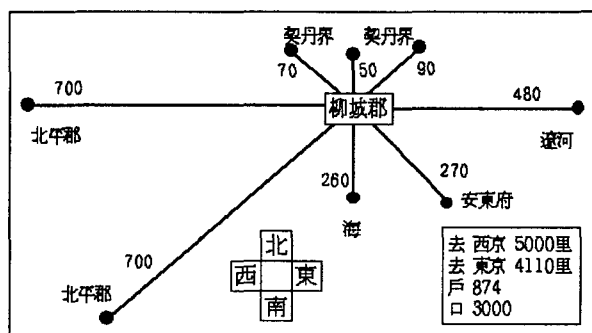


Fig. 2: Base network of Liucheng commandery

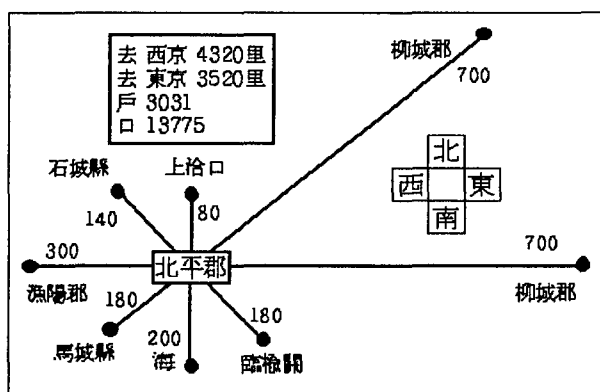


Fig. 3: Base network of Beiping commandery

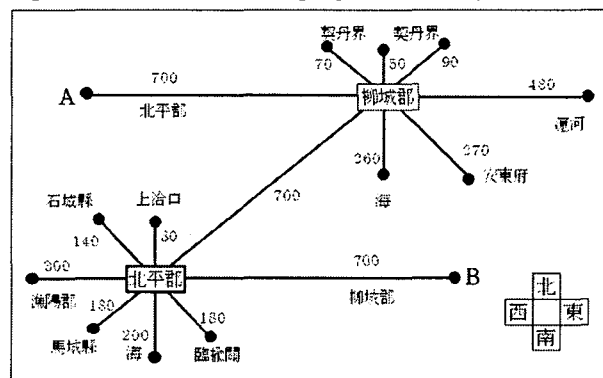


Fig. 4: Inconsistency occurred in combining networks

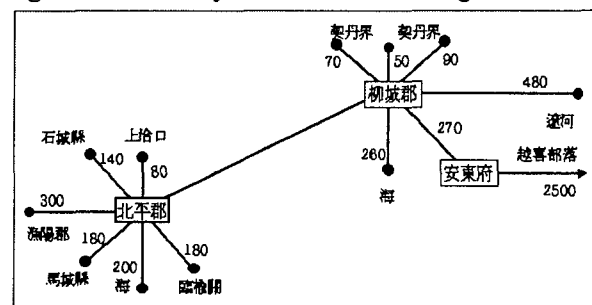


Fig. 5: Combination of neighboring networks by adjusting α and β

Based on the assumptions, base network of a administrative unit can be established by assuming that both α and β are zeros, as is shown in figure 2 and figure 3. By following this process, it become possible to spatially encode descriptions in historical records.

2.3 Construction of small network by combination

Since base network is constructed with spatial information, in principle, it become possible to combine base networks for constructing a small extent network. However, there generally arises two problems, for example, when one tries to combine both networks as is shown in figure 2 and figure 3. It comes from inconsistencies of distance and angle of road between neighboring administrative units because the numerical value constituting a base network become virtual by assuming that both α and β are zeros. As is shown in figure 4, there arises inconsistency of target location in the process of combination. Where, both points A and B in figure 4, one coming from Liucheng commandery to Beiping commandery and another coming from Beiping commandery to Liucheng commandery have no matching point. This problem can be interpreted that the direction coming from Liucheng commandery to Beiping commandery might be in that of west-southwest when one assumes that the road connecting Liucheng commandery and Beiping commandery is a straight line. This corresponds to adjust the β term appropriately. Although inconsistency in distance as well as in angle during simultaneous combination of several neighboring networks is general one, the problem can be solved by appropriately adjusting α and β terms. Figure 5 shows combined results of neighboring networks on the basis of small adjustment of both terms.

2. Procedure of constructing large network

3.1 Construction of large network

It is possible to construct large network by combining small networks on the basis of similar concept used in constructing small network. However consideration should imposed on geospatial encoding of overall shape of large network and the problem of error propagation. Up to above-mentioned step, there is rare information of geographic coordinate or realistic location on the earth because small network reveals relative positions only

between neighboring administrative units. Plausible geographic coordinate or realistic location information can be encoded, with respect to almost units by constructing large network on the basis of combining small networks. This can be done by geographically encoding the overall shape of large network into well known topographic feature of large area such as mountain and/or river and/or coastlines. This is a similar concept of using Ground Control Points (GCPs) for geospatially encoding vector or raster data.

The problem of error propagation is inevitable because there is rare way to decide the tolerance terms α and β without the comprehensive archeological excavation. However strong propagation of error may be abated by geospatially encoding the shape of network into topographic features.

3.2 Procedure of construction

Based on above discussions, the author proposes a way of constructing geographic network, as is shown in figure 6, from historical records.

Firstly, small network is constructed by combining base networks of several administrative units that is generated based on table of historical descriptions. Network is adjusted, during the construction of small network, by checking inconsistency between base networks. Then, large network is constructed by simultaneously doing resizing, rotation, adjustment and combination of small networks, until overall shape of the large network become similar with respect to topographic features.

Figure 7 shows a large network around Bohai gulf and Sandong peninsula that has been constructed, by proposed procedure of construction, using the descriptions in the administrative division of Tongdian.

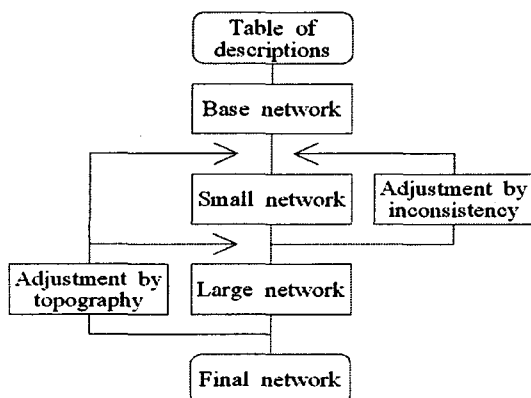


Fig. 6: Procedure of constructing geographic network

4. Conclusions

This paper is the result of a preliminary research in constructing historical geographic network described in the Tongdian. The author proposed a way of constructing base network of an administrative unit and that of doing small network by adjusting inconsistency of base networks, and that of doing large network by adjusting the shape of network using well-known topographic features such as location of mountain, river and/or coastlines. A geographic network around Bohai gulf and Sandong peninsula has been constructed by the proposed way of construction.

Since the synchronic and diachronic geographic information is one of the important infrastructures in doing historical researches, further researches should imposed on developing methodology and procedure of converting the materials of human geography, being produced for political purposes and/or administrative purposes, into that of physical geography.

References

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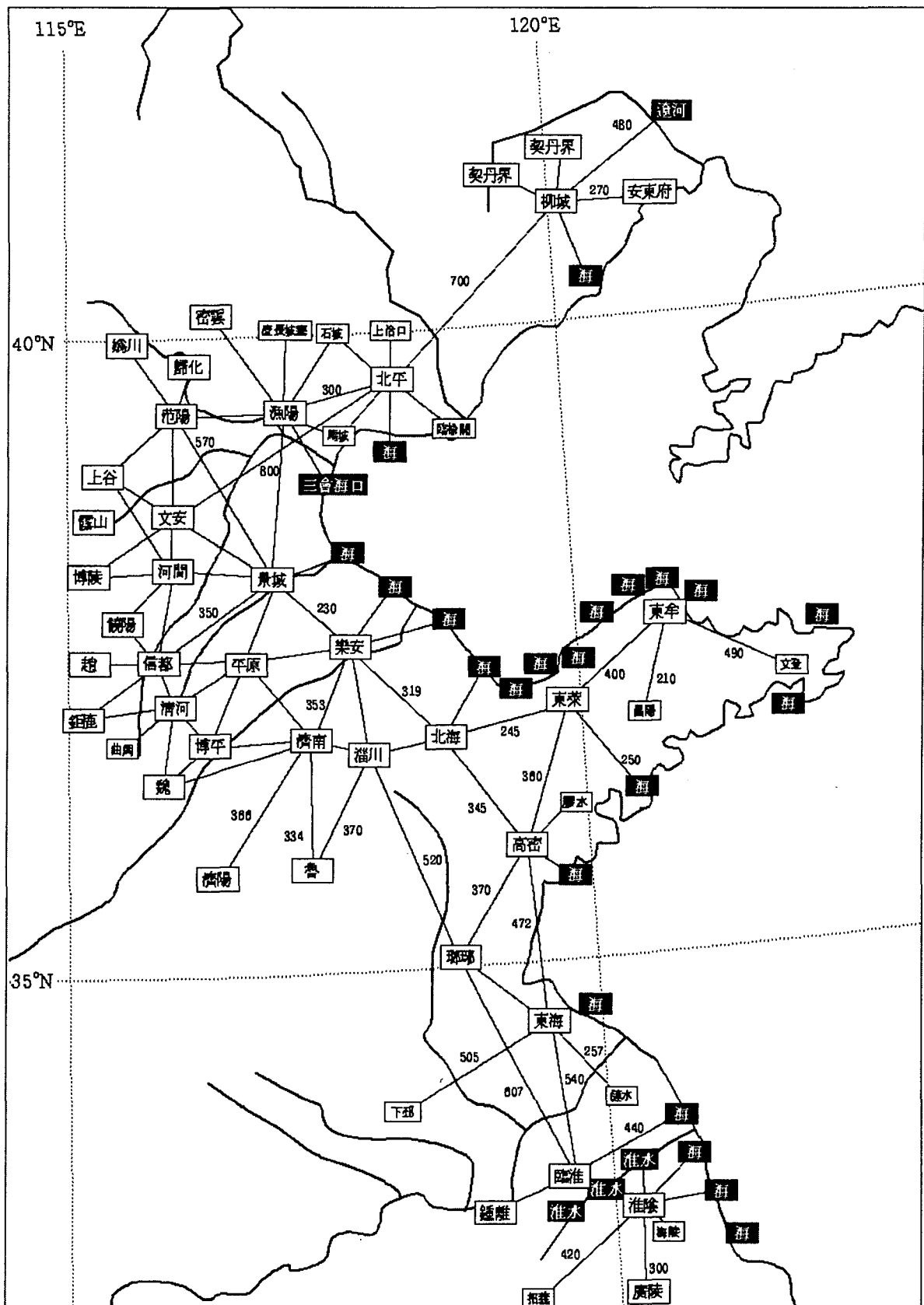


Fig. 7: Geographic network around Bohai gulf and Sandong peninsula