INVESTIGATION OF REVISION TECHNIQUES FOR 25K SCALED TOPOGRAPHIC MAPS

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ABSTRACT:

Revision of 25K topographic maps is one of the main duties of General Command of Mapping (GCM). Up to now, revision is carried out by stereo photogrammetric methods using 35K aerial photographs with different compilation systems (analogue and analytic stereo plotters, digital photogrammetric systems and analogue plotters with digital output).

Due to technological developments and increasing amount of user requirements about digital vector data, it is vital to have a national geographic database of 25K maps in 2D and 3D. In the classical revision techniques with analogue and analytic stereo plotters; elevation, hydrographical and physiographical features were collected from the previous published maps and the other features were collected completely from the stereo model. But the data collected by this technique are not suitable for the digital vector database. For this reason classical revision techniques were abandoned.

From the beginning of 2003, only digital photogrammetric systems have been used for map compilation purpose. Because of the superimposition capability of digital photogrammetric revision technique, elevation data are controlled from the digitized contour data file and the other features are collected completely. Thus, map revision period is increased.

Turkey consists of approximately 5500 25K maps. Performing this task with stereo compilation method will take approximately 12 years with the amount of digital photogrammetric systems in Photogrammetry Department, GCM. This period is very long to meet the user demands.

The aim of this project is to find an alternative map revision method, which is faster, but as effective and accurate as stereo methods. Four different compilation methods were examined by using two different scaled aerial photographs (25K, 35K). And two 25K topographic maps, which have different feature densities, were used in the project. Advantages and disadvantages of these methods and conclusions of the study are presented in this paper.

1. INTRODUCTION

1.1 Purpose of The Project

The investigation of alternative faster approaches to our revision system in order to decrease the current map compilation time was aimed in this project. But it must be as effective and accurate as the stereo methods.

1.2 Current Situation in Revision of Topographic Maps

The revision of 25K topographic maps is one of the main duties of General Command of Mapping (GCM). Turkey consists of approximately 5500 25K maps. Performing this task with stereo compilation method will take approximately 12 years with the current amount of digital photogrammetric systems in Photogrammetry Department, GCM. This period is very long to meet the user demands. Up to now, revision is carried out by stereo photogrammetric methods using 35K aerial photographs with different compilation systems (analogue and analytic stereo plotters, digital photogrammetric systems and analogue plotters with digital output).

From the beginning of 2003, only digital photogrammetric systems have been used for map compilation purpose. Because of the superimposition capability of digital photogrammetric revision technique, elevation data are controlled from the digitized contour data file and the other features are collected completely. Thus, map revision period is increased.

The revision period of a 25K topographic map with a compilation operator takes 10 workdays (=80 hours) in analogue, semi-analytical and digital systems from stereo models. The editing and control time of a 25K vector topographic map is 3 workdays (=24 Hours) and of a 25K classical topographic map is 8 (=64 hours). The resulting topographic map is handed in Topography Division for completion.

2. COMPARISON OF COMPILATION METHODS

2.1 Data Used for the Comparison

35K and 25K aerial photos (black and white) were used in the project. They were digitised in 21 micron resolution by a

precise scanner. Also, digitised contours of the related area were used.

Four different compilation methods were examined. And for compilation two 25K topographic maps, which have different feature densities, were used in the project.

2.2 Method 1: Compilation by Using Orthophotos

The orthophotos used in this method were produced by using Autometric Softplotter Software and digitised contours. The compilation was carried out from orthophotos monoscopically. The resulting map translated from KDMS (vector format of Softplotter) to DGN (MicroStation).

2.2.1 Compilation of the First Map with a Hardness Degree of 2 by Using Orthophotos from 35K Aerial Photos: The compilation was completed in 35 hours. The following problems have aroused during the compilation:

1. Wide arks were confused with constant vehicle roads and summer vehicle roads,
2. There were some problems in recognition of isolated buildings, stony and sandy places,
3. There were some confusion between perennial and intermittent streams,
4. The cuts and fills could not be detected,
5. There were some problems in defining the type of the wood and bushes,
6. The features that don't have enough width and height like hedges and wire fences could not be detected,
7. The features that are so small like wells, fountains and springs could not be detected,
8. Telephone lines and relatively narrow electrical lines could not be seen,
9. Wide electric lines could be detected in case they were in open areas.

The following results were obtained from the comparison of orthophoto against stereo compilation:

1. 43% of the bushes could not be seen and 57% of them defined as a tree,
2. The boundaries of the woods were generalised and some open areas inside the woods could not be detected,
3. 73% of the vineyards could not be seen, 22% defined as orchard and only 5% of them detected,
4. 62% of the trees could be detected,
5. 80% of the orchards are common with the stereo, 5% could not be detected, but 15% could be detected but with some different boundaries,
6. Only one of the macadamised roads in three were defined properly, 30% of the constant and summer vehicle roads were defined as track or trail,
7. 60% of the stony places could not be compiled, 15% of them defined as rocky place,
8. Only 2% of the hedges could not be detected,
9. None of the cemeteries and mosques could be detected,
10. Ruined buildings could not be detected,
11. 95% of underground oil lines could be detected,
12. 85% of perennial streams could be detected and 10% of them defined as intermittent stream,
13. Only 3% of the vents could be detected,
14. 30% of the springs could be detected.
15. The arks narrow canals could not be detected properly,
16. None of the cuts and fills could be detected

2.2.2 Compilation of the Second Map with a Hardness Degree of 4 by Using Orthophotos from 25K Aerial Photos: The compilation was completed in 68 hours. The following problems have aroused during the compilation:

1. There were displacements nearly 30 meters in high buildings when go into next orthophoto, as the building gets higher, greater the displacement,
2. The streams could not be detected in wooded areas,
3. The detection of cuts and fills were very difficult and even impossible in slightly high areas,
4. It is difficult to detect the walls,
5. Because of the height model used, there were distortions especially in newly built up areas, this situation caused border problems in neighbouring orthophotos,
6. The detection of the some buildings were difficult, some other features were perceived as buildings.

The following results were obtained from the comparison of orthophoto against stereo compilation:

1. The difficulties met are nearly the same as **2.2.1** 1 and 2,
2. 25% of the trees could not be detected,
3. 30% of the stony places could not be compiled, some of them were compiled additionally,
4. Only the 5% of the mosques could not be detected,
5. The buildings in built up areas were detected properly,
6. The cemeteries compiled properly,
7. 85% of the perennial streams were detected,
8. 40% of the springs were detected,
9. None of the cuts and fills could be detected,
10. The road lines could not be compiled properly because of building obstruction.

2.3 Method 2: Editing by Using Orthophotos

The orthophotos used in this method were produced by using Autometric Softplotter Software and digitised contours. The vector data to be base for the revision were supplied by Cartography Department in ArcInfo format. This data were converted into KDMS and then DGN format. There were some problems between the format transformations, i.e. some features were lost. And 5 hours extra editing before the compilation were done.

2.3.1 Editing of the First Map with a Hardness Degree of 2 by Using Orthophotos from 35K Aerial Photos: The compilation by editing was completed in 27 hours. The following problems have aroused during the compilation:

1. Because of the intensity of the features and inexperience of the operators, there were some difficulty in editing,
2. Because the vector data were superimposed onto the orthophotos, it was difficult to understand the feature

was really under the vector. Also opening/closing of the vector data takes too much time,
3. Deletion of the inexistent data takes too much time, also there were hardware problems arousing from high dimension of the ortophoto and vector data,
4. Definition of the type of the roads were very difficult, but this difficulty will be overcome by time,
5. Detection of stony places, arks, bridges, vents, perennial and intermittent streams were very difficult,
6. It was nearly impossible to detect the features like walls, hedges, wire fences whereas they were still difficult in stereo models,
7. There were nearly 25 and 20 meters displacement in both X and Y directions respectively.

The following results were obtained from the comparison of orthophoto against stereo compilation:

1. The difficulties met are nearly the same as **2.2.1** 1 and 2,
2. An advantage of the method was that if the revision period was short, so there were few changes. But, in our map for some watering project, the area was changed greatly. The watering system could not be detected.

2.3.2 Editing of the Second Map with a Hardness Degree of 2 by Using Orthophotos from 25K Aerial Photos: The compilation by editing was completed in 90 hours. The following problems have aroused during the compilation:

1. There were a lot of difficulties due to the lack of 3rd dimension,
2. There were 1-25 meters displacements in cartographic features,
3. Editing of these displaced features takes too much time,
4. Some high buildings hindered the some details, such as roads,
5. The detection of electric lines was very difficult except great ones,
6. There were some discrepancies between cartographic features and photogrammetric features,
7. The compilation of streams in wooded areas was very difficult,
8. The superhighways in orthophotos show cut places due to the discrepancy of digital elevation model of the orthophoto,
9. The data was very intense that it took much time to pan the view.

The following results were obtained from the comparison of orthophoto against stereo compilation:

1. The difficulties met are nearly the same as **2.2.1** 1 and 2,
2. An advantage of the method was that if the revision period was short, so there were few changes. But, in our map for some watering project, the area was changed greatly. The watering system could not be detected,
3. By the assumption of the operator that cartographic features were in correct placement, even necessary editing was not done.

2.4 Method 3: Editing by Using Stereo Models

In this method, stereo models were produced in Softplotter software automatically by using the results of the triangulation. The data to control was prepared by the Cartography Department in ArcInfo format. Then they were imported into KDMS format. Two dimension data were converted into 3D by using existing digital elevation model. The resulting map was converted into MicroStation DGN.

2.4.1 Editing of the First Map with a Hardness Degree of 2 by Using Stereo Models from 35K Aerial Photos: The compilation by editing was completed in 20 hours. The following problems have aroused during the compilation:

1. There were some problems because of the conversion,
2. Some 3D problems in the features converted from 2D appeared during stereo editing due to discrepancy of the existing digital elevation model.

The following results were obtained from the comparison of editing against stereo compilation:

1. The problems aroused in other methods related with detection were not met,
2. The method was successful except some 3D faults.

2.4.2 Editing of the Second Map with a Hardness Degree of 4 by Using Stereo Models from 35K Aerial Photos: The compilation by editing was completed in 45 hours. The problems aroused were the same as **2.4.1** during the compilation.

The following results were obtained from the comparison of editing against stereo compilation:

1. The problems aroused in other methods related with detection were not met,
2. The method was successful except some 3D faults.
3. By the assumption of the operator that cartographic features were in correct placement, even necessary editing was not done.

2.4.3 Editing of the Second Map with a Hardness Degree of 4 by Using Stereo Models from 25K Aerial Photos: The compilation by editing was completed in 72 hours. The following problems have aroused during the compilation:

1. The features had nearly 20 meters displacements especially in rapidly changing areas,
2. An area of 7 km² was compiled from the beginning,
3. 25K scale made easy the detection in revision.

The results are the same as the **2.4.2** in comparison of editing against stereo compilation.

2.5 Method 4: The Compilation by Using 25K Stereo Models

In this method, stereo models were produced in Softplotter software automatically by using the results of the triangulation. The compilation was completed in 75 hours. Here are the some results:

1. The detection of the features was easy than 35K stereo models,
2. The intensity of the data made difficult working in the existing software and hardware.

The following results were obtained from the comparison of 25K stereo compilation against 35K stereo compilation:

1. The compilation time increased owing to the excessive amount of details detected,
2. There were some confusion between narrow electric lines and telephone lines,
3. Nearly all the details that cannot be seen in 35K could be seen, i.e. tracks, paths, narrow roads, telephone lines.

3. CONCLUSION

Map	First Map	Second Map (35K)	Second Map (25K)
Hardness Degree	2	4	4
Production Criteria (hour/map)	48	80	
Stereo Editing	20	45	72
Orthophoto	35	-	68
Orthophoto Editing	27	-	90

Table 1. The results obtained from the methods

It was seen in the project that it is less time consuming to produce maps by editing the existing features on stereo models. But the features collected cartographically have some errors nearly 1 mm (it means 25 meters in 25K). So the problems will be carried to the future by editing them with this error.

Less time consuming editing by using orthophotos method will cause some mistakes and missing details due to the lack of 3rd dimension. It also has some errors originating from digital elevation models that are not up-to-date. If the features of 25K scale maps are collected properly from the stereo models, then the next revision will be very effective by editing on the orthophotos.