DRAWING UP OF FIREWORKS VIEWING AREA MAP

Tosio KOIZUMI
Dpt.of Civil Eng., Chiba Institute of Technology
2-17-1,Tsudanuma,Narashino-shi,Chiba 275,Japan

Kunihiko ONO
Chuo Mapping Co,Ltd,Japan

Hideaki KAWASAKI
Tokyo Metropolitan Government,Japan

Commission V, Working Group 2

KEY WORDS : Cartography, CAD, Information, Photography, Close-Range, Thematic Mapping, Fireworks

Abstract :

The objective of this study is to draw up a fireworks viewing area map. This map shows area where fireworks can be seen well. The technical term "fireworks viewing area map" is first used in this paper. On drawing up the maps, aerial photographs are taken from a height over the spot for fireworks by a kite ballon camera system. The area from where fireworks can be seen well is the same area taken by aerial photography. The paper draws up the fireworks viewing area map of Narasino city. Accuracy of the map was checked by some students during the exhibition of fireworks. The fireworks viewing area map measures 40cm by 30cm and has multicolor printing.

1. Introduction

Fireworks were introduced into Japan with fire techniques in general by Netherlander or Portuguese in the Tensho era (from 1573 to 1592). Fireworks of the Sumidagawa River in Tokyo, so-called fireworks of Ryogoku have been continued for about 260 years since the Edo era until today excluding the time of emergency, as a downtown summer event. The start of this event was in Kyoho 17th (1732) under the goverment of the 8th Shogun of Tokugawa Shogunate, Yoshimune Tokugawa. Because in the previous year of the start, there occurred a great famine of Kyoho all over Japan, plagues were prevalent and there were many fires around the same time, fireworks were let off around the Ryogoku bridge at the eve of the opening of the Sumidagawa River as an event to sweep evil spirits away by light and sounda. Since then, fireworks of Ryogoku have become a feature of Edo as an evening festival of the opening of the river. The river opening means to open the Sumidagawa River, which is used for traffic and transportation, for citizens to enjoy the evening cool during summer. From the edo era, fireworks of Ryogoku have increased their magnificence year after year, and splendid fireworks worked out elaborately by producers were praised by viewers with shouts of "Kagiya" and "Tamaya" (names of producers), just as a remarkable attraction of Edo. Set fireworks were devised in various ways, and in the Meiji era (from 1868) blue, yellow and other colors were applied anew to fireworks to have made them colorful which had been limited till then to red and white ones.

Fireworks are originally a useless thing, into which one ivests an immense sum of money to see momentary beauty, but doing-nothing and uselessness of them lead to human pleasure to live. And the spread of the dark sky after the end of fireworks may give sensible people a feeling of a plenty of sadness after the climax of amusement. Other than around the Sumidagawa River, fireworks are set off also in Senju, Shibamata and around the Tamagawa River in Tokyo and give pleasure to firework fans. Similarly, in various local cities, large-scale firework events are held during summer, and several tens of thousands of spectators gather there . People gathering in a firework event drop in night stalls and enjoy a stroll in summer evening with their families and colleagues. Fireworks are indeed a routine event of Japanese ordinary people.

This paper drew up a fireworks viewing area map that describes where fireworks can be seen well using photogrammetry on the basis of the above japanese cultural factors relating to fireworks. In this paper, the fireworks viewing area map was drawn up to the level of a thematic map from the geographical point of view, unlike a recreational illustration map. Information on the fireworks viewing area is useful information to establish the site for the festival, control traffic, guards, location to see fireworks for the host organization and spectators.

On drawing up the maps, mosaic aerial photographs with a 360 degree visual field are taken from a height over the spot for fireworks by a kite balloon camera system. The area from where fireworks can be seen well is the same area taken by aerial photography. This method has many advantages: for example, it can survey without much assistance and can get plane information, furthermore the state of affairs is recorded in photographs so that the work of drawing up a map is easy to do. The paper draws up the fireworks viewing area map of Narashino city.

2. Outline of Narashino City fireworks display festival

Narashino city is a middle seaside town near Tokyo. The population is 150,000. Narashino city opens a fireworks display festival for the citizens of Narashino city, under the sponsorship of Narashino city government as a yearly event in summer. The place for the fireworks display festival is seaside reclaimed land in the city. Around the place, there are warehouses, offices, residential streets, parks, vacant lots, a public cemetery etc, and multi-storied buildings of companies and a university lie scattered around.

In 1995,the fireworks display festival was opened on the 30 of June and so many citizens flocked to the place for the fireworks display festival. The faraway citizens were transported to the place by shuttle bus sent by the city office. The sum of displayed fireworks is 4,500, made up as follows: grand-scale fireworks 1,226, skyrockets 33, set piece of fireworks one, etc. Fireworks display spot height is from about 100m to about 150m. Figure.1 shows the state of the place of Narashino city fireworks display festival.

3. Aerial Photograpy using a Kite Balloon

3.1 Observation system

This system was developed for the purpose of taking oblique aerial photographs from a height over the spot for fireworks by the authors. Figure.2 shows outline of this system. This system is composed of following elements

- Balloon;14m ^{3},helium gas
- String;1,000 meter
- Still camera;35mm,wide angle,f = 28mm(Canon T70)
- Monitor camera;Sony CCD camera
- Radio control;Shutter,monitor and angle control
  - —Horizontal 360 degree
  - —Vertical ±90 degree
- Total payload;7,0kg

Fig .1 Place of fireworks display festival

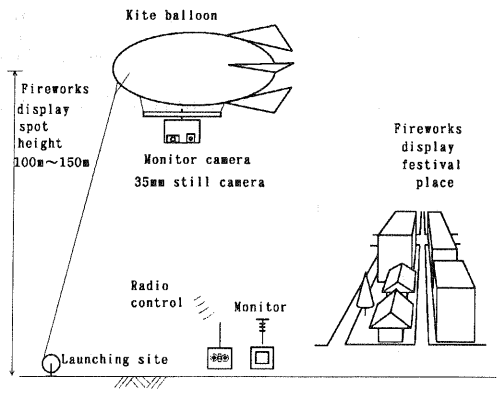


Fig.2 System Outline

3.2 Aerial Photograpy using a Kite Balloon

We took oblique aerial photographs utilizing a kite balloon camera system using a 35 mm servo-controlled camera that was developed by the authors. The oblique aerial photographs were taken from a height over the spot for the fireworks display from 100 m, 120m and150 m high. Figure.3 is the photographing scene. Figure.4

shows the photo-mosaic made from the aerial photographs.

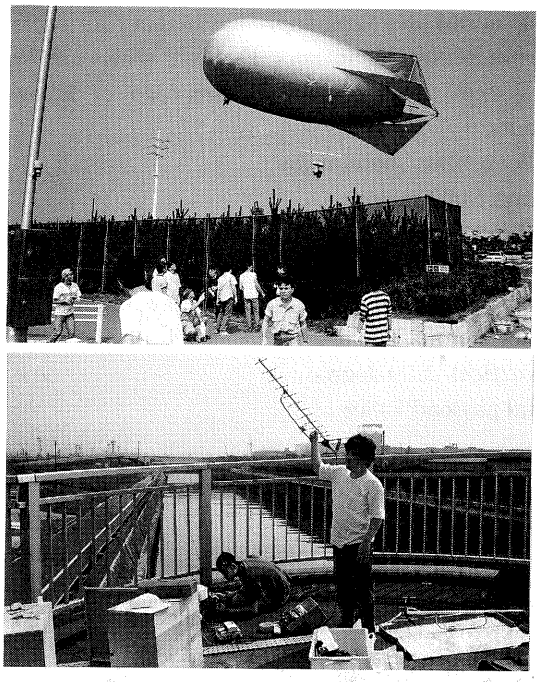


Fig.3 Photograpling scene

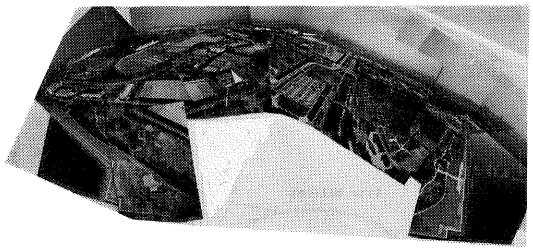


Fig.4 Photo-mosaic from aerial photographs

4. Drawing Up of Fireworks Viewing Area Map

During the drawing up of the maps, firstly, definition on the fireworks viewing area map was given and some rules for drawing up of the map were decided. Secondly, an experimental map was drawn up following the rules. The experimental map was drawn up before the open day of the fireworks display festival. In the third step, verification of reliability for the experimental map was done by some students on the day of the fireworks display festival. In the final step, the fireworks viewing area thematic map was drawn up.
The items in each step were carried out as follows:

4.1 Definition on the fireworks viewing area map

Fireworks viewing area map is a map showing the area where the fireworks can be seen well.

4.2 Policy on drawing up of the map

1) The area where fireworks can be seen well is a zone where can be seen all the shot up fireworks and within about 2km from the launching site of the fireworks. There we can get a view of distant small fireworks, which is not a good area for a fireworks viewing area. The numerical value of 2km should be decided by the scientific method,however it is very difficult, so its value was decided by empirical knowledge in this paper.
2) The treated area is within the limits of Narashino City.
3) The area where the citizens have not access, and unsuitable areas i.e.,cemetery, etc.is not a fireworks viewing area even if the fireworks could be seen.
4) Visibility from windows of buildings excluded, and visibility only from the ground included.
5) The fireworks viewing area needs to be confirmed in either of photographs taken from a height of 100 m,120 and 150m of fireworks display.

4.3 Drawing up of the experimental map on the fireworks viewing area map

The areas from where fireworks can be seen well was drawn up on a topographic map drawn on a scale of 1 - 2,500 under the provisions of the above policy by manual utilizing oblique aerial photographs taken from the height of the spot for fireworks display. The size of the used photographs were approximately from 12× 8cm to 25×20cm.

4.4 Verification of reliability for the experimental map

The reliability on the experimental map was checked by some students at 13 spots for the experimental map at the day of the fireworks display festival. The 13 spots are shown by white and black circles symbols in figure 5. The pairs of students were stationed in their respective posts at the spots from where fireworks can be seen and from where fireworks can not be seen. Each group of students checked whether or not fireworks can be seen in concert with each other.

Four parties of pairs were made, and they moved to several spots after investigation for some time at one spot. The head number of circle symbol in figure 5 is the party's number. The results of the check were filled in on the data sheet with times. Furthermore, the students who were in sight of fireworks took as many

photographs as possible of fireworks and recorded the time. Figure.6(a) shows a photograph from among them. Figure.6(b) shows a photograph taken for the same spot of figure.6(a) in the daytime. Table.1 shows the data sheet. In table 1, the circle symbol is a correct, the cross symbol is a fault and the triangle symbol is a neutral. A neutral is a judgment which is interpreted as a partial sight of the fireworks. From table 2,the percentages of correct interpretation at the estimated fireworks viewing area and the un-estimated fireworks viewing area were 97 percent and 77 percent, provided that the triangle symbol is counted of 0.5 marks per one mark.

Judgment at the un-estimated fireworks viewing area had less reliability than at the estimated area, because the result of photo interpretation is information of central projection but the result confirmed on the ground by students is not information of central projection. Information of central projection is information seen from one spot in the sky, but information checked by students is information regarding the extent of the fireworks. These facts can be seen in table.2, because the number of cross symbols in the cross column in the section of the un-estimated fireworks viewing area is 0 percent. In table 2, the results of verification were highly reliable.

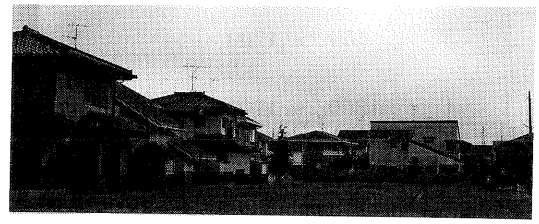
Table.1 Data sheet on verihication of reliability

Observation persons' names 4 squads Sat.30 July,1995

Check point	Verified time	Estimated fireworks viewing area		Consid-eration	Un-estimated fireworks viewing area		Consid-eration
		correct (can see)	fault (can not see)		fault (can see)	correct (can not see)	
4		○				○	
|	7:50pm	○		1)		○	2)
1		○				○	
		○				○	
		○			△		
		○			△		
	8:20pm	○			△		
4		○			△		
|	~	○			△		3)
2		○			△		
		○			△		
	8:27pm	○			△		
		○			△		
		○			△		
4		△				○	
|	8:30pm	△		4)		○	5)
3		△				○	
		△				○	

1)Good visibility
2)Poor visibility owing to the trees
3)Could see upper partial sight of fireworks but could not see lower partial sight of fireworks owing to the houses and trees
4)Could not see lower partial sight of fireworks
5)Poor visibility owing to the houses and trees

(a) Photograph taken when verification of reliability was made



(b) The place in the above photograph(a) in the daytime

Fig.6 Fireworks and surrounding view at a check point (check point)

4.5 Final fireworks viewing area map

The results of verification on the experimental map were highly reliable, so that the final map was drawn based on the experimental map. A map drawn on a scale of 1 to 10,000, the size being about 42cm×30cm, was used because a map drawn on a scale of 1 to 2,500, the size being about 90cm×60cm,is bulky to carry about. The map that only showed the estimated fireworks viewing area is unattractive and posed some questions, for example, why is the area indicated as an area not for fireworks viewing, when it does not recognize the existence of structures which obstruct the view, or much information such as green tracts of land, rivers, public service, cemetery etc was shown in the map. Hereby, a clear, understandable and portable map was made. Figure.7 shows the final fireworks viewing area map.

5. Conclusion

This paper drew up the fireworks viewing area map as the first thematic map in Japan. This method was confirmed as an effective drawing-up method. We will continue to make fireworks viewing area maps throughout the country. Furthermore, this method can be applied in variousways in fields such as urban view planning etc.

Table.2 Result of verification of reliability

Party number	Distance from launching site (m)	Checked fireworks number (numbers)	Estimated fireworks viewing area			Un-estimated fireworks viewing area		
			○	△	×	○	△	×
1	700 ～ 1100	24	100 % (24)	0 % (0)	0 % (0)	67 % (18)	23 % (6)	0 % (0)
2	1300 ～ 1700	18	100 % (18)	0 % (0)	0 % (0)	61% (11)	29 % (7)	0 % (0)
3	450 ～ 1700	8	100 % (8)	0 % (0)	0 % (0)	0 % (0)	100 % (8)	0 % (0)
4	1300 ～ 1700	18	78 % (14)	22 % (4)	0 % (0)	44 % (8)	56 % (10)	0 % (0)
Total		68	94 % (64)	6 % (4)	0 % (0)	54 % (37)	46 % (31)	0 % (0)

1) Numerical value in parentheses is observation data number

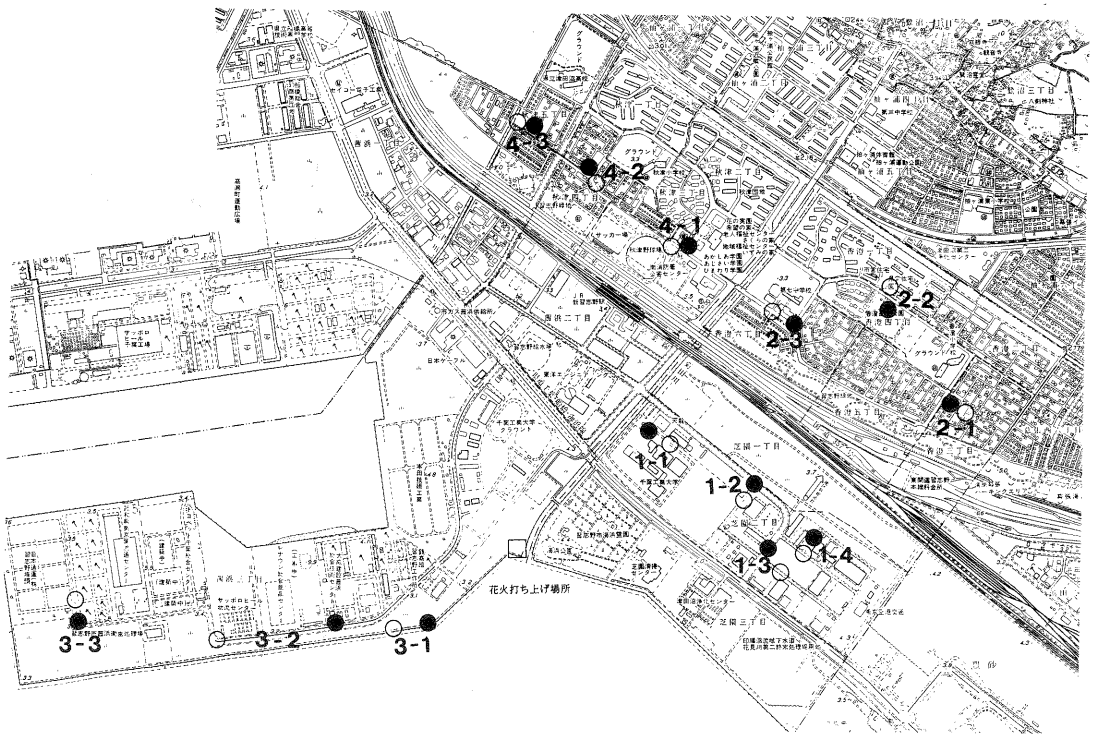
2) Symbol in column of estimated fireworks viewing area
   ○ : Could not see sight of fireworks
   △ : Could see only partial sight of fireworks
   × : Could see perfect sight of fireworks

3) Symbol in column of un- estimated fireworks viewing area
   ○ : Could see perfect sight of fireworks
   △ : Could see only partial sight of fireworks
   × : Could not see sight of fireworks

Estimated fireworks viewing area
{ 64 + (4 / 2) } / 68 = 97 %

Un-estimated fireworks viewing area
{ 37 + (31 / 2 } / 68 = 77 %

Note:Triangle symbol is counted of 0.5 marks per one mark



Legend
● Check point at the estimated fireworks viewing area
○ Check point at the un-estimated fireworks viewing area

Fig.5 Spots of verification of reliability and launching site