

Traffic Accident Site and Photogrammetry : Present Status of Photogrammetry Applied to Traffic Accident Sites in Japan

大嶋, 太市 / 小山田, 清 / Oshima, Taichi / OYAMADA,
Kiyoshi

(出版者 / Publisher)

法政大学工学部

(雑誌名 / Journal or Publication Title)

法政大学工学部研究集報 / 法政大学工学部研究集報

(巻 / Volume)

25

(開始ページ / Start Page)

65

(終了ページ / End Page)

71

(発行年 / Year)

1989-02

(URL)

<https://doi.org/10.15002/00003931>

Traffic Accident Site and Photogrammetry

—Present Status of Photogrammetry Applied to Traffic Accident Sites in Japan—

Taichi OSHIMA* and Kiyoshi OYAMADA**

1. Introduction

The first technique for measuring traffic sites was adopted on a small scale by the police department at Zurich, Switzerland in 1933, Germany in 1935 and Italy followed in part. In Japan, the police headquarters in Saitama Prefecture, one of 47 administrative divisions in Japan, adopted this technique in 1967, followed by Kanagawa, Osaka, Hiroshima and Okayama.

In 1967, the Saitama Prefecture police headquarters sent three policemen for training regarding the photogrammetric technique at a traffic site to the Institute of Industrial Science, Tokyo University. This training continued for six months with practical experiments at actual traffic sites. The application of this photogrammetric method for analysis of traffic accident sites proved to be very effective.

The national police agency in Japan formally adopted this method and established an organization at each prefectural police headquarters. At the same time, they allocated the necessary funds for the program and offered a training course in Tokyo, twice a year, for leaders in the 47 prefectures. The course continued for about 10 days and included lectures and practical applications.

In 1971, all prefectural police headquarters adopted this method at actual traffic sites and carried out the program throughout Japan.

As of 1987, there were 303 stereo-cameras, 68 stereo-plotters and several analytical plotters for performing measurements at the traffic sites and also special police cars in which all necessary instruments were set up. The photogrammetric method proved to be superior to the conventional one, using direct measurements.

The following is a list of positive points:

- (1) The photo-taking results are permanently kept and reproduces the pictorial scene and checks the data at any time.
- (2) The accuracy of measurements were almost the same over the entire area of photo-taking sites with good results being obtained.

* Prof., Dr. of Eng. College of Eng., Hosei University, 3-7-2, Kajinocho, Koganei City, Tokyo 184

** Chief, Traffic Enforcement Division, Traffic Bureau, National Police Agency,

- (3) The necessary time for stopping traffic vehicles at accident sites can be reduced drastically.
- (4) The drivers pay special attention to their driving because of the psychological effect that this very accurate system generates.

The main reason for adopting this photogrammetry for accident sites is that traffic accidents are increasing every year and the Bureau needs to save time at accident sites, and to maintain the reasonable accuracy in making the cause of an accident clear, especially for court judgement.

Nowadays, the use of photogrammetry is expanding to more and more areas within the police bureau, because of the high accuracy of the results. This technique is used not only at traffic accident sites but also at criminal sites, airplane and train accident sites and great fire sites. It has also a special use for estimating car speed from the results of measuring the body strain caused by the auto collisions. Due to the increasing number of accidents, these sites of fatal accidents were mapped photogrammetrically and sent to the court with field survey documents and in the case of slight injury, photos are submitted with this conventional documentation. Frequently, accident sites were mapped beforehand for later use for actual accident reporting.

2. Organization and System

At the first stage, the National Police Agency had the initiative to organize police activities, system development and distribution for the national budget. Since the general training course was completed in each prefecture, the technique of measuring at the accident sites had been executed in each prefectural police agency and application programming has been also promoted at several prefecture police headquarters. Therefore, the National Police Agency is now the liaison and planning office of each prefecture and the office to promote new advanced technology and also to carry out training seminars.

The accuracy of the field direct measurements with tapes relies upon personal skill, but the photogrammetric method comparatively does not include personal errors and constantly maintains accurate mapping. As the authors have described here, the time of traffic congestion at an accident site is minimized.



Photo. 1. Specially designed police motorcar for photo-taking
(Courtesy of Saitama Prefecture Police Headquarters)

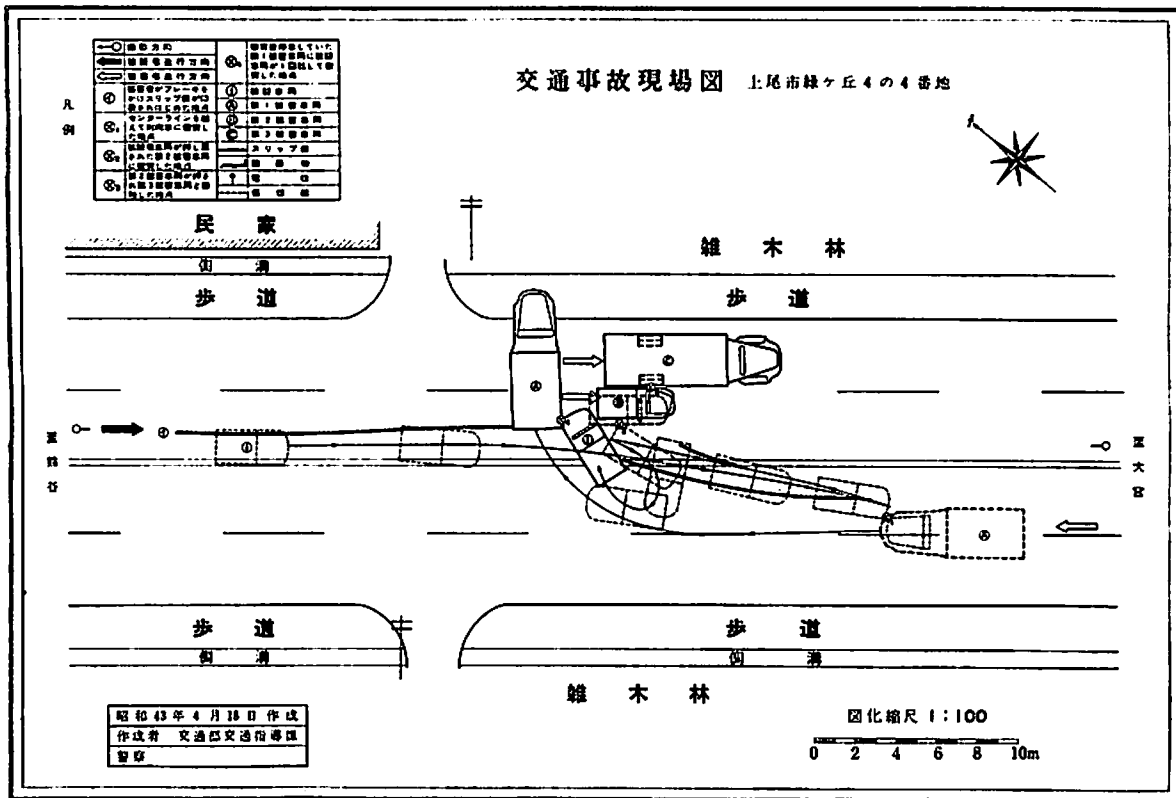


Fig. 1. Mapping at accident site (Courtesy of Saitama Prefecture Police Headquarters)

2.1 Stereometric Camera and Plotting Instrument

The stereometric cameras used by the police in Japan are short-base dual cameras which are rigidly fixed at the two ends of a base-tube. The camera are arranged with parallel axes which are normal to the base-tube. When the clamps holding the base-tube can be rotated and tilted, i. e., the direction of photo-taking can be chosen at will, with the camera axes still remaining normal to the base. Such camera setups are found to be convenient and almost universal for police applications. The camera pointings are equipped with viewfinders provided with cameras. The vehicle, manned by two officers, is fully equipped with photo-taking and photo-processing facilities along with flood-lighting equipment as may be necessary for photo-taking in darkness.

Presently, there are a total of 303 cameras being used in police work of which around 70 cameras are made by Zeiss, Wild and Sokkisha and about 230 cameras by Asahi Co., Ltd. The distribution of these cameras in the various prefectures depends on their workload. Sometimes these are transferable within a prefecture. Some examples of such distributions are (as in 1986) Osaka Prefecture, 21; Saitama Prefecture, 32; Kanagawa Prefecture, 18; Tokyo Metropolitan, 8; and Aichi Prefecture, 13.

Most of these cameras have a 120-cm base and are generally used in jobs requiring stereoplotting. For providing additional information and in circumstances requiring very close-range data acquisition and documentation, camera with 20-cm and 40-cm bases are also used.

Of the total 68 (in 1987) stereoplotting instruments used by the police in Japan, around 42 were made by Asahi Co., Ltd. with trademark of Asahi-Wild, 45; Sökkisha, 16; Nikon, 4; and Zeiss, 3. All of these instruments are capable of yielding three dimensional data of continuous map compilation. Currently, because of the need for a more fully digital type, Pentax Co. developed PAMS (Photogrammetric Analytical Measurement System) and Koei Densi Co., Ltd developed PHOCAS (Photogrammetrical Coordinate Analizing System). The both use not only a metric camera, but also a 35-mm camera specially developed for this schemes.

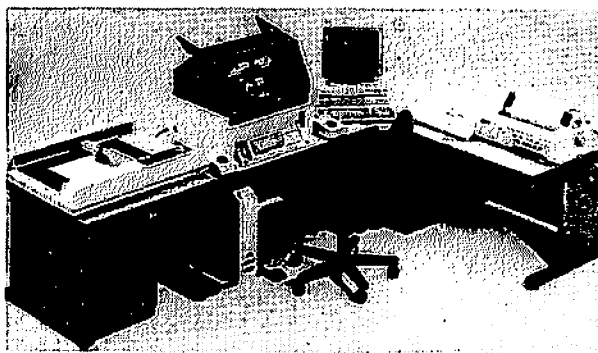


Photo. 2. PAMS (Photogrammetric Analytical Measurement System)

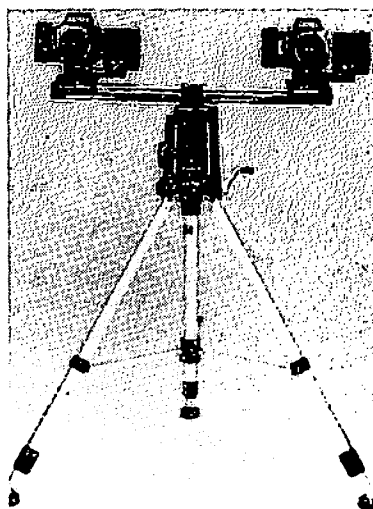


Photo. 3. Specially designed Stereometric Camera
(Asahi Pentax PAMS 645)

2.2 Traffic Accident and Photogrammetry

Unless specially demanded otherwise, all stereo compilation is carried out at a scale of 1:200 with contouring being optional. The extent of police work in the country can be imagined from the 1986 statistics. That year, of the total 579,190 accidents, around 50% (288,213 accidents) occurred in the areas equipped with stereocamera. The participation of police cars with stereo-camera were 169,931 in number and a total of 52,647 photo-pairs were taken of which actually 20,487 scenes were mapped, with numbering 38.9% off total pairs. These plotted maps are used for the use of various courts. There were invariably

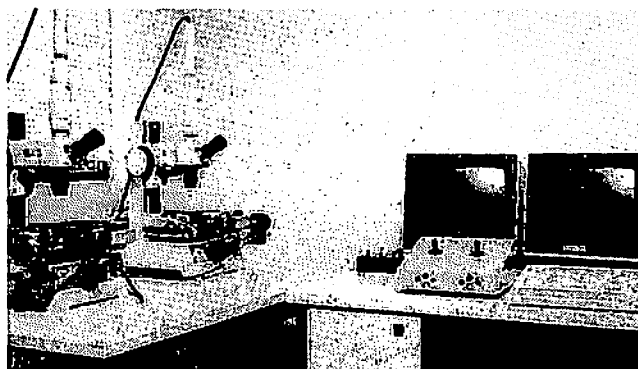


Photo. 4. PHOCAS (Photogrammetrical Coordinate Analizing System)

submitted with field measurement of various types as deemed necessary for disposal of cases. The photogrammetric operations of the police in Japan, although initially discouraged by the legal profession, now seem to enjoy considerable support from the judiciary department.

Japan is divided into 47 administrative divisions (like states in the U. S.) known as prefectures. The total police force in the country is around 220,000 of whom approximately 2,600 are engaged in photogrammetric work. Of these, about 200 are photogrammetric operators, mostly civilians, with roughly 30 percent being uniformed police officers.

3. Analysis results of Mapping

Normally mapping at accident sites at a scale of 1:200 is standard, differ on a case by case basis regarding special jobs, especially for the mapping case for airplane explosions, train collision sites and explosion sites of chemical factories. The mapping accuracy is closely related to the photo-taking conditions, operating instruments and operator's skill. In general, mapping accuracy is normally ± 0.2 mm on the map within the range of 4 to 20 times of base length, that means, ± 4 cm in actual length at a scale of 1:200. In case of an analytical measuring system, accuracy of reading on the plate is $\pm 5 \mu\text{m}$ for PAMS and $\pm 1 \mu\text{m}$ for PHOCAS. Accuracy is related to the control point position and their

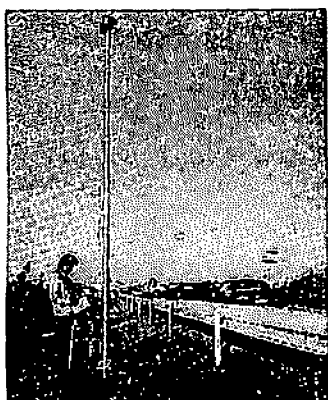


Photo. 5. Specially designed Photo-taking system lifting up to 7.5 m

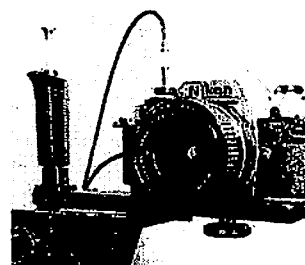


Photo. 6. Nikon FG metric camera

arrangement, especially mark itself is a big cause of error. The Police Agency made up the marks so that they can be seen and measured easily.

To raise up the efficiency, specially designed motorcars which can carry the stereo-cameras are being used. This has automatic controlled elevating system which are connected to the simbal to raise and lower of cameras in a car mechanically after the roof of car opens. At night, a flash gun or specific strobe (guide no. 400) is used to take the photos.

4. Conclusion and Remarks

Seven years has already passed since the national project has started. There are big differences in use depending on the prefecture, some are very active and a few prefectures are dull because of knowledge in photogrammetry and training and also camera and plotting machines are very expensive and take time to master. The regular operations take

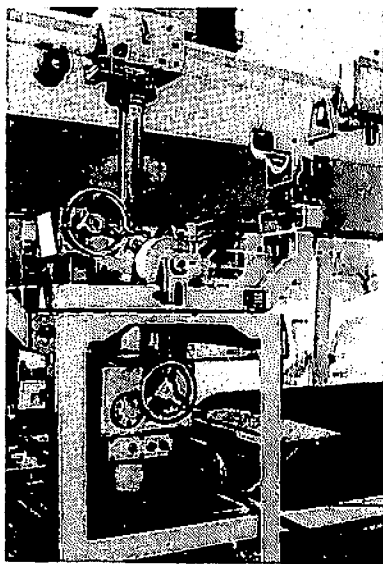


Photo. 7. Mechanism for Raising/lowering a Stereometric Camera in an Accident Disposal Vehicle with Police Department

around 0.1 percent of the total police budget every year in the country. Some cost samples are ¥3.0 million for one stereometric camera with accessories; ¥4.0 million for one special vehicle; and ¥6000 for 12 glass plates.

The experience that the police in Japan have had, resulted in the raising of the scientific management power among the police. But in actual works, there are several problems proposed by each prefecture as shown in followings :

- (1) Deterioration of the camera and plotting machines
- (2) Lack of good technicians for photo-taking and plotting
- (3) Price increares for necessary materials
- (4) Photo-taking trouble at snow and raining areas
- (5) Careless usage of cameras on the road by policemen

(6) Traffic troubles in the down-town area during photographing because of a shortage of policemen

Under the above-mentioned items, the national police agency has started the training course of photogrammetry for traffic accidents again 3 years ago. A seven-day intensive course in photogrammetry and its application is given to all participants. One person per one prefecture is invited to attend this course at national government expense. The text includes not only photogrammetry and its application to police work and judicial treatment, but also machine principle and modern technology of photogrammetry, which are the total system of analytical way using a computer and comparator. The analytical measuring system will become popular in future. There will be more multiplied applying way increased to solve the trouble related to the police. The PAMS (Photogrammetric Analytical Measurement System) is already on the market and 10 instruments are used for police work in Japan.

Acknowledgement

The authors are very indebted to Mr. Tohru Shiota and Mr. Kazumi Akiba, chief associate of Traffic Enforcement Division, Traffic Bureau, The National Police Agency and would like to thank to Mr. Saito, Asahi Optical Corporation, who provided a lot of valuable material.

The authors would like to acknowledge the valuable support and advice rendered by Prof. Dr. S. Ghosh, Laval University, Canada and also would like to thank Mr. Haruo Kobayashi, Police Inspector Traffic Bureau, The National Police Agency, for provided assistance during this research work.

Reference

1. T. OSHIMA, Theory and Practice of Terrestrial Photogrammetry Chap. 6, pp. 235-270, Modern Surveying Technology Vol. 7, Japanese Surveying Association, 1986.
2. T. OSHIMA, Utilization of Photographic Information, Journal of Japan Society of Civil Engineers, 1976.
3. Prof. S. GHOSH, Photogrammetry for Police Use: Experience in Japan, Journal of American Society of Photogrammetric Engineering and Remote sensing, Vol. 46, No. 3, March 1980, pp. 329-332.
4. Mr. M. Ueyama and others, Traffic Accident and its Field Surveying and Appraisal, Gijutsu Shoin Pub. Co. 1986.