

Traffic Accident Site and Photogrammetry  
- Present Status of Photogrammetry applied to Traffic  
Accident Site in Japan -

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1. Introduction

The first technique for measuring the 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 Headquarter in Saitama Prefecture, one of 47 administrative divisions in Japan, adopted this technique in 1967, followed by Kanagawa, Ohsaka, Hiroshima & Okayama.

In 1967, the Saitama Prefecture Police Headquarter sent three police men for training of photogrammetric technique at a traffic Site to Tokyo University, Institute of Industrial Science. This training continued for six monthes with practical experiments at actual traffic sites. The application of this photogrammetric method for analysis of traffic accident sites has proven to be effective.

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

In 1971, all Prefecture Police Headquarters adopted this method at the actual traffic sites and executed the program in all Japan.

As of 1987, there are 303 stereocameras, 68 stereo-plotters and several analytical plotters for measuring at the traffic sites and also specific police cars in which the necessary instruments are set up. The photogrammetric method is superior to the conventional one, using direct measurement.

Following is a list of positive points :

- (1) The photo-taking results are kept forever and reproduces the scene and checks the data at any time.
- (2) The accuracy of measurementnts are almost the same over the entire area of photo-taking sites with good results.
- (3) The necessary time for stopping traffic vehicles at the accident sites can be reduced drastically.
- (4) The drivers pay special attension to their drive because of the psychological affect 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 the accident sites, and to maintain the reasonable accuracy in making the cause of accident clear, especially for the 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 the traffic accident sites but also the criminal sites, airplane & train accident sites and great fire sites. It has also a special use for estimating the car velocity from the result of measuring the body strain caused by the auto-collision. Because of increasing accidents, these sites of fatal accidents, were mapped by photogrammetry and sent to the court with field survey documents and in the case of slight injury, photos are submitted with these conventional documentation. Frequently, accident sites were mapped before-hand for later use in actual accident reporting.

## 2. Organization and System

At the first stage, the national police agency had the initiative to organize the police activity, 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, have been executed in each prefectural police agency and application programming has been also promoted in several prefecture police headquarter. Therefore the national police agency is now liason and planning office of each prefecture and the office to promote the new advanced technology and also to execute the training seminar.

The accuracy of the field direct measurement with the 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 the accident site is minimanized.

### 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 photgraphing can be chosen at will, the camera axes still remaining normal to the base. Such camera set-ups are found to be convenient and almost universal in police applications. The camera pointings are facilitated with view-finders provided with cameras. The vihicl, manned by two officers, is fully equipped with photographing and photo-processing facilities along with flood lighting equipment as may be necessary for photographing in darkness.

Presently, there are a total of 303 cameras in police works of which around 70 cameras made in Zeiss, Wild and Sockisha and about 230 cameras Asahi Pentax made ( manufactured by Asahi Co. Ltd ). The distribution of these cameras in the various prefectures depends on their work load. Sometimes these are transfer-

able within a prefecture. Some examples of such distributions are ( as in 1986 ) Ohsaka Prefecture, 21; Saitama Prefecture, 32; Kanagawa prefecture, 18; Tokyo Metropolitan, 8; and Aichi Prefecture, 13.

Most of these camera 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 as 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 are made by Asahi Co.Ltd.with trade mark of Asahi-Wild, Sockkisha, 16; Nikon, 4; and Zeiss, 3. All of these instruments are capable of yielding three dimensional data of continuous map compilation. Currently, several of them are fully digital, Pentax Co. developed PAMS ( Photogrammetric Analytical Measurement System ) and KOEI, DENSI Co. Ltd developed PHOCAS (Photogrammetrical Coordinate Analizing System ). The both use not only metric camera, but also 35 mm camera specially developed for this schemes.

## 2-2. Traffic Accident and Photogrammetry

Unless specially demanded otherwise, all stereo compilation is done 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, being a total accident of 579,190 and around 50% of the total accidents ( 288,213 accidents ) are number of accidents which occurred in the areas equipped with stereocamera. The participation of police car with stereo-camera are 169,931 in number and a total of 52,647 photo-pairs were taken of which actually 20,487 scenes were plotted/mapped, that is 38.9 of total-pairs. These plotted maps are used for the use of various courts. There were invariably submitted with supporting field ( ground ) 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.

Japan is divided into 47 administrative divisions ( like a state in U.S.A. ) known as prefectures. The total police force in the country is around 220,000 of whom approximately 2,600 are engaged in photogrammetric jobs. 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 the accident sites at a scale of 1:200 is standard, but, but different case to case in special jobs, especially for the mapping case of airplane explosion, train collision site and explosion sites of the chemical factory. The mapping accuracy is closely related to photo-taking conditions, operating instruments and operator's skill. In general, mapping accuracy is normally  $\pm 0.2$  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 analytical measuring system, accuracy of reading on the plate is + 5 um for PAMS and + 1um for PHOCAS. Accuracy is related to the control points position and their arrangement, especially mark itself is a big cause of error. The police Agency made up the marks so that can be seen and measured easily.

To raise up the efficiency, specially designed motorcar which carry the stereo-camera are being used. This has automatic controlled elevating system which are connected to the simbal in order to raising and lowing of cameras in a car mechanically after the roof of car opens. At night, the flush gun or specific strobo (guide no. 400) are managed to make the clear photos taking.

#### 4. Conclusion and Remarks

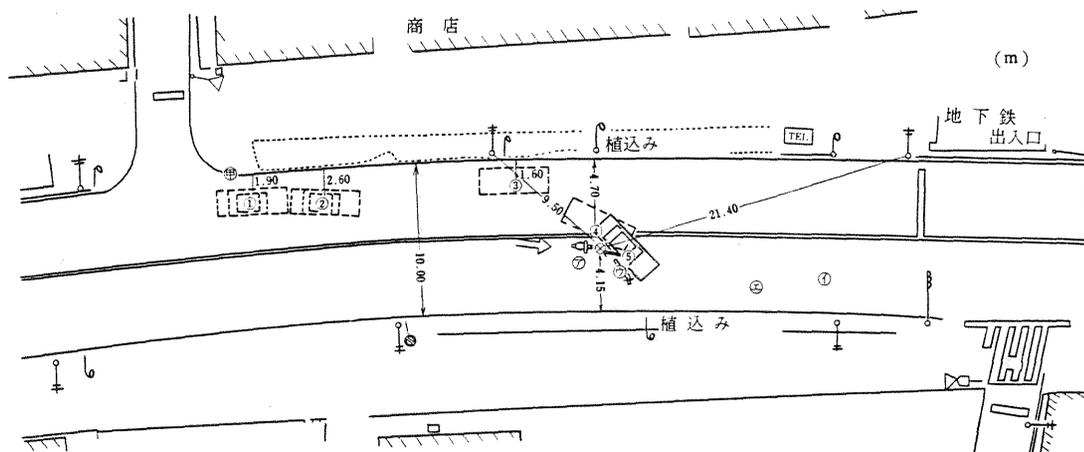
Since the national project has started, it has passed already 11 years. There are big difference in using way depending upon prefecture, some are very active and a few prefecture are dull because of lack of knowledge in photogrammetry and training and also camera and plotting machines are very expensive and take a time to master it. The regular operations take around 0.1 percent of the total police budget every year in the country. Some cost samples are 3.0 million Yen for one stereometric camera with accessories; 4.0 million Yen for one special vehicles; and 6000 Yen for 12 glass plates.

The experience that the police in Japan have had, resulted to raising 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 photographing and plotting
- (3) Price raising of necessary materials
- (4) Photographing trouble at the snow and rain-falling area
- (5) Careless usage of Cameras on the road by police men
- (6) Traffic troubles at down-town area during photographing because of shortage of necessary police men

Under the above mentioned items, the national police agency has started the training course of photogrammetry for traffic accident 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 works and judicial treatment, but also machine principle and modern technology of photogrammetry, which are the total sytem of analytical way using computer and comparator. The analytical measuring system will be popular in future. There will be more multiplied applying way increased to solve the troubles related to the police. The PAMS ( Photogrammetric Analytical Measurement System ) is already in market and 10 instruments are used for police works in Japan.

Acknowledgement: The authors are very indebted to Mr. Tohru Shiota and Mr. Kazumi Akiba, Sub of Traffic Enforcement Division, Traffic Bureau, The National Police Agency and thank to Mr. Saito, Asahi Optical Corporation who gave us the valuable materials.



Mapping at A Accident Site( Courtesy of Mr.Kamiyama)



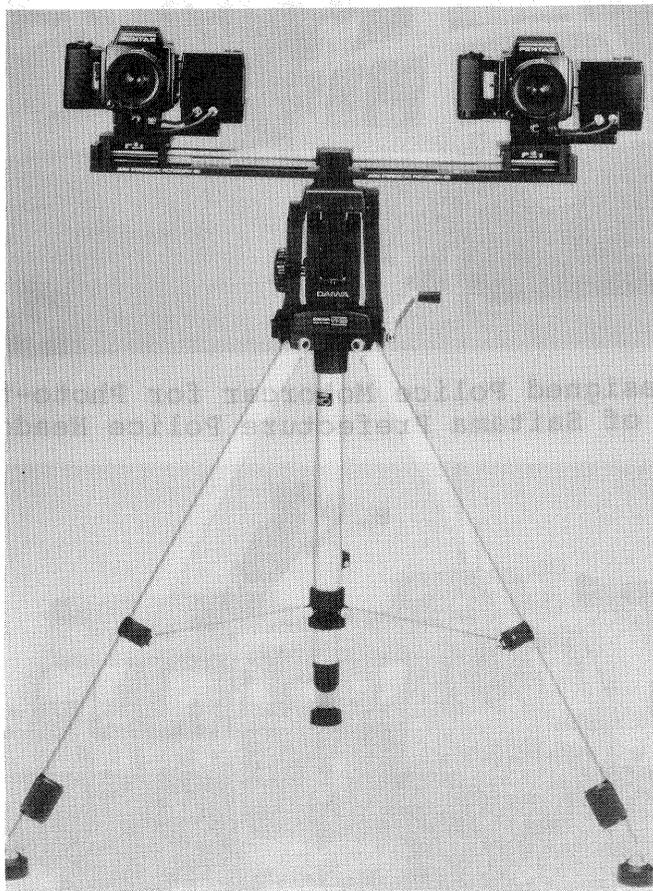
Specially designed Police Motorcar for Photo-taking  
( Courtesy of Saitama Prefecture Police Headquarter )



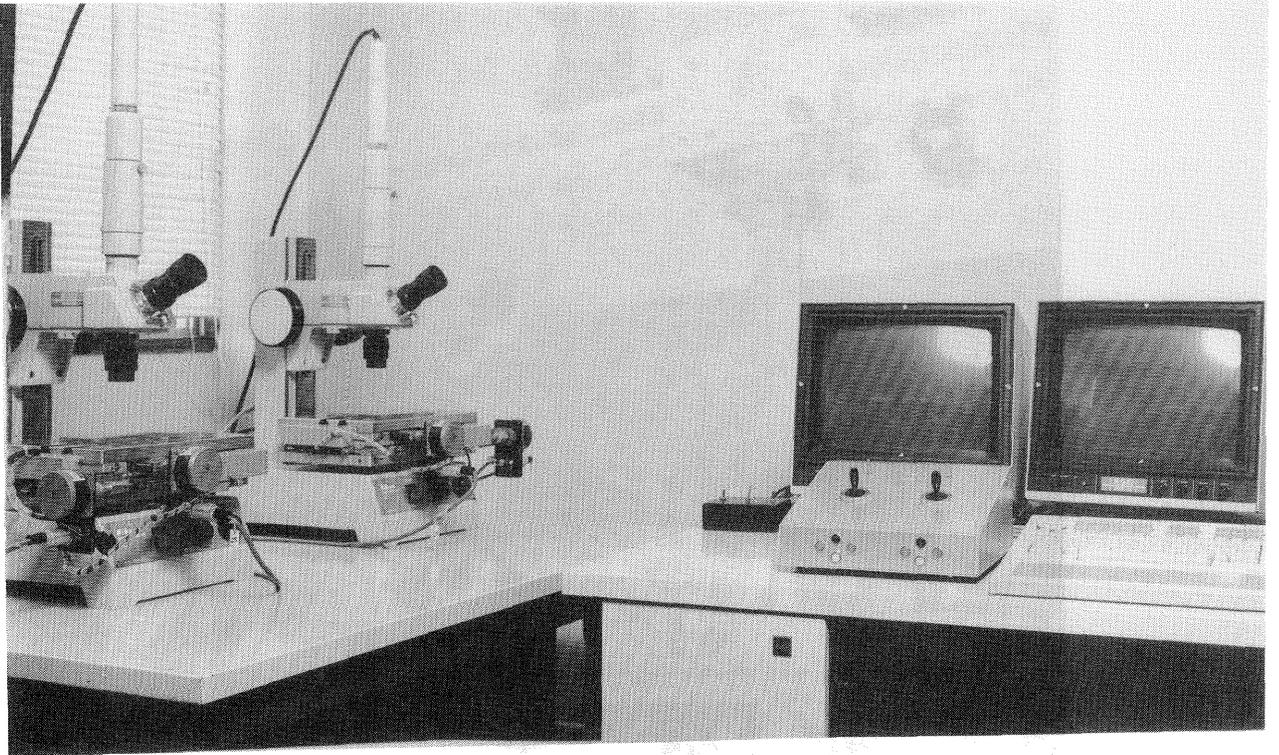
Mechanism for raising/lowering a stereocamera  
( Courtesy of Saitama Prefecture Police Hqr. )



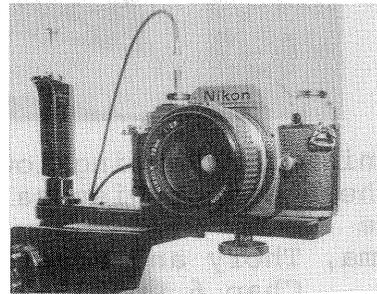
PAMS ( Photogrammetric Analytical Measurement System )



Specially designed Stereometric Camera  
( Asahi Pentax PAMS 645 )

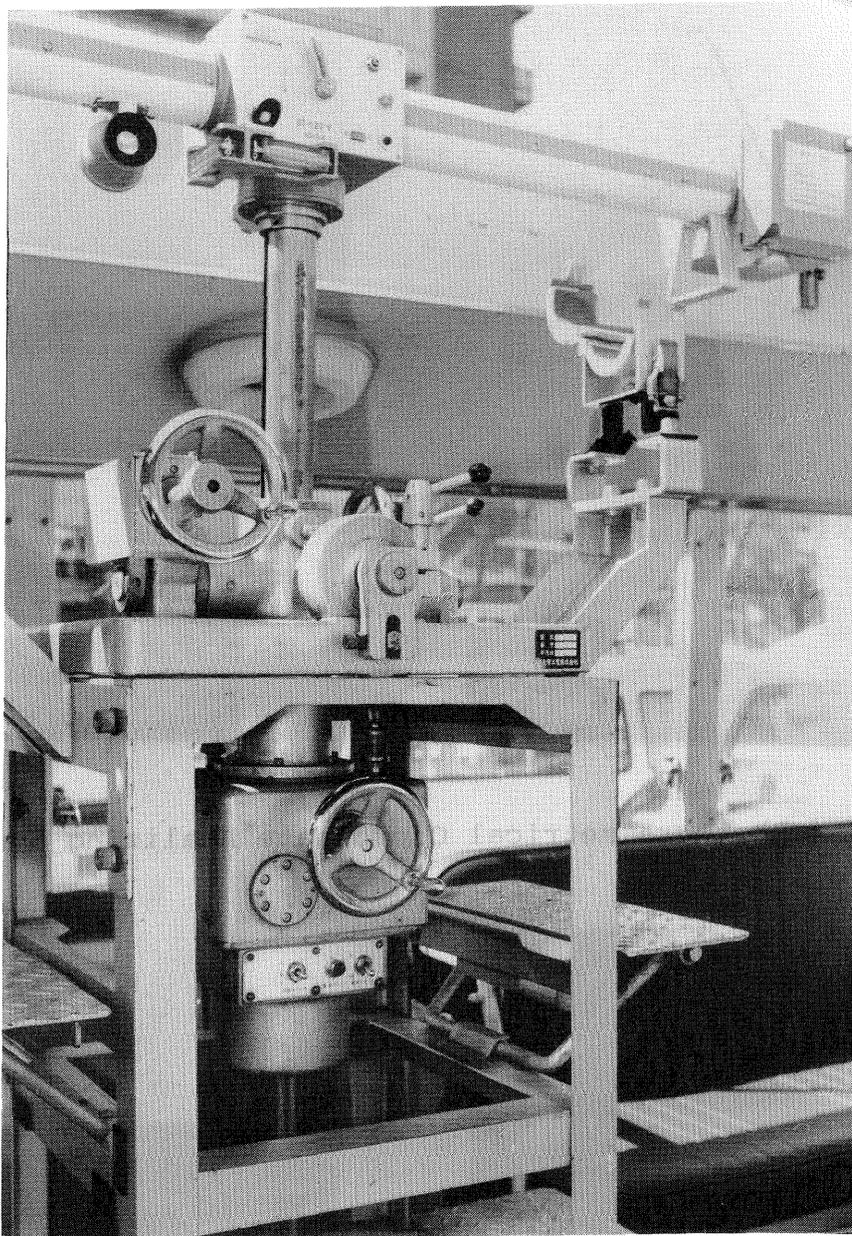


PHOCAS ( Photogrammetrical Coordinate Analizing System )



Nikon FG Metric Camera

Specially Designed Photgraphing System  
Lifting up to 7.5 m



Mechanism for Raising/lowering a Stereometric Camera  
in the Accident Disposal Vehicle with Police Department  
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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 helping us.