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File - Argon Content

INTRODUCTION

There are many academic reasons why the United States may be interested in obtaining a geodetic map of the globe. One of these is the ability of modern weapon systems to hit their target only as accurately as one can direct the missiles from the launching point. From the military point of view this particular use of an over-all grid of known reference points seems to have an overriding urgency with respect to all other possible uses for such a geodetic grid. The targeting problem, however, may be a special case of a world-wide survey and the specialized nature of the launch points as well as the targets may allow a solution without emphasizing the over-all world-wide grid as a necessary means to this end.

With this thought in mind several questions have been listed to indicate a course of action which would lead to a method of obtaining targeting information with somewhat less effort than if the world-wide grid approach were used. This approach is based on the very limited area of the world which is considered to have military targets worthy of ICBM weapon assignment, with the additional factor that such weapons will be launched from an area that is also limited in scope.

THE PROBLEM

In reducing data from a geodetical satellite, one is confronted with the problem of accurate measurements from known reference points and the extrapolation of these points to new reference points of interest. Two questions arise:

(1) How well do we know the reference points?

(2) What methods are available to measure the new points with respect to the references?

The first question has been studied for years by many groups throughout the world. Indications are that we do know reference points to within a tolerance of 500 to 1,000 feet. Some optimistic estimates are much closer than this.

In addition we have information about several hundred points within the Soviet; a significant number of these are recognizable from aerial photography. Assuming that these facts are true, it is our contention that any geodetic data reduction system should be geared this known information to the utmost in an attempt to measure new target points which may be found by future photography.

To design such a system adequately, several points must be clarified.

(1) How many reference points do we have on a world-wide basis?

Probable answer: We expect to find several thousand points on a world-wide basis which are considered prime reference points.

(2) How many reference points do we have in the Soviet Union?

Probable answer: It is our understanding that there are undoubtedly over a thousand reference points in the Soviet Union that are well-known.

(3) What degree of confidence do we have in these points?

Probable answer: Existing confirmation indicates a varying degree of confidence with many points being referred to within 300 feet of a grid which is referent to the eastern world. Other points are indicated as being known to around 5000 feet. The same is true of points in the western world with a 300 foot norm generally showing as a confidence level. It is also expected that two reference datum grids between western and eastern worlds will be the subject of debate. Indications are that these reference grids can be tied together at sea level within 300 to a thousand feet, based on present information.

(4) How many of these are recognizable from the air?

The probable answer here would depend on looking at existing information, together with camera scale, resolution etc.

(5) What is the distribution of these points with respect to probable target areas in the Soviet Union?

Probable answer: It is expected that these reference points cluster in the western + extreme eastern part of the Soviet Union and that a significant area of unknown points exist between the western and the eastern part of this continent.

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(6) How much (if any) aerial photography do we already have of these reference points?

The answer to this question will be the subject of a study ; it is expected that we should have photographs of at least 10 per cent of the points which are presently referenced.

(7) What is the best method of using existing knowledge as a means of recognizing these reference points in "new" photography, such as is now being planned?

Probable answer: The question of air recognition is one of the key points in resolving this problem. As will be seen later, this point will becritical in determining the nature of the ground-handling system.

Once these questions have been answered in a quantitative way, the design of the actual ground handling system can begin intelligently.

Several significant points are already clear in terms of ground handling problems. These are mentioned without attempting to resolve them at this point.

(a) What integrity can we expect from the film itself?

i.e. Will it stretch or change dimension in process, significantly confusing the end use.

The answer to this question will depend on the film used and the method of handling. It may or may not be important depending on the over-all tolerances which one expects to work with. It may be necessary to go to glass plates immediately in order to preserve many changes film-wise. This will affect the design of the ground-handling factors in measuring equipment.

(b) What degrees of rectification should be attempted and by what method (electronic, optical, computational) to preserve integrity?

Apparently, the experts disagree to some extent on the need for rectification in order to do photogrammetry. There seems to be a feeling that improved tolerances will result if rectification is not used and photogrammetry and computational correction for distortions would be better.

(c) Should rectification be used only for photographic matching and reserve the original material for photogrammetry after the recognition process?

Probable answer: At the scales involved, rectification may not be necessary in order to optimize recognition. However, some simulation would be needed to clearly resolve this point. The recognition process may be so acute in these high altitudes that photographic matching would have to be applied and this in turn may necessitate rectification and scale change in order to effect this process.

(d) Is there a possibility that photo matching to aid the recognition process could be accomplished by a modification to the existing twin viewer in Subsystem I.

Probable answer: The present Subsystem I viewer is particularly applicable for superimposing two photographs for optical matching where the human is used as the detector. The economics of doing this would have to be studied. It is expected that such an application may save considerable dollars in development.

(e) Should this be accomplished by using center formats from originals or not?

Probable answer: Central formats may be useful in the recognition process and in using available some (~~cen?~~ Central) filing systems. It is felt that the centra~~l~~ format may be a way of tying together existing photographs from many other sources and such new photographs as we could collect in a frame of reference that was compatible. Such compatibility would allow the use of considerable existing equipment. This does not imply that this would be adequate for the photogra~~mmetric~~ metric process.

(f) In measuring the distance between points, should the photography be exploited on the Nistri type of instrument "presently available" coupled to a standard computer and plotter? If not, what are the objections to this?

Probable answer: It is expected that the bridging process between known and unknown points will allow present state of the art photogrammetry to be used to measure new points. It is expected that presently available computers also can be used after being properly programmed to take advantage of statistical methods of data smoothing and that these can be efficiently coupled to prime instrumentation as mentioned above.

(g.) Will the volume and time involved require a separate set of instruments and computers or can existing equipment be used?

Probable answer: It is expected that presently available instruments and computers will have to be expanded in their capacities in order to handle the volume of data which will be gathered from other sources than the one being discussed here. It is also expected that the "~~power~~ peak loads" imposed by such systems will be accompanied by significant periods of light loads on these computers. There is little doubt that the nature of the program being discussed, the volume of photographs that will be collected and the time needed for data reduction could be sandwiched into presently conceived systems which are being considered for complimentary programs. ~~[redacted]~~ Such systems do not exist (to the writer's knowledge) in the Army Mapping Service and [redacted] a new and different system for their use ~~would~~ should probably be the subject of a discussion outside the scope of this paper.

(h.) What advantages in tolerances accrue from using the stars as a means of establishing the NADIR point?

The answer to this question is a very difficult one. The accuracy with which one can find the nadir of a photograph will depend not only on the ~~[redacted]~~ NATURE of the star photograph which is being proposed but the position in the orbit which the vehicle holds at the time the photograph is taken.

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This predicted position will be the result of the changing velocity of the vehicle as it passes around the earth in its orbit. The orbital mechanics are such this tolerance will have a prime effect on the ability to establish a true nadir point. The answer to this question will probably not be clear until considerable analysis is made of data on a given vehicle with respect to its orbit and it is felt that final photogrammetry will be the result of an iterative process ~~which establishes~~ between orbital points and ground check points ~~for the two is made perhaps two or three times.~~

(i.) What instruments and computers (if any) are needed to exploit this possible advantage?

The answer to this question will depend almost entirely on the resolution of the difficult points raised in question h.

(j.) What tie in is desirable between the phorogrammetry process and the orbital data received from the 1104 to improve and refine orbit data?

Probable answer: It is almost certain that a very ~~close~~ close tie should exist (between?) ground points established by photogrammetry and the orbital points predicted from the tracking computer and it is expected that the accuracy of both of these systems is interdependent and the present system which is being worked out on the complimentary program to the one being discussed should be expanded and revised in order that this tie between

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systems be made as efficient as possible. It is felt that both the 1104 computer presently planned for tracking and such a computer as is chosen for this function should be programmed concurrently and in a complimentary way so that this tie-in can be made as automatic as possible and not cause tremendous delays or use up tremendous amounts of manpower.

(k.) What effect does the camera have on the over-all ground-handling system?

Probable answer: It is expected that the recognition processes will be ~~several~~ severe and that the longest focal length camera consistent with wide-angle coverage will optimize the usefulness of the system. The angles chosen and the direction of flight which would tend to minimize the coverage of unknown territory with respect to known territory would tend to minimize the errors in reducing the data. ~~That is to say~~ (For instance), if one could arrange to fly over control points immediately before entering and immediately after leaving an area of unknown points one would be in the best position to do photogrammetry. The proper choice of camera configurations can make this kind of problem less important.

The above comments on ground-handling would probably apply to any camera that was used but degree of accuracy obtained in the over-all system would be affected materially by choosing an optimum camera. There is some question whether the presently planned camera is adequate in the minds of photogrammetrists. In summary, the following points seem pertinent to accurately resolve this problem regarding the camera; that the longest focal length and largest format compatible with vehicle size and shape would give the best results; that the greatest angular coverage along the orbital track would give further enhancement to the tolerance problem; in regard to operational plan, that each pass be made an attempt to minimize the amount of unknown territory coverage; in regard to ground handling, that a minimum of processing, duplication, rectification be done on the original film before data reduction is attempted; that maximum use be made of existing information and concurrent information gathered by other systems, that existing photogrammetry equipment and existing computers are probably adequate to do the job.

The above comments are made in the context of a special case of target information for a specific mission, as opposed to creating a world-wide grid for a multiple purpose mission. It is not intended that these comments represent a general purpose solution to all problems but that it would be helpful in solving the specific problems with target.