

## PHOTOGRAMMETRIC MANAGEMENT GIS SYSTEM

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### ABSTRACT:

The photogrammetric management GIS system, discussed in this paper, was developed in order to integrate all the separate files, maintained by the different departments, and the Israeli National GIS layers, into one management system.

The paper describes, also, the major milestones of the newly developed system. The first stage included the collection and analyses of the different photogrammetric processes, which were implemented in different departments. These processes include mission planning, air photographs archive, etc. The second stage was to assemble the digital and non-digital photogrammetric data at the Survey and the development of a GIS database, which integrate and combine the various data types collected by the different users. The third stage was the development of modular and user-friendly algorithms which enable: (a) automatic planning of air photography missions; (b) finding archived air photographs by geographic, date and other parameters; (c) automatic production of orthophoto mosaics (from single, stereo or multi photographs); (d) automatic production of a standard "orthophotomap"; and (e) updating the database in real time, including quality control to prevent error propagation into the data stored in the photogrammetric database

The newly developed system proved to be an efficient and most productive tool. Planned as a single-user program, for the use of two sections only, the enhanced multi-user system is serving now all sections of the division of photogrammetry at the Survey. Further development is planned for year 2002 in terms of replacing old archiving techniques, data drilling, pricing, customer service, and much more.

### 1. INTRODUCTION

In the past, most of the photogrammetric processes, at the survey of Israel (SOI), were implemented manually. Only very few tasks were computer-assisted, in partial and a very limited format. The computerization at SOI included an alphabetical database of the photogrammetric data, such as mission, camera, triangulation, parameters. These parameters, in the past, were saved in separated and "private" files. These files served different users, in several departments, in terms of following-up only. All these data were kept without any geographical relations of the air photographs. This was due to the enormous amount of the air photographs data and the complexity of these data. This very complexity of past years, lead to a decision that developing a spatial database and a photogrammetric management GIS system, is needed.

The system was developed in a modular doctrine and it includes the following major stages:

1. Developing a Photogrammetric Database, which includes the spatial and non-spatial data required for implementing the photogrammetric tasks.
2. Developing an Updating Module for real-time updating.
3. Developing module for producing orthophoto from single or many photographs.
4. Developing module for Automatic planning of photography missions.

5. Developing module for Geographic Browsing of archive aerophotographs.
6. Developing Administrator module to manage a multi-user and multi-processing system.

The Above modules are user-friendly and were developed in ARC/INFO macro Language and C complier. A Quality Control processes are implementing, in parallel to all modules, to prevent entering error data to the database.

### 2. DEVELOPING PHOTOGRAMMETRIC DATABASE

The photogrammetric database including the following data:

- Photography Missions Data – mission number, date, photographer, camera, photographs numbers, etc.
- Air photographs Data – mission number, photograph number, type, covering area, etc.
- Stereo-Modules Data – mission number, left and right photograph numbers, etc.
- Strips Data – mission number, photograph numbers, covering area, etc.
- Cameras Data – name, film width, focus, calibration parameters, etc.
- Triangulation Parameters for single, module and strip of photographs.

- Photographs Scanning Data – photograph number, file name, scanning resolution, date, etc.

In addition, the Photogrammetric System making use of the layers and info files from the Israeli National GIS.

While developing the database a different considerations were taken, such as photographic processes, data access speed and convenience. Listed here some of these considerations:

- Photographs stored in the photographic database as covering-area, instead of center point in the old database, to enable finding photographs which cover a specified area.
- Photograph covering-area defined and stored as arc (outline) instead of region in ARC/INFO coverage to fast the geographic selection process. For modules which require regions, the system will convert the outlines to regions, automatically, for the specified photographs only.

### 3. UPDATING MODULE

This module enables updating and recording the photogrammetric processes and data into the photogrammetric database. Listed here some of the operations which enabled in this module:

- Recording the private companies which supplying air photographs for the survey of Israel.
- Recording the cameras and calibration parameters.
- Recording Photography missions.
- Recording Scanning information.
- Measuring fiducial marks for the scanned photographs, to enable automatic production of orthophoto from single photograph.
- Recording triangulation parameters.
- Defining photographs covering-area by (a) screen digitization from scanned maps; (b) importing from missing planning project; (c) importing from GPS files from mission recorders; (d) automatic definition using the triangulation parameters, fiducial marks coordinates, and scanning parameters.

It's important to mention that the Quality Control processes are implementing, in parallel to all updating operations, to prevent entering error data to the database.

### 4. ORTHOPHOTO MOSAIC MODULE

This module enables automatic production of orthophoto from a single photograph, module (pair of photographs) and many photographs (Mosaiking). Besides, the module enable automatic production of orthophotomaps in a standard forms, with full marginalia which describe the sources of the orthophoto.

The production of orthophoto, from single photograph or a module, enabled by selecting only two parameters: photograph/module and output resolution. The other parameters are extracted from the photogrammetric database.

The production of mosaic orthophoto for a specified region in several steps:

- Region definition by box, polygon, municipal boundary, cadastre block, etc.
- Selecting photographs by date, scale, type, etc.

- Selecting output resolution.
- Orthophoto production for each single photographs.
- Seam-lines definition.
- Mosaiking – merging the orthophoto from each photograph after radiometric adjustments.

### 5. AEROPHOTOGRAPHS GEOGRAPHIC BROWSER

In This module, the operator could retrieve photographs, which cover a specified region and have specified parameters. The process includes 4 steps:

- Region definition by box, polygon, municipal boundary, cadastre block, etc.
- Non-spatial parameters definition - Date, Scale, Type, Supplying company, etc.

After the definition of the above parameters, Automatic selection processes were implemented to retrieve the photographs, which satisfy the specified parameters. The list of the selected photographs displayed in form window. The system enables the user to: (a) show the photographs covering-area on the map display; (b) display the scanned file; (c) reduce the selected list; (d) produce a printable report.

### 6. MISSION PALNNING MODULE

This module enables automatic planning of photography missions based on a GIS system. This module is purposed to replace the traditional mission planning. In the tradition mission planning, the operator marks the strip lines, manually on a paper map. In this module, the operator can produce a number of mission planning which stored in a spatial database, to enable exporting these the planned strips to the photogrammetric database, after the implementing of the photography mission.

The system finds the optimal strip lines, which cover a specified region and satisfied several parameters: (a) General direction, the system find automatically the optimal direction according to the region shape; (b) Photography scale; (c) Camera; (d) Overlapping percentage between successive photographs; (e) Overlapping percentage between successive strips; (f) The radius needed for plan U-turn; (g) Limited ranges from country borders.

The system takes into consideration the following factors: (a) regions near the country borders, which limited for civil missions; (b) strips parallel/perpendicular to shore/border line; etc. In addition, the operator could reedit the automated strips, manually, for special conditions, which doesn't consider by the module.

### 7. SUMMARY

The newly developed system proved to be an efficient and most productive tool. Planned for the use of two sections only, the system is serving now all the sections of the division of photogrammetry. Further development is planned for year 2002 in terms of replacing old archiving techniques, pricing, and other customer services.