# PHOTOGRAMMETRY – REMOTE SENSING AND GEOINFORMATION

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**ABSTRACT:**

Earth and its environment are studied by different scientific disciplines as geosciences, science of engineering, social sciences, geography, etc. The study of the above, beyond pure scientific interest, is useful for the practical needs of man. Photogrammetry and Remote Sensing (defined by Statute II of ISPRS) is the art, science, and technology of obtaining reliable information from non-contact imaging and other sensor systems about the Earth and its environment, and other physical objects and of processes through recording, measuring, analyzing and representation. Therefore, according to this definition, photogrammetry and remote sensing can support studies of the above disciplines for acquisition of geoinformation. This paper concerns basic concepts of geosciences (geomorphology, geology, hydrology etc), and the fundamentals of photogrammetry-remote sensing, in order to aid the understanding of the relationship between photogrammetry-remote sensing and geoinformation and also structure curriculum in a brief, concise and coherent way. This curriculum can represent an appropriate research and educational outline and help to disseminate knowledge in various directions and levels. It resulted from our research and educational experience in graduate and post-graduate level (post-graduate studies relative to the protection of environment and protection of monuments and historical centers) in the Lab. of Photogrammetry - Remote Sensing in Civil Engineering Faculty of Aristotle University of Thessaloniki.

## 1. INTRODUCTION

Geoinformation concerns any kind information, qualitative or metric, about the system earth-environment and furthermore the works of nature and man in it.

Different scientific and technologic disciplines produce geoinformation, the acquisition of which can be significantly supported by the methods of photogrammetry and remote sensing.

In this paper, we form a general curriculum of photogrammetry and remote sensing, in order to have a useful reference for the relevant methods that will be selected to acquire geoinformation. The kind of geoinformation, the extent/area, the accessibility and the type of the product, notably affect the above selection.

We also refer to indicative cases of geoinformation acquisition with methods of photogrammetry and remote sensing, concerning subjects of road network, drainage network and climate, including subjects of the above curriculum that we consider suitable for the acquisition of relevant geoinformation.

The whole subject is faced mainly on the base of our experience from teaching in graduate and post-graduate level at the Department of Civil Engineering in Aristotle University of Thessaloniki.

## 2. CURRICULUM OF PHOTOGRAMMETRY – REMOTE SENSING AND GEOINFORMATION

The scientific field of photogrammetry, as metric study of photograph, was developed in parallel with photointerpretation for the understanding – interpretation of the photograph.

Scientific and technologic advances extended the range of metric and interpretation study to images of other types as thermal, multispectral, microwave, etc. In 1980, International Society of Photogrammetry that included the scientific areas of photogrammetry and photointerpretation, was renamed to International Society for Photogrammetry and Remote Sensing. Today, according to ISPRS, Photogrammetry and Remote Sensing is the art, science, and technology of obtaining reliable information from non-contact imaging and other sensor systems about the Earth and its environment, and other physical objects and of processes through recording, measuring, analyzing and representation.

The basic source of information for these scientific disciplines is the radiation, emitted or reflected, from various objects – features. Radiation in different areas – wavelengths of electromagnetic spectrum is used.

A general curriculum of photogrammetry and remote sensing, for the purpose of this paper, may include the following:

Electromagnetic spectrum

Image
one or pair - stereoscopic model, strip, block

analogic, digital
panchromatic, multispectral, thermal, etc.

Sensors
devices for the "collection" of radiation
photographic, electron imagers, radiometers etc.
Replacement Sensor Model consideration

Scanners
thermal, multispectral, microwave, laser, etc.

Platforms
from the surface of the earth (terrestrial takings, mobile mapping systems, real time videogrammetry etc),
airplanes (manned and unmanned),
satellites (electro-optical satellites, radar satellites).

Stereoscopy

Image interpretation
analogic image interpretation – image understanding at the whole and at particular features (geometric, tonal) on the base of recognition elements and keys
digital image interpretation – suitable processes for information acquisition on the base of the digital structure of the image.

Digital image processing
digital manipulation of an image to aid feature visibility, to make measurements or alter image contents (ASPRS, 2004).

Computer vision techniques
automatic extraction of meaningful information from images or sensor data, that is identification of objects depicted in a scene, or understanding a whole scene or even a sequence of images in a holistic way (ASPRS, 2004).

Metric methods and techniques
evolution from analogical to analytical and digital methods,
orientations (inner, outer),
classical photogrammetric equipment,
digital photogrammetric workstations,
aerotriangulation,
close range photogrammetry.

Products
graphical (maps of different kind, facades, sections, perspectives, geometral),
digital (x, y, z coordinates of points),
pictorial (rectification, orthoimage, mosaics),
digital terrain models,
various archives for the formation of GIS databases.

Geoinformation can be acquired from various sources as geomorphology, geology, soils, etc. An outline, relatively to the above, may include:

landforms,
lithology, stratigraphy, structure,
soils horizons, soil erosion,
slope stability,
drainage network (watercourses, drainage basins),
hazards.

## 3. PHOTOGRAMMETRY REMOTE SENSING AND GEOINFORMATION FOR ROAD NETWORK SUBJECTS.

Road network planning and implementation study for an area requires diverse ( e.g. geomorphological, geological, soils, hydrological) studies of the area. We particularly need information about the relief and landforms, soil type and stability, existence of construction materials, land use and cost, traffic data, cost of construction and maintenance, etc. Studies of political, social, and economical factors are also required. These factors will be taken into account with the above technological studies.

The greater advantage of using photogrammetry – remote sensing on road network planning system, is that the image "contains" a large number of qualitative and quantitative information that are offered for multiple use. Therefore, photogrammetry – remote sensing techniques and products can be used in recognition study (setting boundaries of ground corridors), preliminary study and final study.

Photogrammetry - remote sensing can essentially contribute to the above in following framework.

Platforms of data acquisition
terrestrial, airplane, satellite, mobile mapping systems, laser scanners.

Methods and techniques
quantitative (analytical, digital methods, aerotriangulation),
qualitative (interpretation of analogue and digital image),
digital image processing (image classification – land cover mapping),
computer vision.

Products
graphical, digital, pictorial – areal (mosaics, rectification, orthophotography), digital terrain models, 3D virtual environment etc.

Platforms and sensors of data acquisition, as well processing capabilities, follow advances in technology allowing automation in the whole procedure of the road study, for example subjects of automatic road extraction from aerial photographs and satellite images (Mayer et al 2006, Zhang et al, 2006).

## 4. PHOTOGRAMMETRY REMOTE SENSING AND GEOINFORMATION FOR HYDROLOGY SUBJECTS

The processes relatively to drainage network and catchments create multiple and extended geoinformation, the acquisition of which is supported by methods of photogrammetry – remote sensing and computing (Gong et al, 2009).

The geometry of drainage of different order, longitudinal and across sections, the positions and angle in the joint of watercourses, the geometry of the catchment, longitudinal and across sections can be acquired by the study of various images, that is image interpretation and image metric processing with analytical, digital and pictorial methods, digital terrain modelling, aerotriangulation, etc.

The study of extensive areas – geographic regions concerning their drainage system (watercourses, catchments) is a key development for the region.

## 5. PHOTOGRAMMETRY REMOTE SENSING AND GEOINFORMATION FOR CLIMATE

Photogrammetry – remote sensing contribute significantly in the study of climate and its changes. Geoinformation from extensive areas in global level is required. Suitable instruments, equipment and platforms are used. The relevant effort, because of the particular importance of the climate and its changes for man, continues to evolve. Below, we relatively refer to instruments and equipment that have been used for this reason (Campbell, 2002).

Advanced Very-High-Resolution Radiometer (AVHRR).

Earth Observing System (EOS)
Earth Observing System Instruments:
Moderate-Resolution Imaging Spectroradiometer - MODIS,
Earth Observing System Ocean Color Experiment – EOS Color,
Advanced-Spaceborne Thermal Emission and Reflection Radiometer – ASTER,
Multi-Angle Imaging Spectroradiometer – MISR,
Multifrequency Imaging Microwave Radiometer – MIMR,
Earth Orbiting System Synthetic Aperture Radar - EOS SAR.

Earth Observing System Bus for the placement of EOS sensors and standard support functions (Terra was the first of the EOS busses).

## DISCUSSION – CONCLUSIONS

In this paper, we create and edit an outline of photogrammetry – remote sensing and an outline of the relation of geoinformation with photogrammetry – remote sensing indicatively for certain cases.

Photogrammetry and remote sensing are considered in a single approach, as in ISPRS definition. This allows the researcher to have supervision in the selection of subjects, according to his interests, and choice of several methods to achieve its goal.

Photogrammetry – remote sensing has now become a very broad subject area with manifold possibilities.

Geoinformation comes from various scientific and technological disciplines as geosciences, engineering science, social sciences, etc. The type of geoinformation, extent, the accessibility and mainly the degree of knowledge of photogrammetry – remote sensing and geoinformation determine the most efficient cooperation between geoinformation and photogrammetry – remote sensing. With the analysis presented in this paper, various scientific and technological issues can be served.

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