


LA502 Special Studies Remote Sensing

Introduction to Remote Sensing


Dr. Ragab Khalil
Department of Landscape Architecture
Faculty of Environmental Design
King AbdulAziz University
Room 103



Overview

1. What is Remote Sensing
2. What is electromagnetic wave?
3. How Does Remote Sensing Work?
4. Development of Remote Sensing
5. Types of Remote Sensing
6. Remote Sensing applications

Dr. Ragab Khalil KAAU - FED - LA502: RS 2/45



What is Remote Sensing?

- Remote sensing is the science (and art) of acquiring information about the Earth's surface without actually being in contact with it.
- A technology used for obtaining information about a target through the analysis of data acquired from the target at a distance.

Dr. Ragab Khalil KAAU - FED - LA502: RS 3/45

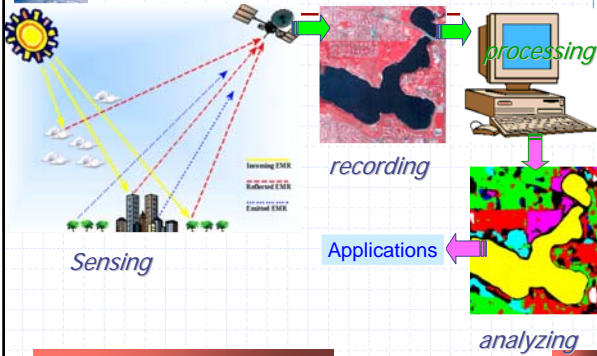


How does Remote Sensing work?

- Remote Sensing is performed by *sensing* and *recording* reflected or emitted energy and *processing*, *analyzing*, and *applying* that information".



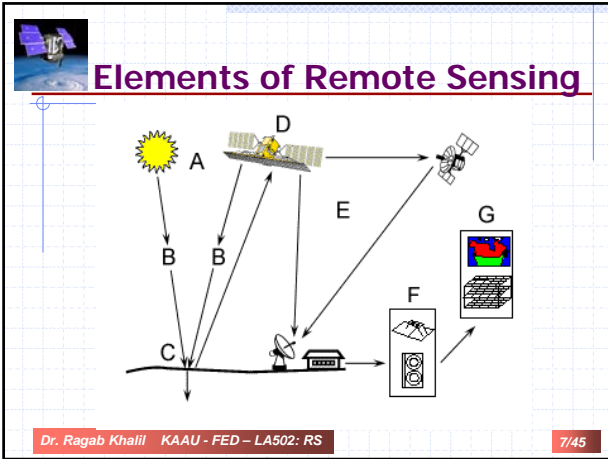
How does Remote Sensing work?

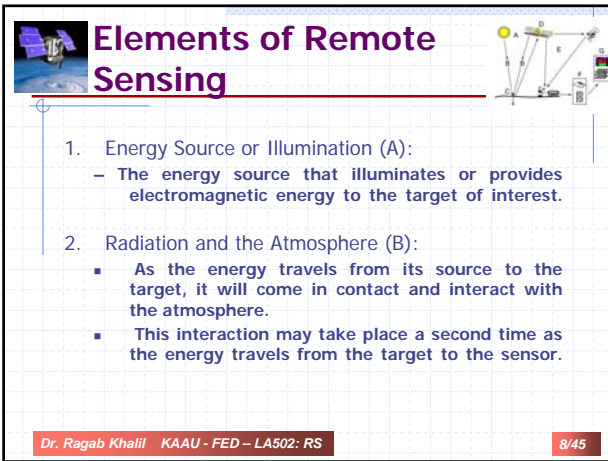


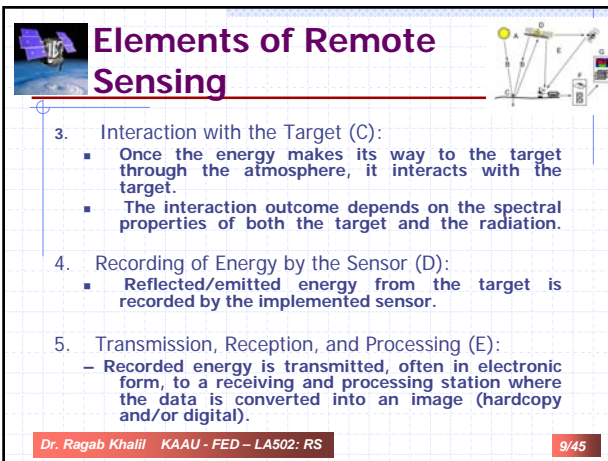


How Does Remote Sensing Work?

- Recording and measuring electromagnetic radiation from the target.
- This recording and measurement can be taken by airborne or satellite sensors.
- Remotely sensed images are processed (rectified and enhanced) to show information better.
- We interpret the images to get information on given locations for mapping, management, etc.









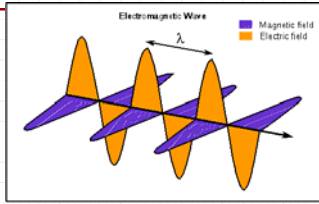
Elements of Remote Sensing



6. Interpretation and Analysis (F):
 - Processed image is interpreted, visually and/or digitally, to extract information about the target which was illuminated.
7. Application (G):
 - Apply extracted information about the target in order to:
 - Gain better understanding of that object,
 - Reveal some new information, or
 - Assist in solving a particular problem.



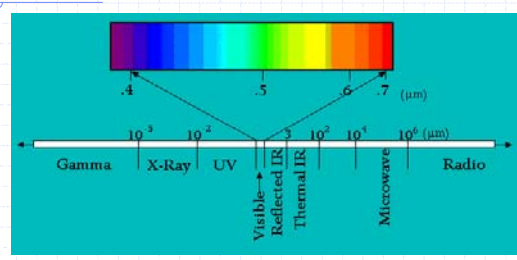
Electromagnetic radiation



Electromagnetic energy is also known as *electromagnetic radiation* because it is a form of energy that is emitted from all objects that are warmer than absolute zero (-273°C) and then radiates outward in all directions.



What can satellites see?



Satellite electromagnetic sensors let us "see" beyond the visible...



The electromagnetic spectrum

- There are several regions of the electromagnetic spectrum which are useful for remote sensing.
 - Visible = 0.4 – 0.7 μm
 - NIR= 0.7-1.3 μm
 - MIR=1.3-3 μm
 - Thermal =3-14 μm
 - Microwave= 1mm-1m
- Wavelength in μm , 1 μm = 1×10^{-6} meter



Development of Remote Sensing

- The term “Remote Sensing” was coined in the early 1960’s by geographers in the Office of Naval Research of USA to apply to the information derived from photographic and non-photographic instruments.



Early aerial photography - balloon

- 1858 – Gaspard Tournachon “Nadar” used balloon to photograph Bievre, France (80m high)





Early aerial photography - balloon

- 1860 – James Black took photograph from a balloon over Boston (365m high)



Dr. Ragab Khalil KAAU - FED – LA502: RS

16/45



Early aerial photography - kite

- 1882 – an English meteorologist Archibald took first aerial photograph from a kite
- Late 1880s - Arthur Batut took kite aerial photographs over Labrugiere, France



Dr. Ragab Khalil KAAU - FED – LA502: RS

17/45



Early aerial photography - kite



- 1906 – George Lawrence photographed San Francisco in ruins shortly after the great earthquake and fire

Dr. Ragab Khalil KAAU - FED – LA502: RS

18/45



Early aerial photography – pigeon

- 1903 – Carrier pigeon



Dr. Ragab Khalil KAAU - FED – LA502: RS

19/45



Early aerial photography – airplane

- 1908 – a photographer took the first aerial motion pictures over Le Mans, France
- During world war I, over one million aerial reconnaissance photographs were taken for military purposes

Dr. Ragab Khalil KAAU - FED – LA502: RS

20/45

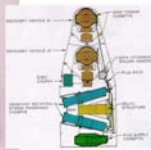


Space-borne imaging

- 1960 – launch of space-borne MetSats
- 1960-72 Corona spy satellite program



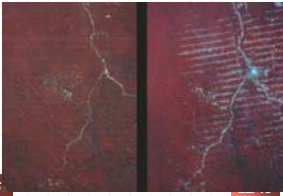


- FED – LA502: RS



Space-borne ima

- 1972 – civilian satellite, launch of ERTS-1, later renamed Landsat 1
 - Landsat MSS Jun 19 1975
 - Landsat TM Aug 1, 1986



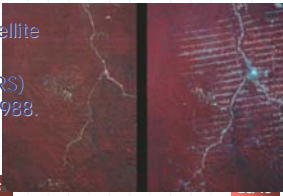




Dr. Ragab Khalil KAAU - FED – LA502: RS

Space-borne ima

Several nations have launched or plan to launch their own earth resources satellites


- Chinasat series since 1975 (China)
- Meteor series of satellites 1980 (former Soviet Union)
- In 1987, the first Japanese satellite MOS 1
- The Indian Remote Sensing (IRS) launched The first satellite in 1988.
- IKONOS 1999

Dr. Ragab Khalil KAAU - FED – LA502: RS

Why should we use Remote Sensing

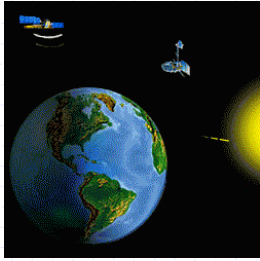
- Remote sensing can bring us accurate, cheap and frequently updated information about the Earth's surface.
- Air photographs offer detailed view of the Earth's surface but limited by many factors.
- Satellite photographs and images provide less detailed but more variety of information with a large and regular coverage.
- It can see "Beyond human eye"



Dr. Ragab Khalil KAAU - FED – LA502: RS 24/45

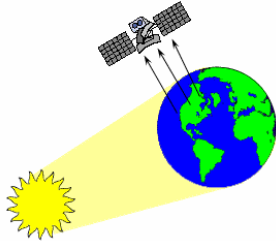
Types of Remote Sensing

- Passive remote sensing
- Active remote sensing



Dr. Ragab Khalil KAAU - FED - LA502: RS 25/45

Passive Remote Sensing




Passive remote sensing:
the sensor detects the reflectance of sunlight from the surface e.g. photographs, multispectral scanners

Dr. Ragab Khalil KAAU - FED - LA502: RS 26/45

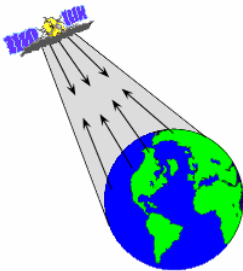
Passive Remote Sensing

- Remote sensing systems which measure energy that is naturally available are called **passive sensors**.
- Passive sensors** can only be used to detect energy which is naturally available.
- Optical imagery can be only captured during the time when the sun is illuminating the Earth.
- Thermal and infrared imagery can be detected day or night, as long as the amount of energy is large enough to be recorded.

Dr. Ragab Khalil KAAU - FED - LA502: RS 27/45




Active Remote Sensing



Active remote sensing:
the sensor detects the reflectance of the signal sent by the remote sensing system e.g. RADAR


Dr. Ragab Khalil KAAU - FED – LA502: RS 28/45



Active Remote Sensing

- Active sensors provide their own energy source for illumination.
- The sensor emits radiation which is directed toward the target to be investigated.
- The radiation reflected from that target is detected and measured by the sensor.
- Advantages for active sensors include the ability to obtain measurements anytime, regardless of the time of day or season.
- Problems: More power is needed.

Dr. Ragab Khalil KAAU - FED – LA502: RS 29/45



Communication and Data Collection Systems

- Remotely sensed data has to be transmitted back to the Earth.
- A network of satellite receiving stations have been established over the world to receive data.
- Some satellite data can be directly received by small instruments.
- Data are available through variable commercial channels.

Dr. Ragab Khalil KAAU - FED – LA502: RS 30/45

Dr. Ragab Khalil KAAU - FED – LA502: RS 31/45

Image Processing

- Digital images are the major types of today's remotely sensed data.
- They are fundamentally numbers.
- To make sense of them, a technology called image processing is employed to distort, enhance and extract information from the images.

Dr. Ragab Khalil KAAU - FED – LA502: RS 32/45

What is a digital image?

70	53	41	64	54	85	81	88	91	87
79	77	45	38	59	77	84	86	85	85
82	82	69	44	52	45	72	86	82	78
88	79	86	87	65	40	41	75	79	78
93	86	93	106	106	84	56	43	58	75
108	104	100	101	95	91	83	51	29	56
105	110	97	88	84	85	87	77	59	44
96	103	89	79	79	75	77	79	74	72
87	93	93	90	82	76	70	67	41	71
79	81	88	97	93	85	78	74	70	72
81	75	78	85	94	97	92	84	82	72

Digital Number (DN)

What your computer sees...

Dr. Ragab Khalil KAAU - FED – LA502: RS 33/45



Remote Sensing Applications

- Meteorology
- Agriculture
- Forestry
- Environmental
- Oceanography
- Cartography

Dr. Ragab Khalil KAAU - FED - LA502: RS

34/45



Weather Monitoring



Dr. Ragab Khalil KAAU - FED - LA502: RS

35/45



Agriculture

- crop type classification
- crop condition assessment
- crop yield estimation
- mapping of soil characteristics





Dr. Ragab Khalil KAAU - FED - LA502: RS

36/45

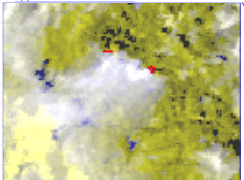
Forestry

- forest cover type discrimination
- clear cut mapping/ regeneration assessment
- Fire monitoring
- infrastructure mapping / operations support
- forest inventory
- species inventory

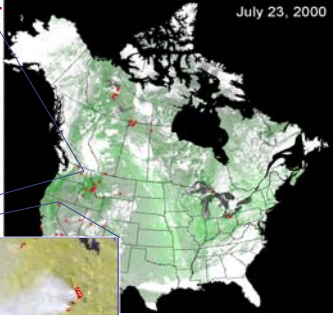



Dr. Ragab Khalil KAAU - FED - LA502: RS

Forest fire monitoring



Fires caused by picnic

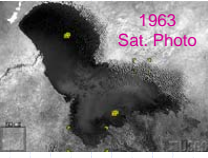


July 23, 2000

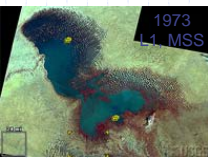
Dr. Ragab Khalil 38/45

Environmental impact

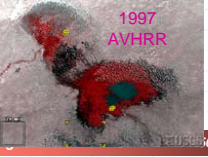
Lake Chad (in the Sahara, West Africa) was once the sixth-largest lake in the world, but persistent drought since the 1960s shrank it to about a tenth its former size.




1963 Sat. Photo



1973 L1, MSS



1997 AVHRR



1987 L5, MSS

Dr. R... LA502: RS 39/45

Ocean & Costal Monitoring

Yangtze river

Yellow river

MODIS real color composite image showing the heavy load of sediments carried by YZ & Y rivers that colored the the East China Sea

Dr. Ragab Khalil KAAU - FED - LA502: RS 40/45

Ocean & Costal Monitoring

Ocean waves

Oil spill detection

Dr. Ragab Khalil KAAU - FED - LA502: RS 41/45

Land cover & Land use

- natural resource management
- wildlife habitat protection
- baseline mapping for GIS input
- urban expansion / encroachment
- damage delineation (tornadoes, flooding, volcanic, seismic, fire)
- legal boundaries for tax and property evaluation
- target detection - identification of landing strips, roads, clearings, bridges, land/water interface

Dr. Ragab Khalil KAAU - FED - LA502: RS 42/45

Temporal land use maps

Urban land use maps from remote sensing images (1975, 1984, 1991, 1997).

■ Urban area	■ Orchard land
■ Cultivated area	■ Shrub land
■ Water area	■ Forest land

Dr. Ragab Khalil KAAU - FED – LA502: RS 43/45

Cartography

- Base line maps
- DEM

Dr. Ragab Khalil KAAU - FED – LA502: RS 44/45

Summary

1. What is Remote sensing, electromagnetic wave
2. How Does Remote Sensing Work?
3. Development of Remote sensing
4. Types of remote sensing
5. Remote sensing applications

Dr. Ragab Khalil KAAU - FED – LA502: RS 45/45
