Remote Sensing Data Acquisition

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Timetable and Schedule

Timetable

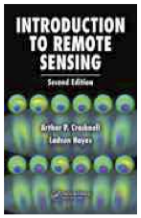
- Monday 9:30-12:30
- Problems? Breaks?
- Office hours: on Thursday afternoon?

Schedule: 13 weeks

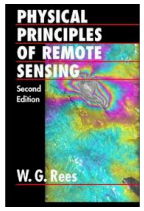
- We may need only 12 weeks
- Any preference?

Course Materials

Books



A. P. Cracknell and L. Hayes.
Introduction to Remote Sensing, CRC Press.
Good introduction to remote sensing systems, main platforms, basic notions of data processing.



W. G. Rees.
Physical Principles of Remote Sensing, Cambridge Univ. Press.
Good presentation of physical principles of remote sensing, electromagnetic waves, interaction with matter, sensors etc.

Course Slides

They cover all the program

Exam

Exam

- Written/oral (depending on the number of candidates)
- Mostly theoretical questions with very simple “problems”

Report

- Optional
- Study of a real acquisition system with a presentation ($\sim$ 30 minutes)
- This adds from 0 to 5 points to the exam mark

Course Program

Introduction to Remote Sensing

- Overview
- Acoustic Remote Sensing
- Electromagnetic Remote Sensing

Platforms

- System Characteristics
- Satellites

Electromagnetism

- Maxwell equations and electromagnetic waves
- Fundamental properties
- Thermal radiation
- Interaction with matter

Course Program

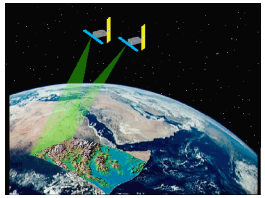
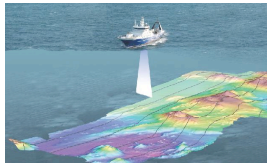
Optical and infrared systems

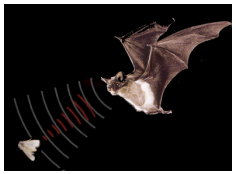
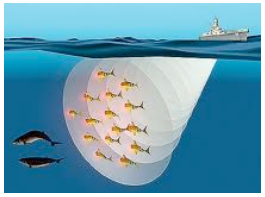
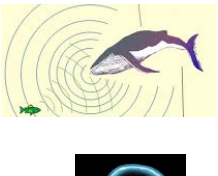
- Passive systems in the visible and near infrared (IR)
- Passive systems in the thermal IR
- Active systems (LIDAR,)

Microwave systems

- Radar and microwave acquisition principles
- Real aperture radar
- Synthetic Aperture Radar (SAR)
- Basic notions of interferometry and polarimetry
- Examples

Remote sensing in a broad sense

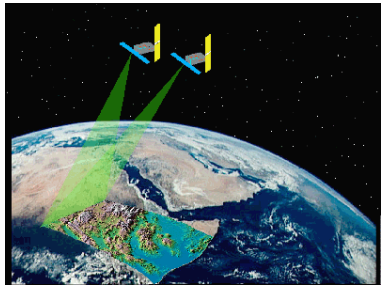
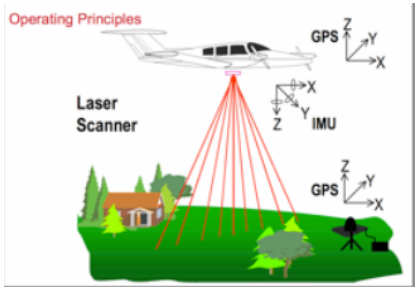



Types of waves used

Electromagnetic waves

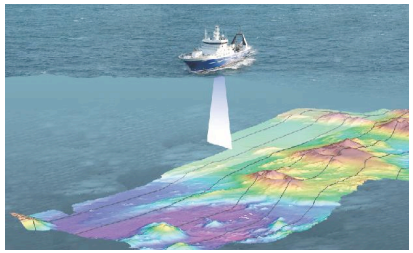
- The information is carried by an electromagnetic wave: electric and magnetic fields varying in space and time
- The largest class of remote sensing systems
- Different types of systems depending on the wavelength

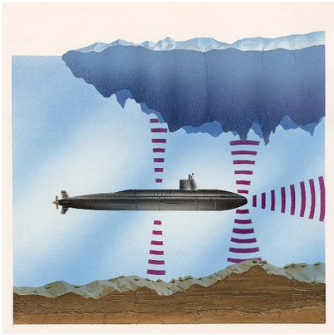



Types of waves used

Acoustic waves

- The information is carried by an acoustic wave: compression and expansion of a physical medium in space and time
- More limited applications, but very important for underwater sensing
- Principles very similar to those used with EM waves





Introduction to Remote Sensing Systems

Players

- Target
  - Environmental: Earth, vegetation, sea bed, atmosphere moon, sun,
  - Objects: boats, buildings, fish, statues etc
  - It can be the source of the signal. For example the sun, a volcano, radioactive material... even the Earth!
  - It can reflect or scatter external signals. For example the Earth when illuminated by the sun.
- Source
  - The source of the wave that hits the target. For example a source of electromagnetic wave (e.g., the sun) or of acoustic waves (a speaker)
  - It determines the type and characteristics of the signal that will be received back

Introduction to Remote Sensing Systems

Players

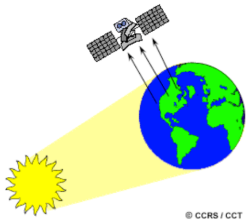
- Sensor
  - The device which receives the signal coming from the target
  - It must be designed to extract the best possible information from the received signal
- Physical Medium
  - The physical medium that allows the perturbation to hit the target and/or the signal to hit the sensor, or simply the matter/space that is interposed between target and sensor. For example the atmosphere, water... even vacuum.
  - It often determines the type of perturbation that can be used for remote sensing (acoustic, electromagnetic, wavelength etc.)

Introduction to Remote Sensing Systems

Roles: the same element can play different roles

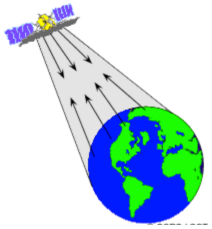
- The target can be the source itself
  - For example in a study of the sun
  - A whale as a source of ultrasonic sounds
  - The Earth is a source of infrared EM waves used for remote sensing signal
- The sensor can also play the role of the source:
  - **Passive sensors:** sensors that do not generate signals, they simply receive them from the target. The source must be an external one or the target itself.
  - **Active Sensors:** sensors that also play the role of the source. These sensors emits a signal that hits the target and, in its way back, brings information to the sensor itself. Trivial example: a camera with flash!

Passive Sensors



- **Pros:** They do not need components that emits radiation. Hence, they require low power and can thus be used in those situations where power consumption is critical.
- **Cons:** They need an external source and, thus, can only use the available type of perturbation. For example, a passive sensor in the visible EM spectrum cannot be used by night.

Active Sensors



- **Pros:** They do not depend on external sources. Hence, they can operate using the most useful type of perturbation for the specific target and medium. Furthermore, it is possible to measure the time-of-flight
- **Cons:** they need an emitting component and thus usually have high power consumption