Definitions of Remote Sensing

Can be very general, e.g.
“The acquisition of physical data of an object without touch or contact” (Lintz and Simonett, 1976)
“The observation of a target by a device some distance away” (Barrett and Curtis, 1982)

Or more specific, e.g.
“The use of electromagnetic radiation sensors to record images of the environment, which can be interpreted to yield useful information” (Curran, 1985)
Definitions of Remote Sensing

Or more specific, e.g. “The use of sensors, normally operating at wavelengths from the visible to the microwave, to collect information about the Earth’s atmosphere, oceans, land and ice surfaces” (Harris, 1987)

Main characteristics
- Physical separation between sensor and target
- Medium = electromagnetic radiation (sonar is an exception)
- Device to sample and measure radiation (sensor)
- Target is the terrestrial environment (atmosphere, oceans, land surface)

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Device to sample and measure radiation (sensor)

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Structure

- Definitions of Remote Sensing
- **Origins of remote sensing**
- Types of aerial photograph
- Photogrammetry
- Parallax
- Human vision
- Conclusions

Origins of Remote Sensing

Remote sensing began with aerial photography
Origins of Remote Sensing

First photographs taken in 1839

1858 Gasper Felix Tournachon "Nadar" takes photograph of village of Petit Bicetre in France from a balloon

Paris by Nadar, circa 1859

Boston by Black and King (1860)
World War One was a major impetus to development of aerial photography.

After the war the technology was in place to begin large scale aerial surveys.

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Types of aerial photograph

- Vertical
- Low oblique
- High oblique
Types of aerial photograph

• Vertical
• Low oblique (no horizon)
• High oblique

Vertical is most important as it has minimum distortion and can be used for taking measurements.

Fiducial marks
An aerial photograph mission will be flown in strips, shutter timing set for 60% endlap (needed for parallax) and strips spaced for 30% sidelap (to avoid missing bits).

- Endlap (or forelap) is the important bit
- It ensures every point on the ground appears in at least two photographs
- Distance between principal point of adjacent photographs is known as the “air base”
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Photogrammetry

If you know focal length of camera and height of aircraft above the ground you can calculate the scale of the photograph.

\[
\text{Scale} = \frac{f}{H-h}
\]

where:
- \( f \) is the focal length (distance from centre of lens to film surface)
- \( H \) is the flying height of aircraft above sea level
- \( h \) is the height of ground above sea level
Photogrammetry

When you know the scale you can take 2-D measurements from a photograph (e.g. horizontal distance, horizontal area, etc.)

But to take “true” measurements on an uneven surface you need to work in 3-D

You can do this thanks to parallax

Photogrammetry

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**Parallax**

Pencil is very displaced because it is close to observer
Church is less displaced because it is further away

Parallax is used to find distance to stars, using two viewing points on either side of Earth’s orbit

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**Parallax**

\[ \text{Height of object} = \frac{H \cdot dP}{P + dP} \]

*For convenience the photo base length of a stereo pair is commonly substituted for absolute stereoscopic parallax (P)*
Human vision

3-D stereoptic viewing of the Earth’s surface is possible using overlapping pairs of vertical stereo aerial photographs.

Human vision

- Cones are sensitive to radiation of specific wavelengths (either red, green or blue)
- Rods are sensitive to all visible wavelengths
Human vision

Two types of light-sensitive cells are present in the retina:

- Cones are clustered around the *fovea centralis*
- Rods are widely distributed elsewhere

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Conclusions

- Remote sensing involves collecting information about the Earth from a distance using electromagnetic sensors
- It evolved from aerial photography
- Vertical stereopairs of aerial photographs are used to take 3-D measurements by measuring parallax
- Human vision is binocular, enabling us to resolve parallax for depth perception
- Human vision includes perception of colour