

Lecture 2 Propagation of Electromagnetic Radiation, Waves and direction finding
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Terms

Radio wave - An electromagnetic wave of a frequency arbitrarily lower than 300 GHz

Electromagnetic wave - A wave produced by the interaction of time-varying electric and magnetic fields

Wave propagation - Movement and behavior of electromagnetic waves in the atmosphere

Telemetry - The use of telecommunication for automatically indicating or recording measurements at a distance from the measuring instrument

Radio Waves

- Produced by charged particles (electrons/protons) changing their direction or speed hence emitting electromagnetic radiation. Long wave length, low frequency and low energy form is called radio waves.
- 3 Cartesian coordinates x, y, and z
 - Electromagnetic field, magnetic field, and direction of propagation
- Travels at the speed of light
- Pass over conductive materials (i.e. antenna) and create an oscillating current (picked up by receiver)
- VHF waves propagate in straight lines (LOS)

Refraction

- As EM waves pass from one substance to another, the speed and direction of propagation change
- Freq. stays the same
- Lower freq. more sharply refracted
- Allows for telemetry in fresh water, through forests

Reflection

- Radio waves bounce off surfaces of the environment
- Predictable angle, higher freq > reflection
- Implications
 - Inaccurate bearings
 - Can't tell if bounce is taking place
 - Impacted by terrain

Diffraction

- Ability of radio waves to bend around obstacles
 - Longer wave lengths have greater ability to bend
 - Objects in the path of the wave create a shadow

Polarization

- Orientation of the electronic component of an EM wave
 - Polarized in the direction of the axis of the transmitting antenna
 - Receiving antenna = transmitting antenna

- Implications
 - Antenna orientation
 - Polarization important in fixed stations

Transmitters

Antennas used

- Whip
- Loop
- Dustcore

Keep in mind when choosing transmitting antenna

- Animal suitability
- Operating frequency
- Method of external connection

Antennas

- Dipole
- Loop
- Multi-element
- Adcock ('H')
- Yagi

Direction Finding

- Found by locating the direction of the strongest signal (loudest)
 - Adjusting gain
 - Taking bearing or homing animal

Triangulation

- When multiple bearings are taken within a short period of time to estimate transmitter location
 - >bearings >accuracy
 - Position is estimated by polygon formed by intersection of bearing lines

References

Amlaner, C.J., 1981. The Design of Antennas for Use in Radio Telemetry. University of Oxford. Pp. 251-261.

British Columbia Ministry of Environment, Lands and Parks. 1998. Wildlife Radio-telemetry standards for components of British Columbia's Biodiversity No. 5 B.C. Resource Information Standards Committee.

Mech, L.D. 1983. Handbook of Animal Radio Tracking. University of Minnesota Press, Minneapolis.

Websites

<http://outreach.atnf.csiro.au/education/everyone/radio-astronomy>

http://imagine.gsfc.nasa.gov/docs/science/know_I1/emspectrum.html