Environmental Remote Sensing

Satellite, airborne and field

Lecturer: Dr. Shimrit Maman

3 hours once a week • **4** credits* • Undergraduate

Course description

Remote Sensing is the technology enabling to acquire information about an area or object without direct physical contact with that area or object. Forms of remote sensing include aerial photographs (nowadays mostly UAVs), satellite images, and field spectroscopy.
This course aims to provide students with both remote sensing theory and practical applications using examples of environmental research and applications. The science and technology of remote sensing will be overviewed alongside hands-on measurements linking satellite, airborne and field data.

GRADING

Your performance in this class will be assessed through discussion, writing, and presenting your final project. Assessments are determined by several components, including:

Class assignments	30%
Final project and presentation	30%
Final exam	30%
Participation, attendance, punctuality	10%

SYLLABUS

Lecture 1– (TBD): From pigeons to CubeSats

- Course overview, expectations and learning styles
- Earth Observations: History, present and future
- Environmental applications and research using RS

Lecture 2+3 – (TBD): Physical basis of remote sensed data

- Definitions: EM spectrum and radiation, reflection and thermal emission
- Interaction of EM radiation with matter: reflection, absorption and transmission

- Interaction of EM radiation and atmosphere including atmospheric scattering, and atmospheric windows.
- Characteristics of Remotely Sensed Data: physical principles behind the interaction of EM radiation and multiple types of land cover (vegetation, water, minerals, rocks, etc.)

Lecture 4 – (TBD): Satellites and Sensors
- Modes of Acquisition
- Acquisition Platforms and orbits
- Multispectral vs hyperspectral scanners and imaging devices

Lecture 5 – (TBD): Resolutions
- Spectral, Spatial, Radiometric and Temporal
- Spectral response curves (using Spectool)

Lecture 6 – (TBD): Acquiring Data 1. Imagery and Terrain
- Choosing the appropriate sensor – class assignment.
- Preparation for field measurements

Lecture 7 – (TBD): Acquiring Data 2. Field Measurements and validation
- Collecting field data (multi and hyper) – **outdoor measurements**
- Spectroscopy and Field validation.
- Thermal imaging.

Lecture 8 – (TBD): Introduction to Image processing and interpretation
- Integration of RS with GIS & GPS.
- Georeferencing Technique.
- Basic image enhancement techniques

Lecture 9 – (TBD): Environmental applications 1: Vegetation, Forestry and Agriculture
- Indices and band ratio
- Normalized Difference Vegetation Index (NDVI)

Lecture 10 - (TBD): Environmental applications 2: Land, Geology, Climate & Meteorology, Oceanography and water bodies
- Classifying Imagery and Derived Products: LULC

- Change detection

Lecture 11– (TBD): Microwave and Lidar sensing

- Active vs. passive RS
- Optical vs. Radar image interpretation
- Surface topography and deformation

Lecture 12 – (TBD): Student presentations & Next generation of Earth observations

- From theory to observations to environmental application – **project presentation**
- CubeSats, BGUSAT
- Advanced hyperspectral future missions
- Course conclusions

Lecture 13 – (TBD): Final Exam

COURSE READINGS

- August, Y., & Stern, A. (2013). Compressive sensing spectrometry based on liquid crystal devices. Optics Letters, 38(23), 4996-4999.
- Ben-Dor, E., Patkin, K., Banin, A., & Karnieli, A. (2002). Mapping of several soil properties using DAIS-7915 hyperspectral scanner data-a case study over clayey soils in Israel. International Journal of Remote Sensing, 23(6), 1043-1062.
- Borengasser, M., Hungate, W. S., & Watkins, R. (2010). Hyperspectral remote sensing: Principles and applications Crc Press.
- Campbell, J. & Wynne, H. "Introduction to Remote Sensing", (5th Ed.), The Guildford Press, New York, 2012.
- Clark, R. N. (1999). Spectroscopy of rocks and minerals, and principles of spectroscopy. Manual of Remote Sensing, 3, 3-58.
- Drury, S. A., "Image Interpretation in Geology", 2nd Ed, Allen & Unwin, 1993.
- Cracknell, A.P., "Introduction to Remote Sensing", (2nd Ed.), Tylor & Francis, London, 1991.
- Goetz, A. F., Vane, G., Solomon, J. E., & Rock, B. N. (1985). Imaging spectrometry for earth remote sensing. Science (New York, N.Y.), 228(4704), 1147-1153. doi:228/4704/1147 [pii]
- Govender, M., Chetty, K., & Bulcock, H. (2007). A review of hyperspectral remote sensing and its application in vegetation and water resource studies. Water Sa, 33(2).
- Gupta, R. P., "Remote Sensing Geology", 2nd Ed., Springer, 2003.