

Image Processing for Remote Sensing

ECE697RS

Instructor

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Office hours: TBD Class website: TBD

Required Textbook

Weekly assigned readings, no required textbook.

Optional References

- John A. Richards, Xiuping Jia, *Remote sensing digital image analysis: an introduction*, Springer, 2006.
- Robert A. Schowengerdt, *Remote sensing: models and methods for image processing*, Academic Press, 2007.
- John R. Schott, *Remote sensing: the image chain approach*, Oxford University Press US, 2007.

Learning purposes

This course is a comprehensive introduction to the numerical algorithms and techniques for processing and analyzing remote sensing images of Earth and other planets. The class will focus on statistical analysis with methods borrowed from classical image processing and machine learning but will exploit the physics underlying the remote sensing image formation process. Examples of research topics that will be covered include image texture recognition, image classification, spectral unmixing and change detection.

Prerequisites

Students possessing some familiarity with concepts of signal theory equivalent to those obtained in ECE 608 are encouraged to apply. Although attendance of ECE 608 is not a requirement and the necessary concepts for this class could be learned along the way, student unfamiliar with signal theory should consult with instructor.

| Week | Topics/Sections | Some Standard Examples/Concepts |
|-------------|---|---|
| 1 | Introduction and review | Course introduction, math review, platforms, sensors, image statistics, geostatistical analysis |
| 2 | Image calibration and atmospheric removal | Atmospheric and terrain energy matter interactions, path radiance. Atmospheric correction: empirical line calibration and other image base approaches. Topographic correction |
| 3 | Image geometric processing | Internal and external geometric error, Ground Control Points, coordinates transform, resampling, mosaicking |
| 4 | Pre-processing of remotely sensed data | Image enhancement, dimensionality reduction, contrast enhancement, visualization, image denoising |
| 5 | Contextual and texture measures | Texture statistics, texture recognition and synthesis, random fields |
| 6 | Target and anomaly detection | Difficult targets, background characterization and removal, |
| 7 | Supervised image classification | Ground truthing, cross-validation, hyperspectral image classification techniques |
| 8 | Unsupervised image classification | Clustering and image segmentation of hyperspectral data |
| 9 | Spectral unmixing | Supervised and unsupervised linear and nonlinear models for spectral unmixing, spectral libraries, validation of unsupervised unmixing |
| 10 | Change detection | Feature and distribution matching |

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| 11 | Thermal infrared remote sensing | Brightness temperature and emissivity mapping |
| 12 | Data Fusion | Fusion of datasets from different instruments, spatial and spectral resolution issues, panchromatic sharpening |
| 13 | Final project | |
| 14 | Final project | |
| 15 | Final Presentation | |
| 16 | Project report due | |