ECE 7402: Advanced Machine Learning for Remote Sensing Image Interpretation

Course Description

Introduces basic high-resolution remote sensing concepts with focus on optical remote sensing, and computational solutions for typical remote sensing problems. Students are assumed to know basic knowledge in statistical estimation, linear algebra and numerical methods for engineering. Students with prior experiences on remote sensing/machine learning/computer vision will find this easier to follow

Transcript Abbreviation: MACH LEARN REM SEN
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Graduate
Student Ranks: Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Graduate standing, or instructor permission
Exclusions: Not open to students with credit for CIVILEN 7421
Cross-Listings: Cross-listed with CIVILENG 7421

Course Rationale: No existing advanced course on theories, methodologies math details of the existing

tools

and beyond in remote sensing.

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.0801
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

The students understand both the geometric and spectrum characteristics of common remote sensing data
The students understand the basic concepts in statistical learning and deep learning;
The students should be able to design algorithmic flows for typical remote sensing problems such as object detection, semantic segmentation, and change detection, and will be able to implement their own system with state of the art packages.
Students will be able to understand image formation, spectral analysis, segmentation, and machine learning based object recognition.
Students will be able to incorporate relevant knowledge into their Ph.D. or Master Research topics.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction to remote sensing	3.0							
Image geometry and spectroscopy	3.0							
Spectroscopic analysis with remote sensing images	3.0							
Statistical learning, SVM and applications to land cover classification of remote sensing images (optical and SAR)	3.0							
Decision-tree and random forest, for application of landcover classification of low-to-high resolution satellite images	3.0							
Neural networks and backpropagation	3.0							
Feature engineering using remote sensing multispectral images remote sensing linear indices	3.0							
Feature Engineering Spatial and geometric features on remote sensing dataset	3.0							
Deep learning for semantic segmentation of satellite images	3.0							
Common architectures for satellite images	3.0							
GAN for remote sensing image synthesis and super-resolution	3.0							
Deep learning for multi-source data fusion	3.0							

Grades

Aspect	Percent
Homework	70%
Final project	30%

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
	c	An ability to design a system, component, or process to meet desired needs.
	d	An ability to function on multi-disciplinary teams.
	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.

Course Contribution		College Outcome
	j	A knowledge of contemporary issues.
	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CpE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
*	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
*	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
**	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
	7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

EE ABET-EAC Criterion 9 Program Criteria Outcomes

Course Contribution		Program Outcome
	1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
	2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
	3	an ability to communicate effectively with a range of audiences
	4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
	5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
	6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
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Prepared by: Betty Lise Anderson