Master in Information and Communications Sciences

Emphasis: Geomatics

NAME OF THE SUBJECT: ADVANCED METHOD IN IMAGE ANALYSIS

- Obligatory (X): Basic ( ) Complementary ( )
- Elective (): Intrinsic ( ) Extrinsic ( )

NUMBER OF ACADEMIC CREDITS: Four (4).

COURSE TYPE: THEORETICAL: ___ PRACTICAL: ___ THEORETICAL-PRACTICAL: _X_
Methodological alternatives:
Master Class (X), Seminar ( ), Seminar - Workshop (X), Workshop ( ), Practice (X), Tutored projects ( ), Other: _____

Justification

A teacher in information science with an emphasis on geomatics should deepen Concepts, techniques and methods used to extract information about the biophysical medium from digital images.

A master in information and communications science with an emphasis in geomatics must internalize the mathematical operations that are used in the processing and analysis of digital images, not only those that have been traditionally used in remote sensing applications, but also the most advanced techniques They have been used. generated in other disciplines.

An information science teacher with an emphasis in geomatics must be able to use a programming language to implement, adapt and / or use in a creative and critical way several machine learning algorithms in digital image processing. In this way, you can make better use of the potential that remote sensing offers to obtain thematic information.

PREREQUISITE: Remote Sensing, linear algebra

GENERAL OBJECTIVE

Understand and apply theoretical concepts and perform practical exercises related to digital image processing to develop a creative and critical perspective on remote sensing applications.

The main issues to be resolved are:

Is it possible to define a conceptual framework for extracting thematic information from remote sensor images?
What is the most appropriate spatial unit for analyzing a digital image?
What are the basic principles of pattern recognition?
What are the mathematical concepts used in advanced algorithms such as vector support machines, decision trees and random forests?
What are the most useful texture measures in the classification of sensor images?
remote?
How can advanced algorithms be used in classification or regression tasks?

SPECIFIC OBJECTIVES

- Define a conceptual framework to extract information from the biophysical medium from images of remote sensors.
- Understand the basic principles of pattern recognition and its association with image classification processes.
- Understand what are the criteria to define the most appropriate spatial unit to perform digital image analysis.
- Understand what vector support machines, decision trees and random forests are and learn how to apply these algorithms with digital images
- Evaluate different texture measures and evaluate their usefulness in the classification of land cover.

Content

SYNTHETIC PROGRAM:

MODULAR UNIT 0. BASIC CONCEPTS IN IMAGE ANALYSIS: Explain the principles and concepts that constitute the state of the art of remote sensor image analysis.
Topics:
- Satellite image data

- Image display
- Image statistics
- Radiometric, geometric corrections and image enhancements.
- Precision thematic and geometric evaluation.

MODULAR UNIT 1. ADVANCED CONCEPTS OF IMAGE ANALYSIS: Explain the principles and concepts that constitute the state of the art of remote sensor image analysis.
Topics:
- Data sources
- Types of thematic information that can be extracted from a digital image.
- Pixel based analysis
- Image object based analysis
- Thematic and geometric precision evaluation.

MODULAR UNIT 2. PRINCIPLES OF PATTERN RECOGNITION: Explain the fundamental concepts of pattern recognition and its relationship to the classification of digital images.
Topics:
- Manipulation in the spectral space.
- Selection of predictive variables.
- Fundamental pattern recognition techniques
- Combination of classifiers.
- Incorporation of additional information.
- Sampling schemes and sample size
- Thematic accuracy assessment

MODULAR UNIT 3. VECTOR SUPPORT MACHINES: Understand the theoretical concepts of vector support machines and make their application to obtain information on soil cover.
Topics:
- Linear classification
- Nonlinear classification - Parameter determination
- Multiclass classification
- Selection of predictive variables.
- Image classification of remote sensors

MODULAR UNIT 4. METHODS BASED ON DECISION TREES: Understand the basic concepts related to decision trees and make their application to obtain information on land cover.
Topics:
- Selection of predictive variables.
- Algorithms based on decision trees
- Tree pruning
- random forests

- Classification of images based on trees

MODULAR UNIT 5. TEXTURE-BASED METHODS: Review the state of the art of texture measurements and their application in image classification processes.
Topics:
- Texture measures
- Impact on thematic accuracy

Strategies

METHODOLOGY:

In the academic space, master classes are proposed, in which the topics proposed in the units are oriented and mandatory and optional readings are indicated. Also, practical workshops are carried out that allow to know the functionalities and basic parameters of use of the different algorithms. In addition, theoretical and practical work is done to understand and apply the concepts and evaluate the usefulness of the different algorithms.

	Hours			Teacher hours / week	Student hours / week	Total Hours Student / semester	Academic credits
Type of course	DW	CW	AW	(DW + CW)	(DW + CW +AW)	X 16 weeks	
	3	1	8	4	12	192	4

Direct Presential Work (DW): classroom work in plenary session with all students.
Mediated-Cooperative Work (CW): Teacher tutoring work to small groups or individually to students.
Autonomous Work (AW): Student work without the presence of the teacher, which can be done in different instances: in work groups or individually, at home or in a library, laboratory, etc.)

Resources

Next, each of the proposed resources will be described according to the model that will be completed:

Media and support: for this course, remote sensor images will be used in digital format available in the public domain and computer equipment with open source software, for example, the statistical program R, SNAP. Proprietary software such as ERDAS, ENVI.

Virtual classrooms: there is a virtual learning space where information specific to the academic program is shared https://ingenieria.udistrital.edu.co/course/view.php?id=1134. Moodle-UDIN - Francisco District University

Institutional mail: the institutional email through which you receive information from the University of the District and can be used for different academic purposes.

Guide and complementary texts:

B. Tso and P. M. Mather, Classification Methods for Remotely Sensed Data, Second Edition, CRC Press, 2009.
J. Gao, Digital Analysis of Remotely Sensed Imagery, McGraw-Hill, 2009.
J. R. Jensen, Introductory Digital image Processing – A remote sensing perspective, Third Edition. Prentice Hall, 2005.
P. M. Mather and M. Koch, Computer Processing of Remotely-Sensed Images, Fourth Edition, Wiley-Blackwell, 2011

Scientific Magazines: S
e recomienda para los espacios académicos de las áreas de profundización y/o investigación centralizarse más en artículos de revistas y de bases de datos

International Journal of Remote Sensing. An official journal of the Remote Sensing and Photogrammetry Society. Taylor & Francis.

Internet addresses:

Remote Sensing Letters. Rapid Communication Series of the IJRS. Taylor & Francis.
T. Hastie, R. Tibshirani and J.Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Second Edition. 2009. Springer.
http://www-stat.stanford.edu/~tibs/ElemStatLearn/

BIBLIOGRAPHIC RESOURCES:

- IEEE Database
- SPRINGER Database
- ELSEVIER Database

Course Schedule

Week /Unid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Basics in remote sensors	X	X	X													
2. Basics in image analysis				X	X	X										
3. Methods based on vector support machines							X	X	X							
4. Methods based on decision trees										X	X	X				
5. Methods based on textures													X	X	X	X

Evaluation

The evaluation criteria must be previously known by the students.

1. Assessment of student learning in its dimensions: individual / group, theory / practice, written oral.
2. Self-assessment: the evaluation of student performance by the student.
3. Co-evaluation of student performance among students and teachers.
4. Evaluation of teaching performance.

The evaluation will be carried out taking into account:

	TYPE OF EVALUATION	DATA	PERCENTAGE
FIRST **NOTE**	Partial in Moodle-UDIN - University of the District of Francisco 20%, Written report 15%	Week 5	35%
SECOND **NOTE**	Partial in Moodle-UDIN - University of the District of Francisco 20%, Written report 15%	Week 10	35%
Exam	Delivery of the final report and support.	Week 16	30%