



## Teaching Guide

| Teaching Guide             |   |               |  |         |
|----------------------------|---|---------------|--|---------|
| Identifying Data           |   |               | 2021/22                                  |         |
| <b>Subject (*)</b>         | Advanced Image Processing and Analysis  | <b>Code</b>   | 614535002                                |         |
| <b>Study programme</b>     | Máster Universitario en Visión por Computador   |               |  |         |
| Descriptors                |   |               |  |         |
| Cycle                      | Period  | Year          | Type                                     | Credits |
| Official Master's Degree   | 2nd four-month period   | First         | Obligatory                               | 6       |
| <b>Language</b>            | English   |               |  |         |
| <b>Teaching method</b>     | Hybrid  |               |  |         |
| <b>Prerequisites</b>       |   |               |  |         |
| <b>Department</b>          | Ciencias da Computación e Tecnoloxías da Información  |               |  |         |
| <b>Coordinador</b>         | Barreira Rodriguez, Noelia  | <b>E-mail</b> | noelia.barreira@udc.es                   |         |
| <b>Lecturers</b>           | Barreira Rodriguez, Noelia<br>Ramos García, Lucia   | <b>E-mail</b> | noelia.barreira@udc.es<br>l.ramos@udc.es |         |
| <b>Web</b>                 |   |               |  |         |
| <b>General description</b> | <p>This curricular unit addresses the most advanced topics in image processing and analysis and presents itself as a sequence of a curricular unit where the fundamental topics are presented. It is designed to provide the essential foundation for students wishing to pursue research in this area. In addition to the study and application of advanced techniques of image processing and analysis, applications in this area are studied that aim to solve real problems. This approach gives students the necessary tools to apply the algorithms studied in practical cases, as well as the basis for developing new algorithms.</p>   |               |  |         |
| <b>Contingency plan</b>    | <p>1. Modifications to the contents</p> <ul style="list-style-type: none"><li>- There are no changes</li></ul> <p>2. Methodologies</p> <p>*Teaching methodologies that are maintained</p> <ul style="list-style-type: none"><li>- Laboratory practice</li><li>- Guest lecture/keynote speech</li><li>- Objective test</li></ul> <p>*Teaching methodologies that are modified</p> <p>3. Mechanisms for personalized attention to students</p> <ul style="list-style-type: none"><li>- Email: daily to answer questions and schedule virtual meetings.</li><li>- Moodle: daily, depending on the needs of the students</li><li>- Teams: daily, depending on the needs of the students and one weekly session in group to assess the learning progress and the development of the assignments.</li></ul> <p>4. Modifications in the evaluation</p> <ul style="list-style-type: none"><li>- There are no changes</li></ul> <p>*Evaluation observations:</p> <p>5. Modifications to the bibliography or webgraphy</p> <ul style="list-style-type: none"><li>- There are no changes</li></ul> |               |  |         |



| Study programme competences |   |
|-----------------------------|---|
| Code                        | Study programme competences   |
| A1                          | CE1 - To know and apply the concepts, methodologies and technologies of image processing  |
| A3                          | CE3 - To know and apply the concepts, methodologies and technologies of image and video analysis  |
| A4                          | CE4 - To conceive, develop and evaluate complex computer vision systems   |
| A5                          | CE5 - To analyze and apply methods of the state of the art in computer vision   |
| B1                          | CB6 - To possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context |
| B5                          | CB10 - That students possess the learning skills to enable them to continue studying in a largely self-directed or autonomous manner                                      |
| B7                          | CG2 - Ability to analyze a company's needs in the field of computer vision and determine the best technological solution for it   |
| B8                          | CG3 - Ability to develop computer vision systems depending on existing needs and apply the most appropriate technological tools   |
| B10                         | CG5 - Ability to identify unsolved problems and provide innovative solutions  |
| B12                         | CG7 - Ability to learn autonomously for specialization in one or more fields of study   |

| Learning outcomes  |  |  |             |
|--|--|--|-------------|
| Learning outcomes  | Study programme competences  |  |             |
|  | Study and application of advanced digital image processing techniques. | AC1                                      | BC5<br>BC12 |
| Study and application of advanced techniques of digital image analysis.  | AC3  | BC5<br>BC12                              |             |
| Analysis of real problems, and design and development of solutions based on advanced image processing and analysis technologies. | AC4<br>AC5   | BC1<br>BC5<br>BC7<br>BC8<br>BC10<br>BC12 |             |
| Evaluation of the adequacy of the methodologies applied in specific problems.  | AC4  |  |             |
|  |  |  |             |

| Contents  |   |
|---|---|
| Topic   | Sub-topic   |
| Advanced denoising  | Total variation   |
| Advanced edge detection                                   | Bilateral filter<br>Anisotropic diffusion<br>Phase congruence   |
| Advanced segmentation                                     | Deformable models<br>Level-set methods<br>Markov Random Fields<br>Graph cuts  |
| Learning-based segmentation                               | Active shape/appearance models  |
| Saliency and attention models                             |   |
| Selected topics on advanced image processing and analysis | Semantic segmentation<br>Multi-view enhancement<br>Superresolution<br>Inpainting<br>Coloring<br>Photo stitching<br>Background removal |



## Planning

| Methodologies / tests          | Competencies                    | Ordinary class hours | Student?s personal work hours | Total hours |
|--------------------------------|---------------------------------|----------------------|-------------------------------|-------------|
| Laboratory practice            | A1 A3 A4 A5 B5 B7<br>B8 B10 B12 | 24                   | 80                            | 104         |
| Objective test                 | B1 B8 B10                       | 3                    | 0                             | 3           |
| Short answer questions         | A1 A4 A5                        | 0                    | 5                             | 5           |
| Guest lecture / keynote speech | A1 A3                           | 14                   | 24                            | 38          |
| Personalized attention         |                                 | 0                    |                               | 0           |

(\*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

| Methodologies                  | Description   |
|--------------------------------|---|
| Laboratory practice            | Analysis and resolution of practical cases using techniques learned in the lectures.  |
| Objective test                 | Test with questions about the theoretical contents of the subject as well as practical problems.  |
| Short answer questions         | Online quizzes with short answer questions about the topics learned in the lectures that will be used to assess the acquisition of knowledge. |
| Guest lecture / keynote speech | Oral presentation (using audiovisual material and student interaction) designed to transmit knowledge and encourage learning.                 |

## Personalized attention

| Methodologies       | Description   |
|---------------------|---|
| Laboratory practice | Teachers will answer the doubts during the laboratory practice and they will provide personal advising for the supervised projects. |

## Assessment

| Methodologies          | Competencies                    | Description  | Qualification |
|------------------------|---------------------------------|--|---------------|
| Objective test         | B1 B8 B10                       | Written test with theoretical questions and practical problems to be solved.   | 0             |
| Laboratory practice    | A1 A3 A4 A5 B5 B7<br>B8 B10 B12 | Practical exercises about the topics learned in the lectures. It will be assessed the suitability of the proposed solutions and the quality of the obtained results. | 80            |
| Short answer questions | A1 A4 A5                        | Online quizzes with short answer questions about the topics learned in the lectures that will be used to assess the acquisition of knowledge.                        | 20            |

## Assessment comments

The objective test is 100% of the final grade. However, students can achieve this percentage of the final grade with the laboratory exercises and the short answer questions during the year. This way, if the laboratory exercises and the short answer questions are presented, the exam is optional.

If a student submits the laboratory exercises and the short answer questions and attends the objective test, the grade obtained in the objective test will prevail over the grade achieved in the laboratory exercises and the short answer questions.

## Sources of information



|                      |   |
|----------------------|---|
| <b>Basic</b>         | <ul style="list-style-type: none"><li>- Gary Bradski, Adrian Kaehler (2008). Learning OpenCV. O'Reilly</li><li>- David A. Forsyth, Jean Ponce (2002). Computer vision: a modern approach. Prentice - Hall</li><li>- Richard Szeliski (2010). Computer vision: algorithms and applications. Springer</li><li>- Simon J.D. Prince (2012). Computer Vision: Models, Learning, and Inference. Cambridge University Press</li><li>- Ian Goodfellow, Yoshua Bengio, Aaron Courville (2016). Deep learning. MIT Press</li><li>- M. Sonka, V. Hlavac, R. Boyle. (2015). Image Processing, Analysis, and Machine Vision. 4th edition. Cengage Learning</li></ul> |
| <b>Complementary</b> |   |

## Recommendations

### Subjects that it is recommended to have taken before

Fundamentals of Machine Learning for Computer Vision /614535007

Fundamentals of Image Processing and Analysis /614535001

Image Description and Modeling/614535004

### Subjects that are recommended to be taken simultaneously

Visual Recognition/614535005

Advanced Machine Learning for Computer Vision/614535008

### Subjects that continue the syllabus

### Other comments

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.