VNIVERSITAT DE VALÈNCIA

# Course Guide
# 34318 Vision of movement and depth

## COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 34318 |
| **Name** | Vision of movement and depth |
| **Cycle** | Grade |
| **ECTS Credits** | 4.5 |
| **Academic year** | 2021 - 2022 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1207 - Degree in Optics and Optometry | Faculty of Physics | 4 | First term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 1207 - Degree in Optics and Optometry | 16 - Optional subjects | Optional |
| 1207 - Degree in Optics and Optometry | 20 - Visual perception: mechanisms and clinical applications | Optional |

**Coordination**

| Name | Department |
|---|---|
| MALO LOPEZ, JESUS | 280 - Optics and Optometry and Vision Sciences |

## SUMMARY

The subject presents the basic description of the movement as a variation of the irradiance in the image plane (speed as optical flow) and the dependence of it with the three-dimensional (depth) structure of the scene. The functioning of the physiological mechanisms in V1 and MT that allow the estimation of the speed in the human visual system is analyzed. Likewise, the consequences of binocular vision (for example binocular correspondences) are analyzed in the perception of the depth structure of the scenes, as well as the physiological basis for the realization of such calculations and their similarity with the estimation mechanisms of speed.

# PREVIOUS KNOWLEDGE

## Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

## Other requirements

There are no strict restrictions
It is convenient having attended to Psychophysics in 2nd year and Mechanisms and Models of Vision in 3rd year

# OUTCOMES

## 1207 - Degree in Optics and Optometry

- Knowing how to apply the knowledge acquired to professional activity, knowing how to solve problems and develop and defend arguments.
- Being able to gather and interpret relevant data to make judgments.
- Being able to transmit information, ideas, problems and solutions to both a specialized and non-specialized audience.
- Development of learning skills necessary to undertake further studies with a high degree of autonomy.
- To know the way in which the information of the various perceptual dimensions is integrated to make judgments about the scene.
- To know and to handle advanced vision models (non-linear and / or integrated by elements belonging to the extra striated cortex).

# LEARNING OUTCOMES

• Summation and binocular interaction mechanisms • Neurophysiological bases of depth vision.• Differences between perceived visual space and real space.• Disparity detection types• Depth perception limits.• Development and anomalies of depth perception • Recognition of the different approaches to the study of motion vision: (1) with shapes of objects analisys and their temporal evolution, and (2) from the temporal irradiance evolution (without object recognition).• Optical flow concept.• The relationship between the spatial structure of the optical flow and the 3D structure of the scene in relation to the observer movement.• Analysis of motion in the 3D Fourier domain • Speed perception limits: spatiotemporal CSF and visibility window.• Mechanisms tuned to spatiotemporal frequencies in V1 and to speeds in MT • Basic elements for generating sequences on a computer: spatial and temporal frequencies sampling and speed control.

## DESCRIPTION OF CONTENTS

### 1. Movement perception

1 Approaches to the study of the vision of movement
2 Concept of optical flow and relationship with the depth structure of the scene: movement-depth relationship
3. Optical flow equations
4. Psychophysical and physiological aspects of movement vision

### 2. dDepth perception

1. Binocular interaction and binocular summation.
2. The perception of space. Relationship between perceived space and real space.
3. Physiological mechanisms / psychophysics of depth detection: disparity and correspondence between images
4. Abnormalities of stereopsis

### 3.

## WORKLOAD

| ACTIVITY | Hours | % To be attended |
|---|---|---|
| Theory classes | 30,00 | 100 |
| Tutorials | 7,50 | 100 |
| Laboratory practices | 7,50 | 100 |
| Development of group work | 7,50 | 0 |
| Study and independent work | 60,00 | 0 |
| **TOTAL** | **112,50** | |

## TEACHING METHODOLOGY

The methodology includes (1) master class, (2) demonstration professorship experiments using simulation tools such as Vistalab (http://isp.uv.es/code/visioncolor/vistalab.html), and (3) practical sessions in the classroom of computer science where these tools are used to reinforce the learning of the concepts.

The work of the students has character:

• In person consisting of:

o Theory classes (exhibition and chair experiments)

o Practical classes in computer room designed to illustrate the models treated by solving exercises using simulation and calculation tools designed for the subject. This type of exercises is the core of the subject and therefore the assistance and completion of the exercises is mandatory

• Non-contact, formed by:

o Voluntary extension of the simulations presented in the demonstration sessions

o Preparation of the alternative exam if you decide not to attend the practical sessions (with the delivery of exercises).

• Individual and / or collective tutorials to monitor the evolution of the exercises.

## EVALUATION

The following options are taken into account in the evaluation (with their respective items and scores):

**Option 1:**

Evaluation based on the realization of the proposed practical exercises (necessary requirement to pass) and additional practical theoretical exam (voluntary) to raise the grade.

A- Delivery of the proposed numerical exercises (up to 64% of the final grade).

B- Attendance to the theoretical sessions - practices and demonstrative seminars (up to 5% of the final grade).

C- Examination of theoretical-practical issues (up to 31% of the final grade).

The fulfillment of sections A and B (the attendance and the correct execution of the exercises) is a necessary requirement to approve according to this Option 1. Otherwise it will be evaluated according to Option 2.

**Option 2:**

For students who decide not to attend the sessions regularly or present the exercises, an evaluation is proposed exclusively based on the examination of theoretical - practical issues.

The evaluation will be adjusted to the Qualification Regulations of the Universitat de València. At the time of drafting this teaching guide, the current regulations are those approved by the Governing Council of the UVEG of January 27, 2004, which is in accordance with what is established for that purpose by Royal Decrees 1044/2003 and 1125 / 2003. It basically establishes that the qualifications will be numerical from 0 to 10 with expression of a decimal and to which the qualitative qualification corresponding to the following scale must be added:

From 0 to 4.9: "Suspense"

From 5 to 6.9: "Approved"

From 7 to 8.9: "Remarkable"

From 9 to 10: "Outstanding" or "Outstanding with Honors"

## REFERENCES

### Basic

- Apuntes de clase y software de generación de estímulos proporcionadas por el profesor (disponibles en el aula virsual)
  Howard & Rogers. Binocular Vision & Stereopsis. Oxford UNiversity Press.
  B. Wandell. Foundations of Vision

### Additional

- Artículo Watson & Ahumada, JOSA A 1985
  Artículo Heeger, JOSA A 1987
  Artículo Heeger & Simoncelli, Vision Research 1998

## ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

TEACHING METHODOLOGY

In the event that the health situation requires a hybrid teaching model, the teaching modality approved in the Academic Degree Committee in a session of July 20, 2020 will be adopted, which consists of 100% presence of the students in all activities, but with a classroom capacity of 50% in theory classes.

If a total reduction in attendance is required, then the synchronous videoconference modality would be used, given at the time set by the subject and the group, during the period determined by the Health Authority.