COURSE DATA

Data Subject	
Code	34318
Name	Vision of movement and depth
Cycle	Grade
ECTS Credits	4.5
Academic year	2023 - 2024

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

Introduction. Uses of movement information.
Limits of vision in the spatio-temporal domain.
Spectrum of a moving scene. The optical flow equation.
Graphic representation and motion vision models (single channel vs multichannel).
Apparent movements.
On the physiological mechanisms of motion perception.

2. dDepth perception

Interaction and binocular summation.
The perception of space. Relationship between perceived space and real space.
Physiological and psychophysical mechanisms for depth detection: disparity and correspondence between images.
Stereopsis abnormalities.

3.

Generation of moving sequences.
Filtering of sequences with the spatio-temporal CSF.
Responses of spatio-temporal neurons in V1 and MT.
Optical flow in depth navigation.

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

Option 1: Assessment based on the completion of the proposed practical exercises and examination of additional theoretical-practical questions (voluntary) to raise the grade.

A.- For the delivery of the practical exercises proposed in both the theoretical and practical sessions (69% of the final mark).

B.- For the examination of theoretical-practical questions (31% of the final mark).

The mandatory compliance conditions to be evaluated for this modality are:

1.-Attendance at practical sessions (seminars and laboratory).

2.-Achieve a minimum grade of 5 in the exercises presented.

Option 2: For students who decide not to regularly attend the practical sessions or do not present the exercises, an evaluation based exclusively on the examination of theoretical-practical questions is proposed (100% of the final grade).

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