GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2026-2027

Visual Computing (E010311)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2026-2027

A (semester 1)	English	Gent
B (semester 1)	Dutch	Gent

Lecturers in academic year 2026-2027

Goossens, Bart	TW07	lecturer-in-charge
Philips, Wilfried	TW07	co-lecturer

Offered in the following programmes in 2026-2027	crdts	offering
Bridging Programme Master of Science in Computer Science Engineering	6	A
Master of Science in Electrical Engineering (main subject Communication and Information Technology)	6	A
Master of Science in Electronics and ICT Engineering Technology(main subject Electronics Engineering)	6	A
Master of Science in Electronics and ICT Engineering Technology(main subject Embedded Systems)	6	A
Master of Science in Electronics and ICT Engineering Technology(main subject ICT)	6	A
Master of Science in Computer Science	6	A
Master of Science in Computer Science Engineering	6	B
Master of Science in Computer Science Engineering	6	A
Master of Science in Information Engineering Technology	6	A
Exchange Programme Electronics and ICT Engineering Technology	6	A
Exchange Programme in Computer Science (master's level)	6	A

Teaching languages

English, Dutch

Keywords

Imaging, camera models, color reproduction, image representations, image data structures, image display

Position of the course

This course offers an introduction to the fundamental concepts and techniques of visual computing. The entire processing chain of visual information is covered: from light and image acquisition and sensory perception to image representations, analysis, reconstruction, and display.
The course discusses the underlying principles in terms of physics, mathematics, and computer science, which form the foundation of modern visual systems. These principles are illustrated with application examples from industry and scientific research in the fields of image enhancement, 3D reconstruction, and AR/VR.

Contents

Image Acquisition and Perception:

- Physical properties of light and its interaction with materials
- Photometric and radiometric quantities, reflection models (BxDF)
- Sensors and imaging: conversion of light into digital signals, exposure parameters, dynamic range, lens behavior, depth of field, camera models
- The human visual system: color perception, stereoscopy, perceptual aspects
- Sampling theory, linear filtering

- Computational imaging and applications

Estimation Theory:

- Basic principles of estimation theory (maximum likelihood estimator, maximum a posteriori estimator), applied to image/video
- Noise models and image statistics, probabilistic image models
- Linear and nonlinear image processing techniques: inverse filters, regularization, Wiener filtering, linear and nonlinear diffusion

Representations and Data Structures:

- Color representation and color adaptation
- Plenoptic function with links to light fields, motion fields, etc.
- Structured and unstructured data (pixels, voxels, point clouds)
- Implicit and explicit 3D representations (SDF, NeRF, 3DGS)
- Image and video representations
- Conversion between representations, image transformations
- Multiscale representations and wavelets

Rendering, Analysis, and Modeling:

- Image reproduction: display systems
- Introduction to computer graphics: simple graphics pipelines, rasterization, shading models, ray casting
- Basic techniques for image and video analysis, segmentation techniques
- Light field visualization for immersive applications

Initial competences

Basic knowledge of mathematics and physics

Final competences

1 Understanding the principles of image formation, analysis and synthesis
2 Processing image and video data, analysis and visualization using appropriate algorithms and models
3 Modeling visual systems based on concepts from physics and mathematics
4 Modeling visual systems based on concepts from physics and mathematics

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, Practical

Extra information on the teaching methods

Practical sessions:

- Application of image processing and visualization techniques
- Implementation and analysis of algorithms on real image and video data
- Experimentation with parameters, noise, filtering and visualization

Study material

Type: Syllabus

Name: Course text Visual Computing
Indicative price: € 12
Optional: no
Language : English
Number of Pages : 200
Oldest Usable Edition : 2026
Available on Ufora : No
Online Available : No
Available in the Library : No
Available through Student Association : No
Additional information: The syllabus is intended for clarifying, supplementing and deepening the presentations, but it does not contain additional study material.

References

W.K. Pratt. *Digital Image Processing*. John Wiley, 2001. ISBN 0-471-37407-5
R.C. Gonzalez and R.E. Woods. *Digital Image Processing*. Addison-Wessley, 3rd edition, 1992. ISBN 0201508036

Szeliski, R. (2022). *Computer vision: algorithms and applications*. Springer Nature. ISBN 978-1848829343
Zhang, Y. J. (2024). *3D Computer Vision: Foundations and Advanced Methodologies* (pp. 1-469). Springer. ISBN 978-981-19-7602-5

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

Periodic assessment: written closed-book exam.
Non-periodic assessment: assessment of practical reports.
Students who fail in the first exam period can only retake the theoretical part in the second exam period.

Calculation of the examination mark

The final score is a weighted average of the practical work (1/3) and the exam (2/3), except when the practical score is below 8.
In that case, the final score equals min(exam score, practical score -2).