Information Technologies for Image Processing

Classification	Module ID	Kind of Module	Number of Credits (ECTS)
		Elective	5

Location	Language	Duration of Module	Frequency of Module	Max. Number of Participants
Online	English	One Semester	Winter Semester	60

Module Convenor	Professor / Lecturer
Assoc. Prof. Dr. Nataliia Bezugla	Assoc. Prof. Dr. Nataliia Bezugla

Prerequisites*

Knowledge of higher mathematics, special topics in mathematics and programming.
*** Note: Please also note the prerequisites according to the examination regulations in the respective valid SPO version.**

Usability	Teaching Methods	Workload
The module is offered by the Department of Computer-Integrated Technologies of Device Production, Igor Sikorsky Kyiv Polytechnic Institute, as an elective module for the Digital Technology and Management Bachelor's degree programme. The usability in other courses of study must be checked in each individual case.	Lecture; practical exercises in Python (NumPy, Matplotlib, OpenCV); short student presentations	Contact time: 60 h Self-study: 60 h Exam preparation: 30 h Total effort: 150 h

Learning Outcomes
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After successful completion of the module, students will have acquired the following professional, methodological and personal skills and competencies:
Professional Skills:
- Students can explain how images of various types are formed and how digital images are sampled, quantised, coded and stored.
- Students are able to apply geometric, arithmetic, logical and morphological operations as well as enhancement, filtering and restoration methods to digital images.
- Students can extract image features, perform segmentation and template matching, and explain the fundamentals of object recognition.

Methodological Skills:
- Students are able to use the Python libraries NumPy, Matplotlib and OpenCV to develop their own image processing programs and applications.
- Students can apply mathematical modelling and numerical methods to select a suitable processing algorithm for a given task.

Personal Skills (Social Competence and Self-competence):
- Students are able to research additional information independently and present it briefly to their peers.

Course Content

Methods and tools for forming images of various types and their mathematical representation. Digital images: sampling and quantisation, compression, storage and coding. Main stages and applications of digital image processing. Geometric, arithmetic and logical operations on images: translation, skew, rotation. Image enhancement: contrast adjustment, histogram transformations, sharpening. Image filtering: optimal linear, median and non-linear filtering. Image restoration: algebraic, filtering-based and iterative methods, compensation of edge effects. Image analysis: feature extraction, segmentation, correlation-extremal methods. Fundamentals of object recognition: decision-theoretic and structural methods. Practical work in Python with NumPy, Matplotlib and OpenCV: creating, saving and reading images, geometric operations, morphological processing, segmentation and template matching.

Literature

1. Gonzalez R. C., Woods R. E. Digital Image Processing. Reading, Massachusetts: Addison-Wesley, 1992.
2. Borovytskyi M. V. Development of Programs for Digital Image Processing Using OpenCV. Kyiv: Igor Sikorsky KPI, 2022 (in Ukrainian).
3. Drobyk O. V. et al. Digital Processing of Audio and Video Information in Multimedia Systems. Kyiv: Naukova dumka, 2008 (in Ukrainian).
4. Young I. T., Gerbrands J. J., Van Vliet L. J. Fundamentals of Image Processing. 1998.
5. VanderPlas J. Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly Media, 2017.

Internationality (content-related)

The module uses the international reference literature on digital image processing and open-source tools (Python, OpenCV) that are standard in research and industry worldwide.

Method of Assessment (if applicable, notes on multiple choice as form of examination - APO §9a)

Form of Examination*1)	Type/Scope incl. Weighting*2)	Learning Objectives/Competencies to be Assessed
Portfolio examination	Defences of practical assignments (4): 60 % Written tests (2): 40 % Optional written credit test (two theoretical and one practical question) to improve the semester rating	All of the above-mentioned competencies are assessed by way of the aforementioned examination forms.

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden
*2) Please provide additional information on the weighting (in % share) and, if applicable, explain the bonus system.