COURSE DESCRIPTION CARD - SYLLABUS

Course name
Image processing and analysis [S1MiBM2>PiAO]

Course

Field of study
Mechanical Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge about technical metrology, optical measurement systems, mathematical analysis and statistics, basic of image processing.

Course objective

Getting to know about modern methods of image processing and analysis. Acquiring knowledge about mathematical methods for measurement results analysis, data processing algorithms, and processing techniques of images obtained by optical measurement systems. Getting to know about free software environment for image processing - R.

Course-related learning outcomes

Knowledge:
A student can:
describe optical measurement signals,
describe tools for image analysis,
prepare an algorithm for image processing and analysis.

Skills:
A student can:
choose the right mathematical tool for image processing and analysis,
roughly prepare an optical measurement data analysis procedure,
elaborate and analyse images,
describe data analysis error sources and reduce their influence.

Social competences:
A student can collaborate in a group.
A student knows the role of image processing and analysis in modern science and technology.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Summative assessment:
Lectures: final course test, written (4 open questions)
Laboratory: written/oral answer + lab reports; passing rules: positive assessments for all lab exercises.

Programme content

Lectures:
1. Optical measurement systems - an introduction.
2. Mathematical aspects of image processing.
3. Languages and programs for optical data processing.
4. Basis of R environment for image analysis.
5. Methods of image filtering.
6. Methods of image processing and analysis.
7. Optical signals in holography and interferometry.
8. Examples of image processing and analysis in R.
9. Examples of image processing and analysis in various fields of science and technology.

Laboratory:
Lab exercises:
1. Principles of optical data importing to an analysis setup.
2. Algorithms preparation for imported image evaluation.
3. Processing and analysis of holographic images in microscopy.
4. Processing and analysis of interferometric images for surface texture measurements.
5. Processing and analysis of images in optical hardness Brinnel tests.
6. Development of methods for data presentation and reporting.

Course topics

none

Teaching methods

Lectures: oral presentation with illustrated examples on a blackboard, discussions and tasks analysis.
Laboratory: practical exercises, teamwork, tasks solving, discussions

Bibliography

Basic:
1. Tadeusiewicz, R., Korohoda, P. (1997). Komputerowa analiza i przetwarzanie obrazów. Wydwnictwo Fundacji Postępu Telekomunikacji, Kraków.
https://winntbg.bg.agh.edu.pl/skrypty2/0098/komputerowa_analiza.pdf
2. Rogalski, A., Bielecki, Z., (2020). Detekcja sygnałów optycznych (wyd. II). Wydawnictwo Naukowe PWN, Warszawa.

Additional:
1. Kabacoff, R. I. (2015). R in Action (Second). Manning. http://www.worldcat.org/isbn/9781617291388
2. Pau, G., Fuchs, F., Sklyar, O., Boutros, M., & Huber, W. (2010). EBImage--an R package for image processing with applications to cellular phenotypes. Bioinformatics, 26(7), 979-981.

https://doi.org/10.1093/bioinformatics/btq046
3. Jiang, J., & Dong, J. (2011). Effective methods for Brinell Hardness Measure based on vision. 2011 4th International Congress on Image and Signal Processing, 4, 1884-1888. https://doi.org/10.1109/CISP.2011.6100587
4. Meijer, F., Kucharski, D., & Stachowska, E. (2018). Determination of the phase in the center of a circular two-beam interference pattern to determine the displacement of a rough surface. Optical Engineering, 57(10), 1. https://doi.org/10.1117/1.OE.57.10.104101

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00