

Course “Image processing”

Field of study: Applied and Computer Optics

Course level: Master

Specialization: 200400.68. Optical design

	Hours						
Semester	Workload	Lectures	Practical work	Lab.	Seminar	Independent studies	Tests
spring	108	17	-	51	20	20	Exam

Abstract

Course “Image processing” covers wide range of issues, related to main methods of image processing for visual improvement. The course includes the study of main color models and their mutual conversions, methods of element wise image processing, including methods of preparation. The main emphasis of the course is on methods of image improvement and recovery using different kinds of filtering.

Goals and Objectives of the Course

Knowledge of

- modern principles of computer coding of images, including methods of color-coding;
- basic computer image processing algorithms and their practical importance;
- theory of digital signal processing and methods of image processing.

Theoretical Skills

- be able to assess the need for methods of image processing;
- be able to choose the most productive method for image processing.

Practical Skills

- be able to use methods and means of computer processing of images;
- be able to implement mathematical models of image processing in the form of software modules.

Course prerequisites:

Knowledge in physics, mathematical analyses, theory of geometrical and physical optics; ability to work with mathematical apparatus and mathematical software; basic knowledge of C/C++ and basic skills in GUI programming (Qt or MFC).

Course structure

Volume of the course: 3.0 ECTS credits, 108 hours

Chapter	Types of activities					Total in hours
	Lectures	Practical work	Laboratory work	Seminar	Independent studies	
Basics of registration, modeling and digital processing optical image	8	-	24	6	6	52
Methods and algorithms for optical image processing	9	-	27	14	14	56
Total:	17	-	51	20	20	108

Section 1. "Fundamentals of registration, modeling and digital optical image processing"

- 1.1. Image formation .
- 1.2. Registration and coding optical image .
- 1.3. Image sampling and quantization .
- 1.4. Basic digital processing optical signals.
- 1.5. Color spaces and color-coding standards .
- 1.6. The mechanisms of image compression .
- 1.7. Improving the visual quality of the image.

Section 2 . "The methods and algorithms for processing optical images"

- 2.1. Geometric image transformations .
- 2.2. Logical image conversion .
- 2.3 . Arithmetic image conversion .
- 2.4. Filtering image.
- 2.5. Selection of the optimal method of image filtering .
- 2.6. Recovery image. Image models and their distortions.

Lectures

Hours	Theme
2	Image formation. Registration and coding optical image. Sampling and quantization of the image.
2	Basics of digital processing of optical signals. Mechanisms of image compression.
2	Color spaces and color coding standards.
2	Improving the visual quality of the image. Element wise image processing.
2	Geometric image transformation.

2	Logical image transformation. Arithmetic image transformations.
2	Filtering image. Selection of the optimal method of filtering image.
3	Image restoration. Image models and their distortions

Laboratory work

Hours	Theme
4	Registration and image inputs to the computer. Implementation of algorithms for reading and writing images using raster image formats.
7	Implementation and study methods of images preparation.
8	Implementation and study of methods of geometrical transformations images.
14	Implementation and study of methods of logical and arithmetic transformations images.
8	Implementation and study of methods of image filtering.
10	Implementation and study of methods of image distortions and methods of their compensation

Independent studies

- Preparing for laboratory works
- Writing reports
- Home work

Assessment Methods

- Test;
- Laboratory work;
- Home tasks
- Personal skills of a student are estimated;
- Exam

Lab works description

Lab 1. "Registration, input images to a computer"

The goal is to acquire the practical skills of development of the basic algorithms for the simulation input and graphic images on a computer, creating software for image research.

The sequence of key actions: the acquaintance with the stages of the input image, the study of the development environment. Imparting the skills to create the frame of software and the use of standard input algorithms and simulation images.

Lab 2. "Research methods for preparation of images"

The goal is to acquire the practical skills in using standard algorithms to improve image quality and make it stand out on the basis of the characteristics of self-developed functions.

The sequence of key actions: the implementation of standard algorithms for image preparation by self-development functions. Fostering the skills of researching and comparing the results of using standard algorithms for image enhancement and allocation of its characteristic features.

Lab 3. "Research methods of geometric transformations of images"

The goal is to acquire the practical skills in using standard algorithms for geometric transformations of image based on self-developed functions.

The sequence of key actions: the implementation of standard algorithms for image preparation by self-development functions. Fostering the skills of researching and comparing the results of using standard algorithms for image enhancement and allocation of its characteristic features.

Lab 4. "The study of methods of logical and arithmetic manipulations of images"

The goal is to acquire the practical skills in using standard algorithms for logical and arithmetic manipulations images based on self-developed functions.

The sequence of key actions: the implementation of standard algorithms for image preparation by self-development functions. Fostering the skills of researching and comparing the results of using standard algorithms for image enhancement and allocation of its characteristic features.

Lab 5. "Research methods for image filtering"

The goal is to acquire the practical skills in using standard algorithms for image filtering based on independently developed functions.

The sequence of key actions: the implementation of standard algorithms for image preparation by self-development functions. Fostering the skills of researching and comparing the results of using standard algorithms for image enhancement and allocation of its characteristic features.

Lab 6. " Choosing the best method of image restoration"

The goal is to acquire the practical skills in using the standard methods of image reconstruction algorithms based on self-developed functions, obtaining skills choosing the best method for image restoration.

The sequence of key actions: the implementation of standard algorithms for image preparation by self-development functions. Fostering the skills of researching and comparing the results of using standard algorithms for image enhancement and allocation of its characteristic features.