

Optical System Design

Course Structure

This course consists of approximately 36 hours of lectures with labs and 108 hours of projects. Volume of the course 4.0 ECTS credits.

Course Description

If you want to know more about optical systems such as telescopes, photographic objectives, microscope objectives, looking glasses and others, understand what are aberrations, why we need so many sorts of the glass and complicated form of the surfaces in different optical systems, how aberrations affect optical image quality and how we can predict the image quality and correct if necessary if you want to practice in developing of optical systems by your own - this course is for you!

The course includes basics of image aberration theory and design using theory of Seidel sums and automatic correction using special software. Course covers the range of issues related to basic principles of designing of optical systems, embracing synthesis, optimization (correction) and estimating the manufacturability. The course includes such topics as classification of aberrations that would be necessary during the analysis and evaluating the image quality and finding the most critical aberration to correct. The course also contains some elements of the theory of the third order aberrations and ideas of automatic image quality correction.

Projects include different optical system designing using well known special optical software.

Lectures and Labs

- Process of developing of optical systems.
- Main characteristics for different types of optical systems.
- Methods of optical system synthesis.
- Optical system aberrations, chromatic aberrations and monochromatic third order aberrations.
- Evaluating the image quality. Functions and criteria for estimating the image quality.
- Mathematical basics of automatic correction.
- Choosing function for automatic correction (optimization) and variable parameters. Using constraints for variables.
- Designing systems for visual region.
- Design of systems of mirror and catadioptric systems
- Designing of systems for IR region.

Projects

- Design an optical system for laser beam collimating;
- Design an optical system for laser beam concentrating
- Design of an looking class with prism or lens inverting system
- Design of a two-mirror system
- Design of the photoobjective with fixed focal length – Petzval scheme
- Design of a microscope objective with small aperture
- Design of an objective for LWIR region
- Design of an objective for MWIR region