Image Science

Syllabus Number 3D331
Special Subjects
Elective 2 credit

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1. Course Description

Students will learn the followings in this course,
(1) Physical and mathematical principles for image treatise (geometrical optics, theory of image formation, epipolar geometry)
(2) Basic computational implementations of above theories.

2. Course Objectives

In this course we shall learn the basics of image science which will further lead us to deeper understanding and full utilization of modern advanced imaging technologies.

3. Grading Policy

You will be graded by your quiz results and submitted reports (total 50%) and final examination marks (50%). Quiz results and reports are returned within 2 weeks after submission.

4. Textbook and Reference

Textbook
Text for the first half of the lectures and supplementary materials are provided online on LMS.
For the second half, we use the textbook below.
Editing Committee for Digital Image Processing Digital Image Processing [Revised version] (Japanese) CG-ARTS Association
Reference
Hiroshi Imai Let's learn the lightwave engineering (Japanese) Riko Tosho
Nobukatsu Takai Introduction to MATLAB (Japanese) Kougakusha

5. Requirements(Assignments)

Read the corresponding part of the text carefully (~1 hour).
It is recommended to verify the mathematical expressions and programs in the text and supplied materials in the review process (~2hours).

6. Note

None.

7. Schedule

[1] Introduction: how 2D images are formed physically
[2] Physics of light 1 (Maxwell equations, wave equation and polarization)
[3] Physics of light 2 (Theoretical models in optics)
[4] Geometrical optics (Concept of rays and their properties, refraction-reflection-absorption)
[5] Review of linear algebra
[6] Theory of image formation 1 (Ray transfer matrix, free space propagation)
[7] Theory of image formation 2 (Functions of lenses, mechanics of image formation)
[8] Exercise #1 (Simulation of image formation by simple ray tracing)
[9] 3D reconstruction from images 1 (Parallel stereovision)
[10] 3D reconstruction from images 2 (Geometrical relation between image and space)
[11] 3D reconstruction from images 3 (Epipolar geometry)
[12] 3D reconstruction from images 4 (Camera calibration)
[13] 3D reconstruction from images 5 (Principles of stereovision)
[14] Exercise #2 (3D reconstruction from stereovision)
[15] Test and summary