Human sensation and perception, 4 ECTS, TUT semester 3

Course moderator: Prof. Shigeki Nakauchi

Course instructors: Prof. Shigeki Nakauchi, Assoc.prof. Kowa Koida

Learning outcomes

After the course, students will be able to understand the structure and function of the sensory systems and how sensation and perception work together to help us to guide our behavior. Students will able to utilize psychophysical methods to measure the perception, and data analysis theory as well.

Content

Courses on physiological mechanisms for sensation and perception, the visual cortex and beyond (1st quarter), colour perception, objects/scene, depth and size, motion, attention, and project work on “Illusion Hack” (2nd quarter).

Modes of study

Course and project work, active participation

Teaching methods

Lectures 30 hours (15 hrs/cu x 2 cu)

Study materials

E. Bruce Goldstein, “Sensation and Perception”, 8th edition

135 Visual Phenomena & Optical Illusions (https://michaelbach.de/ot/index.html)

E. Kandel et al., "Principles of Neural Science", 5th Edition

Evaluation criteria

(written assignments / project work)

Scale 0-5 (0 = fail, 5 = excellent)

X reality and psychology, 4 ECTS, TUT semester 3

Course moderator: Prof. Michiteru Kitazaki,

Course instructors: Prof. Michiteru Kitazaki, Assoc. prof. Toshie Matsui, Assoc. prof. Tetsuto Minami

Learning outcomes

After the course, students will understand the principles of virtual reality (VR), mixed reality (MR), augmented reality (AR), and X reality (cross reality: XR), on psychological, physiological, and functional levels. They will also be able to understand the benefits and challenges of VR/MR/AR/XR on the future society.

Content

Visual cognition, auditory cognition, tactile and other modality cognition, cross-modal cognition, high-level cognition, embodied perception, virtual reality basics, applications of VR, MR, and AR (1st quarter). Project works on related topics (2nd quarter).

Modes of study
Course and project works, and active participation

Teaching methods
Lectures 30 hours (15 hrs/cu x 2 cu)

Study materials
Gazzaniga, M., Ivry, R. B., Mangun, G. R. (2018). Cognitive Neuroscience:

The Biology of the Mind, Fifth International Student version, WW Norton & Co.

Evaluation criteria
Written assignments, project work

Scale 0-5 (0 = fail, 5 = excellent)

3D Vision Computation, 4 ECTS, TUT semester 3
Course moderator: Assoc.prof. Yasuyuki Sugaya

Course instructors: Assoc.prof. Yasushi Kanazawa, Assoc.prof. Yasuyuki Sugaya

Learning outcomes
After the course, students will understand the principles of 3-D reconstruction from images, camera calibration, camera pose estimation and SLAM systems. They will also be able to compute geometrical relationship between a camera and the target scene and be able to implement X reality systems on software and hardware levels.

Content
3-D reconstruction from two views, 3-D reconstruction from multiple views, geometric camera calibration, camera pose estimation using special markers, camera pose estimation from natural scene information, and simultaneous localization and mapping(SLAM)

Modes of study
Course and project work, active participation

Teaching methods
Lectures 30 hours (15 hrs/cu x 2 cu)

Study materials
K. Kanatani, Y. Sugaya, and Y. Kanazawa, Guide to 3D Vision Computation: Geometric Analysis and Implementation, Springer International, Cham, Switzerland, December, 2016.

Evaluation criteria
Written assignments, project work

Scale 0-5 (0 = fail, 5 = excellent)

Robotic perception and human-robot interaction, 4 ECTS, TUT semester 3

Course moderator: Prof. Jun Miura

Course instructors: Prof. Jun Miura, Assoc.prof. Naoki Ohshima

Learning outcomes

The first aim of this course is to understand the principles of statistical sensor fusion with its application to robotic scene recognition and human-robot interaction. The second is to utilize tools and platforms to construct human-robot affective communication in a real-world scenario.

Content

Statistical sensor fusion with Bayesian filters, robotic mapping and localization, human detection, tracking, and identification, task-level human-robot interaction (1st quarter). Conversation system with real-time multimodal processing, cloud network for robot manipulation, 3D robot printing technology and project work on building interactive sociable robots of the future. (2nd quarter).

Modes of study

Course and project work, active participation

Teaching methods

Lectures 30 hours (15 hrs/cu x 2 cu)

Study materials

S. Thrun, W. Burgard, D. Fox, Probabilistic Robotics, MIT Press, 2005

C. Breazeal, Designing Sociable Robots (Intelligent Robotics and Autonomous Agents series), A Bradford Book, 2004.

Evaluation criteria

Written assignments, project work

Scale 0-5 (0 = fail, 5 = excellent)

Data science and analysis, 4 ECTS, TUT semester 3

Course moderator: Prof. Shigeru Kuriyama

Course instructors: Prof. Shigeru Kuriyama, Prof. Masaki Aono, Assoc.prof. Tomoyosi Akiba

Learning outcomes

After the course, students will understand the principles of statistical analysis of massive data including text documents and images. They will be able to utilize machine learning methodology for analyzing their experimental data. The data to be analyzed will be either specified by instructors, or shall be collected in an XR world. The former type of data is going to be used for machine learning as well as deep learning, while the data collected in an XR world is utilized to develop a smart system that can bridge between real and virtual information spaces.

Content

Data mining, visual data analysis, text mining, natural language processing, deep learning.

Modes of study
Course and project work, active participation

Teaching methods
Lectures 30 hours (15 hrs/cu x 2 cu)

Study materials
Jake VanderPlas, Python Data Science Handbook, Oreilly, (2016)

Francois Chollet, Deep Learning with Python, Manning Publications, (2017)

Colin Ware, Information Visualization: Perception for Design, (2012)

Evaluation criteria
(Written exam / written assignments / project work)

Scale 0-5 (0 = fail, 5 = excellent)

Advanced research methods, 6 ECTS, TUT semester 3
Course moderator/instructors: Supervisors

Learning outcomes
Students will be able to understand the background and research questions of the topics for master thesis, and design experiments in an appropriate way to achieve the research goal under the supervision of .

Content
literature review, progress report, research presentation & debate

Modes of study
Project work, active participation

Teaching methods
Project work 60 hours (30hrs/cu x 2 cu)

Study materials
given by supervisors

Evaluation criteria
(project work)

Scale 0-5 (0 = fail, 5 = excellent)

Case study in imaging and light in XR, 6 ECTS, TUT semester 3
Course moderator/instructors: Supervisors

Learning outcomes
Students will be able to explain the background and research questions of the topics for master thesis, discuss and interpret the preliminary results for master study, and show the future work, in a poster presentation format.

Content
literature review, progress report, research presentation & debate

Modes of study
Project work, active participation

Teaching methods
Project work 60 hours (30hrs/cu x 2 cu)

Study materials
offered by supervisors

Evaluation criteria
(project work)

Scale 0-5 (0 = fail, 5 = excellent)

Japanese culture and society, 4 ECTS, TUT semester 3
Course moderator/instructors: TBA

Learning outcomes
In this series of lectures, the excellent experts of our university from different areas will impart to the engineering students highly interesting insider knowledge. After the lectures, students are able to know Japan of today from technical, economic and social viewpoints.

Modes of study
Active participation

Teaching methods
Lectures 30 hours (15 hrs/cu x 2 cu)

Evaluation criteria
(Written exam / written assignments)

Scale 0-5 (0 = fail, 5 = excellent)

Japanese industrial technologies and innovations, 2 ECTS, TUT semester 3
Course moderator/instructors: TBA

Learning outcomes
It becomes important even for academia to commercialize the findings from research and development at universities. After the course, students are able to understand basic knowledge of innovation management and practical management tools for project complement.

Modes of study

Active participation

Teaching methods

Lectures 15 hours (15 hrs/cu x 1 cu)

Evaluation criteria

(Written exam)

Scale 0-5 (0 = fail, 5 = excellent)

Master thesis, 30 ECTS, TUT semester 4

Course moderator/instructors: Supervisors

Modes of study

Project work, active participation

Teaching methods

Project work 270 hours (45hrs/cu x 6 cu)