

THE CHINESE UNIVERSITY OF HONG KONG
M.Sc. Programme in Mechanical and Automation Engineering

First Term, 2023-2024

MAEG5715: Computer Interface and Simulation

Course Coordinator: Prof. LAM Hiu Fung Alan (alam@mae.cuhk.edu.hk)
Mentor: Mr. JIN Liuchao (liuchao.Jin@link.cuhk.edu.hk)
Mr. MO Haoming (hmmok@link.cuhk.edu.hk)
Class Day: Monday
Class Period: 6:30 p.m. – 9:30 p.m.
Classroom: Room 505, Yasumoto International Academic Park, CUHK (YIA 505)

Course Outline

Computer interface: sensor interface, interface design for automated systems, human-computer interaction, and teleoperated systems. Virtual reality: solid modeling, graphic software, haptic interfaces, and applications. Simulation: off-line programming, motion planning, introduction to dynamic simulation.

Learning Outcomes

1. Understand sensors and sensor interface for automated systems;
2. Understand human-computer interfaces and teleoperated systems;
3. Understand solid models and their applications in computer simulations and virtual reality.

Academic Honesty

Students are expected to conform to the highest standards of honesty and integrity. Students are encouraged to discuss course material to foster the motivations of ideas and produce high quality works. They may work together in the preliminary stages of individual homework assignments but the final work must reflect their originality and individual efforts. Plagiarism is considered a disciplinary offence which can result in reduced grades, failed subjects and suspension from the university. (<http://www.cuhk.edu.hk/policy/academichonesty>)

Class	Date
1	Sep 4, 2023 (Mon)
2	Sep 11, 2023 (Mon)
3	Sep 18, 2023 (Mon)
4	Sep 25, 2023 (Mon)
	Oct 2, 2023 (Mon) Public holiday – The day following National Day
5	Oct 9, 2023 (Mon)
6	Oct 16, 2023 (Mon)
	Oct 23, 2023 (Mon) Public holiday – Chung Yeung Festival
7	Oct 30, 2023 (Mon) – Mid-term Presentation
8	Nov 6, 2023 (Mon)
9	Nov 13, 2023 (Mon)
10	Nov 20, 2023 (Mon)
11	Nov 27, 2023 (Mon)
12	Dec 4, 2023 (Mon)
13	Dec 11, 2023 (Mon)
14	Dec 18, 2023 (Tue) – Final Presentation

Course Content:

Week1:

Lecture 1: Introduction to Computer Interface

- 1) Overview of computer interface design, Importance of good interface design, Basic principles of interface design, Historical overview of interface design.
- 2) Introduction to system, hardware and software, block diagram, interface, input and output.
- 3) Based on some examples to share about system and control. To learn block diagram and interface.

Week2:

Lecture 2: Sensors and interface

- 1) Introduction to sensor, types of sensors, design consideration for sensors
- 2) Process unit and actuator as well as human-machine interface.
- 3) Examples of sensor use in computer interface design. To learn the structure and design of sensor and actuator system.

Week3:

Lecture 3: Actuators and feedback

- 1) Introduction to actuator, types of actuators, design consideration for actuators
- 2) Overview of haptics, Types of haptic feedback, Applications of haptic feedback in computer interface design
- 3) Examples of actuators use in computer interface design. To learn the structure and design of sensor and actuator system.
- 4) HW 1 submission

Week4:

Lecture 4: System communication

- 1) Introduction to communication, types of communication and communication protocol
- 2) Wire and wireless system and interface.
- 3) Examples of different communication interface. To learn the communication interface of wire and wireless system.

Week 5:

Lecture 5: Control algorithms

- 1) Overview of control algorithms
- 2) Examples of control algorithms in computer interface design
- 3) Design considerations for control algorithms
- 4) HW 2 submission

Week 6:

Lecture 6: System model

- 1) Introduction to system model, design and control.
- 2) Overview of 3D object modeling, Types of 3D modeling software, Design considerations for 3D object modeling
- 3) Overview of deformation of 3D objects , Types of deformation techniques, Design considerations for deformation of 3D objects

Week7:

Project presentation. Project is to design a mechanical and automated system: 1) Block diagram, 2) Communication interface, 3) Sensor and Actuators application, 4) How it works, 5) Reason for having it (Market), 6) Cost structure.

Week 8:

Lecture 8: Human-Computer Interaction

- 1) Overview of human-computer interaction
- 2) Types of human-computer interaction
- 3) Design considerations for human-computer interaction
- 4) Examples of human-computer interaction in computer interface design

Week 9:

Lecture 9: Introduction to virtual reality and Augmented Reality

- 1) Overview of virtual reality, modelling, control (display, control, processing and feedback), navigation, simulation of 3D objects, Types of simulation techniques, Design considerations for virtual reality
- 2) Overview of augmented reality, modelling, control (display, control, processing and feedback), navigation. To learn basic concept of augmented reality and design considerations for augmented reality
- 3) Example of VR and AR such as training, museum, game, and etc. To learn the daily example of VR and AR applications.
- 4) HW 3 submission

Week 10:

Lecture 10: Integrated Interaction and Simulation System

- 1) Overview of integrated interaction and simulation system
- 2) Design considerations for integrated interaction and simulation system
- 3) Examples of integrated interaction and simulation system in computer interface design

Week11:

Lecture 11: Path planning and motion control.

- 1) Overview of navigation, path planning and motion control.
- 2) Examples of path planning and motion control
- 3) Dynamic simulation in VR application with path planning and motion control.
- 4) HW 4 submission

Week12:

Lecture 12: Brain-Computer Interface

- 1) Overview of brain-computer interface, Types of brain-computer interface, Design considerations for brain-computer interface
- 2) Introduction Artificial intelligence and deep learning.
- 3) Examples of brain-computer interface in computer interface design
- 4) To learn basic AI and learning in VR and simulation application.

Week13:

Lecture 13: Future of Computer Interface Design

- 1) Overview of the future of computer interface design
- 2) Emerging trends in computer interface design
- 3) Ethical considerations in computer interface design
- 4) Concluding remarks and final project presentation

Week14:

Lecture 14: Final presentation/exam. To present the course project.

Assessment Scheme

4 Assignments	40%
2 Project Reports	30%

2 Project Presentations 30%

Grade Descriptor

'A': EXCELLENT - exceptionally good performance and far exceeding expectation in all or most of the course learning outcomes; demonstration of superior understanding of the subject matter, the ability to analyze problems and apply extensive knowledge, and skillful use of concepts and materials to derive proper solutions.

'B': GOOD - good performance in all course learning outcomes and exceeding expectation in some of them; demonstration of good understanding of the subject matter and the ability to use proper concepts and materials to solve most of the problems encountered.

'C': FAIR - adequate performance and meeting expectation in all course learning outcomes; demonstration of adequate understanding of the subject matter and the ability to solve simple problems.

'D': MARGINAL - performance barely meets the expectation in the essential course learning outcomes; demonstration of partial understanding of the subject matter and the ability to solve simple problems.

'F': FAILURE - performance does not meet the expectation in the essential course learning outcomes; demonstration of serious deficiencies and the need to retake the course.

Enrollment Requirement

For students in MSc Mechanical and Automation Engineering.