Course Form for PKU Summer School International 2025

Course Title	Title in English: Introduction to Affective Intelligent Robotics
	Title in Chinese: 情感智能机器人引论
Teacher	王韬 Tao WANG
First day of classes	June 30, 2025
Last day of classes	July 25, 2025
Course Credit	2 credits

Course Description

Objective：

1. Let students understand the historical development and key technologies of affective intelligent robots;
2. Enable students to master the core concepts of hardware and software of affective intelligent robot system;
3. Let students have an understanding on the important research fields of affective intelligent robots, enable them to conduct more in-depth research in the future.

Pre-requisites /Target audience

Undergraduate and graduate students with unlimited majors

Proceeding of the Course

The course is a four-week, 32 hours program scheduled for June 30 to July 25 2025, sessions will combine class teaching and discussion.

Assignments (essay or other forms)

One Essay submitted by the end of the course

Evaluation Details

- Participation：50%
- Essay：50%

Text Books and Reading Materials

Handbook of Robotics 2nd Ed.
Bruno Siciliano, Oussama Khatib (Eds.)
Springer
2016
978-3-319-32550-7

Academic Integrity (If necessary)

CLASS SCHEDULE (Subject to adjustment)

Session 1：***The historical development of robots***	Date: July 1, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- What is a robot?
- The historical development of robots.

【Questions】

Why “robots” instead of “machines”?

【Readings, Websites or Video Clips】

None

【Assignments for this session (if any)】

None

Session 2：***Modern robots***	Date: July 2, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Kinds of robots
- The characteristics of various kinds of robots

【Questions】

Imagine a practical scenario, what would a robot look like? What useful abilities does it have?

【Readings, Websites or Video Clips】

None

【Assignments for this session (if any)】

None

Session 3：***Basic concept of robotics***	Date: July 4, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Hardware structure of robots
- Simplified model of intelligent robots

- Preliminary kinematics and dynamics

【Questions】

1. What components should a robot have?
2. Why can robots complete tasks such as movement and operation?

【Readings, Websites or Video Clips】

None

【Assignments for this session (if any)】

None

Session 4：***Overview of robot sensing***	Date: July 8, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- General perception process
- Sensors commonly used for robots

【Questions】

1. What steps does a robot need to perceive the environment?
2. What sensors do robots need?

【Readings, Websites or Video Clips】

None

【Assignments for this session (if any)】

None

Session 5：***Common sensing methods (part 1)***	Date: July 9, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Visual sensing
- Distance sensing
- Inertial sensing

【Questions】

1. What are the principles of these sensing methods?
2. How to implement these sensing methods?

【Readings, Websites or Video Clips】
None

【Assignments for this session (if any)】
None

Session 6：***Common sensing methods (part 2)***	Date: July 11, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Auditory sensing
- Force/tactile sensing

【Questions】

1. What are the principles of these sensing methods?
2. How to implement these sensing methods?

【Readings, Websites or Video Clips】
None

【Assignments for this session (if any)】
None

Session 7：***Software architecture of intelligent robots***	Date: July 15, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Layered robot control architecture
- Robot Operating System (ROS)

【Questions】

1. What are the advantages of layered robot control structure?
2. What benefits does ROS bring to robot design/manufacturing?

【Readings, Websites or Video Clips】
None

【Assignments for this session (if any)】
None

Session 8：***Mobile robots***	Date: July 16, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Fundamentals of mobile robots
- Simultaneous Localization and Mapping (SLAM)

【Questions】

1. What is the relationship between mobility planning and obstacle avoidance? What's the difference?
2. What are the commonly used map representations? Which scenarios are they suitable for?

【Readings, Websites or Video Clips】

None

【Assignments for this session (if any)】

None

Session 9：***Intelligent manipulation***	Date: July 18, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Grasping and manipulation tasks
- Singularity
- Compliant motion
- Visual servoing

【Questions】

1. What constraints should be considered during manipulation planning?
2. When is compliant motion required? When is visual servoing required?

【Readings, Websites or Video Clips】

None

【Assignments for this session (if any)】

None

Session 10：***Affective intelligent robots***	Date: July 22, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Overview of affective intelligent robots
- Being with affective intelligent robots

【Questions】

When do robots need affection?

【Readings, Websites or Video Clips】
None

【Assignments for this session (if any)】
None

Session 11：***Methods for emotion recognition***	Date: July 23, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Basics of emotion recognition
- Multimodal emotion recognition

【Questions】
How can robots quickly recognize human emotions?

【Readings, Websites or Video Clips】
None

【Assignments for this session (if any)】
None

Session 12：***Roboethics***	Date: July 25, 2025

【Description of the Session】(purpose, requirements, class and presentations scheduling, etc.)

- Roboethics
- Coexistence of humans and affective intelligent robots

【Questions】
Are there any ethical issues for robots that you have seen? Why?

【Readings, Websites or Video Clips】
None

【Assignments for this session (if any)】
None