ENGN6528: COMPUTER VISION

Course Outline (2021)

Overview:

Computer Vision is an important disciplinary field within Artificial Intelligence. It is concerned with "how to extract information from image or video, and how to build a machine to see". Recent explosive growth of digital imaging technology, advanced computing, and deep learning makes the problems of automated image interpretation even more exciting and much more relevant than ever.

This course introduces students to fundamental problems in image processing and computer vision, as well as their state-of-the-art solutions. This course is designed at upper undergraduate level and first-year postgraduate level. It aimed to introduce students to understanding of the fundamental problems in computer vision, and their state-of-the-art solutions.

Topics covered in detail include image formation, image filtering, camera geometry, thresholding and image segmentation, edge, point and feature detection, geometric frameworks for vision, single view and multi-view geometry; 3D visual reconstruction; stereo vision, image classification and object recognition, deep learning and neural networks for visual recognition etc.

The course features rich practical and design components including computer labs and Term projects that provide students with the opportunity to practice and refine their skills in image processing and computer vision.

Mode of Delivery	Remote (Zoom)
Assumed knowledge	Linear Algebra, Probability Theory, Basic Programming;
Incompatible Courses	ENGN 4528
Co-badged Courses	ENGN6528 Computer Vision, only for postgraduate students.
Course Convener/Lecturer :	Convenor: Dr. Miaomiao Liu Lecturers: Miaomiao Liu
Contacts:	Miaomiao.Liu@anu.edu.au

	Office Hour: Monday 5:00PM—6:00PM. Office location: Building-115: Room B351 (call me at the ground level reception).

Study Format (total approximate workload per week = 10 hours) :

(1) Attend weekly lectures/tutorial (3 hours per week, we may use the one-hour lecture for tutorial);

(2) Work on C-Labs problems individually, during the assigned weekly lab session (2 hours), as well as study during afterhours (avg. 3 hours per week);

(3) Read textbook or other class materials for preview or review (avg. 2 hour per week).

Expected Learning Outcomes:

Upon successful completion, students will have the knowledge and skills to:

1. Proficiently apply specialised knowledge, methods and skills in image processing and computer vision applications, research and development.
2. Identify, formulate and innovatively solve problems in image processing and computer vision.
3. Critically analyse, evaluate and examine existing practical computer vision systems.
4. Communicate effectively to both specialist and non-specialist audiences to integrate and synthesize complex visual information processing systems.
5. Critically review and assess scientific literature in the field and apply theoretical knowledge to identify the novelty and practicality of proposed methods.
6. Apply research methods and advanced knowledge to design and develop practical and innovative image processing and computer vision applications or systems.
7. Conduct themselves professionally and responsibly in the areas of computer vision, image processing and deep learning.

Syllabus

A high-level summary of the syllabus is as follows:

I. Low-level vision

- Image formation
- Image filtering
- Binary image analysis
- Background subtraction
- Image enhancement (sharpening, histogram equalization, median filtering)

II. Image features: mid-level vision

- Corner point,
- Line detection
- Hough transform
- Fitting lines and curves
- Robust fitting, RANSAC
- Segmentation and clustering

III. 3D Computer Vision: Multiple view geometry

- Image transformations and alignment
- Planar homography
- Epipolar geometry and stereo
- SFM pipeline
- Shape from X

IV. Recognition: high-level vision

- Object detection
- Object recognition
- Supervised classification
- Deep learning, convolutional neural networks (basics)

Indicative Assessment Components:

1. C-Lab Reports/homework assignments:

   Lab1 Assignment : 15%
   Lab2 Assignment : 15%
   Lab3 Assignment : 20%

2. Mid-term quiz, Exam: midterm quiz (20%) + final exam (30%)

Related Texts

- Computer Vision: Algorithms and Applications, (FREE) Richard Szeliski.
- Computer Vision, Shapiro and Stockman, Prentice-Hall, 2001. Original chapters available (FREE)at this URL
- Hartley R, and Zisserman A. Multiple view geometry in computer vision. Cambridge university press; 2003.

Feedback

Staff Feedback

Students will receive feedback in the following forms in this course:

- written correspondence
- via e-mail to lecturers/tutors.
- to the whole class (Wattle Forum)
- to small groups (tutorials, individuals, study groups, focus groups)

Student Feedback

ANU is committed to the demonstration of educational excellence and regularly seeks feedback from students. One of the key formal ways students can provide feedback is through Student Experience of Learning Support (SELS) surveys. The feedback given in these surveys is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching, and opportunities for improvement.

For more information on student surveys at ANU and reports on the feedback provided on ANU courses, go to http://unistats.anu.edu.au/surveys/selt/students andhttp://unistats.anu.edu.au/surveys/selt/results/learning.

Policies

ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and implement them. You can read the University's education policies and an explanatory glossary at: http://policies.anu.edu.au/.

Academic Integrity

Students are expected to know their responsibilities with respect to academic integrity. Please read the ANU policies on academic honesty and plagiarism.

This course does allow for collaboration if your collaborators are mentioned in your submission and some additional rules are followed:

- **The writing of code and documentation that you intend to submit must always be done entirely by you, and you only**.

- You may exchange ideas on scrap paper, boards, and the like, but do not work together on documents (e.g. reports or code) that are intended for submission.
- Do not collaborate or communicate with other students about your submission right before you start writing your submission documents. After you discuss ideas with anybody else, wait a few hours before you start writing your own submission.

Detection is very likely (even though it might not always appear so from an individual perspective), and the consequences of plagiarism are harsh. Please help to make this a clean course which focuses entirely on the learning process and not on policing.

A student in this course is expected to be able to explain and defend any submitted assessment item. The course convener may conduct or initiate an additional interview about any submitted assessment item for any student in the course. Any significant discrepancy between the two forms of assessment may trigger an investigation for academic misconduct.

Late Policy

The late policy for this course is as follows:

- Late submissions will incur 10% per day, of the total marks of the assessment component.
- Late by 7 days or more will result in nil mark for the entire component.