UNSW Course Outline

ELEC4622 Multimedia Signal Processing - 2024

Published on the 05 Jun 2024

General Course Information

Course Code : ELEC4622
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Electrical Engineering & Telecommunications
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course covers the theory and application of digital signal processing techniques for the processing of multimedia signals.

Course content includes: Signal acquisition, sampling and interpolation for signals in 1, 2 and 3 dimensions; digital representation of multimedia signals, including representations for colour; Fourier transforms, power spectra and convolution in multiple dimensions; Introduction to shape, geometry and motion processing techniques; software and hardware techniques for representing and processing multimedia signals; convolutional neural networks for media processing. The course may also provide an introduction to compression technologies and standards for image, video, speech and audio signals.

Course Aims

This course provides a broad introduction to multimedia signal processing. The major emphases of the course are:

1. Extension and application of one dimensional signal processing concepts into multiple dimensions (2 dimensions for images and 3 dimensions for video);

2. Practical implementation of signal processing algorithms in software, using real programming environments (particularly C/C++) as opposed to Matlab;

3. Understanding, estimating and enhancing specific multimedia features of shape, texture, colour and motion; and

4. Introduction to multimedia formats and compression standards.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain multimedia signal representations, acquisition, file formats and standards
CLO2 : Apply Fourier transforms, power spectra, convolution, and other signal processing concepts to multi-dimensional signals
CLO3 : Design filters and other algorithms to enhance and extract important features from multimedia signals
CLO4 : Implement multimedia signal processing algorithms in both Matlab and C/C++

Course Learning Outcomes	Assessment Item
CLO1 : Explain multimedia signal representations, acquisition, file formats and standards	• Three Laboratory Projects • Final examination • Mid-term Quiz
CLO2 : Apply Fourier transforms, power spectra, convolution, and other signal processing concepts to multi-dimensional signals	• Three Laboratory Projects • Final examination • Mid-term Quiz
CLO3 : Design filters and other algorithms to enhance and extract important features from multimedia signals	• Three Laboratory Projects • Final examination • Mid-term Quiz
CLO4 : Implement multimedia signal processing algorithms in both Matlab and C/C++	• Three Laboratory Projects

Learning and Teaching Technologies

Moodle - Learning Management System

Other Professional Outcomes

The Course Learning Outcomes (CLOs) contribute to the Engineers Australia (National Accreditation Body) Stage I competencies as outlined below

Engineers Australia (EA), Professional Engineer Stage 1 Competencies

PE1: Knowledge and Skill Base:

PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals: CLO 2,3

PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing: CLO 2,3,4

PE1.3 In-depth understanding of specialist bodies of knowledge: CLO 1,2,3,4

PE1.4 Discernment of knowledge development and research directions: n/a

PE1.5 Knowledge of engineering design practice: CLO 1,2,3,4.
PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice: n/a

PE2: Engineering Application Ability:
PE2.1 Application of established engineering methods to complex problem solving: CLO 2,3,4
PE2.2 Fluent application of engineering techniques, tools and resources: CLO 1,3,4
PE2.3 Application of systematic engineering synthesis and design processes: CLO 3,4
PE2.4 Application of systematic approaches to the conduct and management of engineering projects: n/a

PE3: Professional and Personal Attributes:
PE3.1 Ethical conduct and professional accountability: n/a
PE3.2 Effective oral and written communication (professional and lay domains): n/a
PE3.3 Creative, innovative and pro-active demeanour: CLO 4
PE3.4 Professional use and management of information: n/a
PE3.5 Orderly management of self, and professional conduct: n/a
PE3.6 Effective team membership and team leadership: n/a

This course is also designed to provide the course learning outcomes which arise from targeted graduate capabilities. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (also listed below).

Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;

- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning

UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.
- Developing citizens who can apply their discipline in other contexts, are culturally aware and environmentally responsible, through interdisciplinary tasks, seminars and group activities

Additional Course Information

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is ELEC3104, Digital Signal Processing. Postgraduate students taking this course should have previously taken at least an introductory subject in one-dimensional signal processing. It is further assumed that all students undertaking this course have at least some familiarity with C programming.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Three Laboratory Projects Assessment Format: Individual	30%	
Final examination Assessment Format: Individual	60%	
Mid-term Quiz Assessment Format: Individual	10%	

Assessment Details

Three Laboratory Projects

Assessment Overview

Initial laboratory sessions in the course are to help you become familiar with key concepts required to undertake the series of three laboratory projects. These projects require you to develop solutions to a series of connected tasks that are each focussed on a particular aspect of the material taught in lectures. You will need to write your own programs in C/C++ to solve the problem, and you will need to be able to know whether your solution is a correct one or not. It is essential that you prepare as much as possible of your solution to each project before attending the lab. Each project is worth 10%, your solution will be marked by the demonstrator. It is essential that you document your approach to solving the problem, using labeled diagrams that you can refer to during marking. Verbal feedback will be provided during marking.

Course Learning Outcomes

- CLO1 : Explain multimedia signal representations, acquisition, file formats and standards
- CLO2 : Apply Fourier transforms, power spectra, convolution, and other signal processing concepts to multi-dimensional signals
- CLO3 : Design filters and other algorithms to enhance and extract important features from multimedia signals
- CLO4 : Implement multimedia signal processing algorithms in both Matlab and C/C++

Final examination

Assessment Overview

The exam in this course is a two-hour written examination. University-approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course (including laboratory and tutorials) unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses

Course Learning Outcomes

- CLO1 : Explain multimedia signal representations, acquisition, file formats and standards
- CLO2 : Apply Fourier transforms, power spectra, convolution, and other signal processing concepts to multi-dimensional signals
- CLO3 : Design filters and other algorithms to enhance and extract important features from multimedia signals

Mid-term Quiz

Assessment Overview

The mid-term one-hour written examination tests your general understanding of the course material and is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any material already covered in the course schedule. It may contain questions requiring some (not extensive) knowledge of laboratory material, and will definitely contain numerical and analytical questions. Marks will be assigned according to the correctness of the responses. Verbal class-wide feedback will be given during lectures and individual feedback will also be provided upon request.

Course Learning Outcomes

- CLO1 : Explain multimedia signal representations, acquisition, file formats and standards
- CLO2 : Apply Fourier transforms, power spectra, convolution, and other signal processing concepts to multi-dimensional signals
- CLO3 : Design filters and other algorithms to enhance and extract important features from multimedia signals

Assessment Length

50 minutes

Submission notes

This is an in-person assessment; answers will be written next to the questions and returned at the end of the test.

General Assessment Information

Bonus Mark System

Laboratory projects can attract bonus marks.

All marks, including bonus marks, from all laboratory projects will be tallied to arrive at the project component of your assessment, which is out of 30.

If your tallied marks exceed 30, the excess mark corresponds to your final bonus B, which will be used to reduce the effective weighting of your midterm and final examination marks.

Specifically, your final mark for the subject is computed as L + B + (1-B/70)x(E+M), where L is your lab mark out of 30, E is your final exam mark out of 60 and M your midterm exam mark out of 10.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Continuous and discrete LSI systems + review of native programming in C + memory organization and management + multi-dimensional filtering.
	Laboratory	
Week 2 : 3 June - 9 June	Lecture	Imaging systems, aliasing, resampling and intro to multi-dimensional filter design
	Tutorial	
Week 3 : 10 June - 16 June	Lecture	Multi-dimensional filter design, correlation and Discrete Fourier Transforms in multiple resolutions
	Laboratory	
Week 4 : 17 June - 23 June	Lecture	Multi-resolution processing and transforms
	Tutorial	
Week 5 : 24 June - 30 June	Lecture	Low level image analysis, focussing on DoG features
	Laboratory	Project-1 is assessed in the laboratory
	Assessment	Midterm test is on Friday
Week 6 : 1 July - 7 July	Laboratory	Lab is open and staffed to allow students to catch up.
Week 7 : 8 July - 14 July	Lecture	Convolutional neural networks
	Tutorial	
Week 8 : 15 July - 21 July	Lecture	Colour processing, conversion and analysis
	Laboratory	Project-2 is assessed in the laboratory
Week 9 : 22 July - 28 July	Lecture	Motion and optical flow
	Tutorial	
Week 10 : 29 July - 4 August	Lecture	Introduction to media compression
	Laboratory	Project-3 is assessed in the laboratory

Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

General Schedule Information

See the course handout on Moodle for the tentative course schedule.

Course Resources

Prescribed Resources

A complete set of typeset lecture notes for the course, written by Prof. Taubman, are available via Moodle. These might be ammended from time to time over the running of the course, but are nonetheless very stable. They should be treated like a textbook and read carefully as essential

prescribed material for the course.

These lecture notes form an integral part of the course; they are not to be treated as supplementary material.

Laboratory assignments, projects and tutorial problems will also be made available via Moodle.

Course Evaluation and Development

Continual Course Improvement

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the online student survey myExperience. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	David Taubman		EE446	9385 5223		No	No
Lecturer	David Taubman		EE446	9385 5223		No	Yes
Demonstrator	Reji Mathew					No	No
	Aous Naman					No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be

awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and

students may be asked to leave the class.

Use of AI for assessments

Your work must be your own. If you use AI in the writing of your assessment, you must acknowledge this and your submission must be substantially your own work. More information can be found on this website.

Workplace Health & Safety (WHS)

WHS for students and staff is of utmost priority. Most courses involve laboratory work. You must follow the rules about conduct in the laboratory. About COVID-19, advice can be found on this website.

School Contact Information

Consultations: Lecturer consultation times will be advised during the first lecture. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with ELEC/TELExxxx in the subject line; otherwise they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Student Support Enquiries

For enrolment and progression enquiries please contact Student Services

Web

Electrical Engineering Homepage