School of Electrical Engineering & Telecommunications

UNSW Engineering

ELEC4622

Multimedia Signal Processing

Term 2, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
David Taubman	d.taubman@unsw.edu.au		EE446	9385 5223

Lecturers

Name	Email	Availability	Location	Phone
David Taubman	d.taubman@unsw.edu.au		EE446	9385 5223

Demonstrators

Name	Email	Availability	Location	Phone
Reji Mathew	reji.mathew@unsw.edu.au			
Aous Naman	aous@unsw.edu.au			

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

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

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)

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, 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

Course Details

Units of Credit 6

Summary of the Course

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. Compression technologies and standards for image, video, speech and audio signals. Communication technologies and standards for real-time multimedia signals, including protection. against and concealment of errors. Software and hardware techniques for representing and processing multimedia 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

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Be familiar with multimedia signal representations, acquisition, file formats and standards	PE1.1, PE1.2, PE1.3, PE2.2
2. Be comfortable with Fourier transforms, power spectra, convolution and other signal processing concepts for multi-dimensional signals	PE1.1, PE1.2, PE1.3, PE2.1, PE2.2
3. Be able to design filters and other algorithms to enhance and extract important features from multimedia signals	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2
4. Be confident in implementing multimedia signal processing algorithms in both Matlab and C/C++	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE3.3, PE3.4

Teaching Strategies

- Lectures provide foundational knowledge and are the only efficient way to provide instruction in the theoretical aspects of multimedia signal processing.

- Lectures are supplemented by the provision of typeset written notes (not powerpoint bullets) on the major theoretical topics. Students will need to study these notes in order to realize solutions to practical problems presented to them.

- Laboratory sessions provide practical experience and a forum to demonstrate independent design. Laboratories also provide an excellent opportunity for interaction between the lecturer and students. Students are expected to come highly prepared to laboratory sessions.

- Tutorials focus on the more theoretical aspects of the course, providing a forum to exercise mathematical concepts and obtain further clarification from the lecturer/tutor.

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.

Assessment

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.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Three Laboratory Projects	30%	Not Applicable	1, 2, 3, 4
2. Final examination	60%	Not Applicable	1, 2, 3
3. Mid Session Quiz	10%	01/07/2022 05:00 PM	1, 2, 3

Assessment 1: Three Laboratory Projects

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. This last point is easily overlooked – it is one thing to write a program that compiles and produces an output, but quite a different thing to know that the output is correct. This is a key attribute of a competent engineer and it comes from understanding the fundamentals that are taught in lectures.

It is essential that you prepare as much as possible of your solution to each project before attending the lab, since in most cases your solution will be marked in the second part of the laboratory session. Demonstrators are there to help you, but less so once marking commences. It is essential that you document your approach to solving the problem, using labeled diagrams that you can refer to during marking.

Assessment 2: Final examination

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), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses.

Assessment 3: Mid Session Quiz

Start date: 01/07/2022 04:00 PM
Due date: 01/07/2022 05:00 PM

The mid-term 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.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

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

View class timetable

Timetable

Date	Type	Content
O-Week: 23 May - 27 May		
Week 1: 30 May - 3 June	Lecture	Continuous and discrete LSI systems + review of native programming in C + memory organization and management + multi-dimensional filtering
	Laboratory	Not assessed, but pretty much a critical lab to help you prepare to do the projects later in the ourse.
Week 2: 6 June - 10 June	Lecture	Imaging systems, aliasing, resampling and intro to multi-dimensional filter design
	Tutorial	Takes place in the last 90 minutes of the TLB slot. Note that online TLB slots will not be recorded, since in-person tutorial slots are obviously not recorded.
Week 3: 13 June - 17 June	Lecture	Multi-dimensional filter design, correlation and Discrete Fourier Transforms in multiple resolutions
	Laboratory	Not assessed, but pretty much a critical lab to help you prepare to do the projects later in the ourse.
Week 4: 20 June - 24 June	Lecture	Multi-resolution processing and transforms
	Tutorial	Takes place in the last 90 minutes of the TLB slot. Note that online TLB slots will not be recorded, since in-person tutorial slots are obviously not recorded.
Week 5: 27 June - 1 July	Lecture	Shape and morphological processing
	Laboratory	Project 1 is due in this laboratory

	Assessment	Midterm test takes place on Friday from 4pm-5pm.
	Assessment	Mid Session Quiz
Week 6: 4 July - 8 July	Laboratory	This is Flexibility Week, but the laboratory session will run to give you a chance to catch up on project work.
Week 7: 11 July - 15 July	Lecture	Segmentation and image feature analysis
	Tutorial	Takes place in the last 90 minutes of the TLB slot. Note that online TLB slots will not be recorded, since in-person tutorial slots are obviously not recorded.
Week 8: 18 July - 22 July	Lecture	Colour processing, conversion and analysis
	Laboratory	Project 2 is due in this laboratory
Week 9: 25 July - 29 July	Lecture	Motion and optical flow
	Tutorial	Takes place in the last 90 minutes of the TLB slot. Note that online TLB slots will not be recorded, since in-person tutorial slots are obviously not recorded.
Week 10: 1 August - 5 August	Lecture	Introduction to media compression
	Laboratory	Project 3 is due in thei laboratory

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.

Laboratory Workshop Information

Laboratory Information

Your attendance at and performance in all scheduled laboratories will be recorded.

In Weeks 5, 8 and 10, a majority of the laboratory time is devoted to one-on-one marking of your projects, so you must be available for marking at all times during the laboratory session.

Academic Honesty and Plagiarism

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

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.

Academic Information

COVID19 - Important Health Related Notice

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate**. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the Nucleus: Student Hub. If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for special consideration through the Special Consideration portal. To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this form.

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the Safe Return to Campus guide for students for more information on safe practices.

Dates to note

Important Dates available at: https://student.unsw.edu.au/dates

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/policy), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both formal classes and *independent, self-directed study*. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. Be aware of the "fit to sit/submit" rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see https://student.unsw.edu.au/special-consideration.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:

https://student.unsw.edu.au/guide

https://www.engineering.unsw.edu.au/electrical-engineering/resources

Disclaimer

This Course Outline sets out 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 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 (as updated in Moodle), the description in the Course Outline/Moodle applies:

Image Credit

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Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	✓
PE3.4 Professional use and management of information	✓
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	