UNSW SYDNEY

Course Outline – Term 2, 2020

Australia's Global University | Faculty of Engineering | School of Electrical Engineering and Telecommunications

Course Staff

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Consultations: TBA – since this instantiation of the course will be entirely online, consultation will also need to be online. In the first couple of weeks, a common time that can work for all students, will be determined, taking timezones and other course demands into account.

Email enquiries: ALL email enquiries should be made from your student email address with ELEC4622 in the subject line.

Keeping Informed: Announcements may be made during classes and/or via Moodle. Please note that you will be deemed to have received the information on this web-site, so you should not rely solely upon materials uploaded to Moodle.

Course Summary

Contact Hours

The course consists of 3 hours of lectures, and a 3-hour laboratory session every week. The laboratory session will be divided flexibly between a tutorial and a computer laboratory. To help you get up to speed as quickly as possible in the new term model, there are four additional 1-hour lectures scheduled in the first 4 weeks.

NB: In the new UNSW timetable, **Week 6** cannot be used to deliver lectures, but can be used to provide supervised laboratories to help you with your projects.

	Day	Time	Location	Weeks
Lectures	Tuesdays	9am - 12noon	Microsoft Teams meeting online	W1-W5, W7-W10
Extra Lecture	Wednesdays	12pm - 1pm	Microsoft Teams meeting online	W1-W4
Labs and Tutorials	Slot 1: Thursdays Slot 2: Fridays	1pm - 4pm 9am - 12noon	Microsoft Teams or Blackboard Collaborate online	W1-W10 W1-W10

Context and 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, orientation, texture, colour and motion.
4. Understanding multi-media formats and representation schemes.

Assumed Prior Knowledge

Students taking this course should have previously taken at least an introductory subject in one-dimensional signal processing, and have at least some computer programming skills.

Syllabus

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. Segmentation and image feature analysis. Introduction to shape, geometry and motion processing techniques. Colour processing, conversion and analysis. Compression technologies and standards for image and video signals. Software and hardware techniques for representing and processing multimedia signals.

Assessment for ELEC4622

- Final exam: 60%
- Midterm test (Week 5): 10%
- Three laboratory projects (assessed in Labs in Weeks 5, 8 and 10): 30% (+ possible bonus marks)

The final mark for the subject is $B + (1 - B/100) \cdot (E + Q + L)$, where B, E, Q and L are the bonus, exam, quiz and laboratory marks mentioned above.

Student learning outcomes

At the successful completion of the course the student should:

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

Rationale behind this course's approach to learning and teaching

- Signal processing is an important branch of Electrical Engineering, which is foundational to multimedia processing and telecommunications. The initial mathematical framework for signal processing is introduced in earlier courses in signals and systems and the third year signal processing course ELEC3104. However, many students find that they do not feel confident enough to implement real signal processing algorithms to solve practical problems. In view of this, the present professional elective has been deliberately designed to have a strong emphasis on practical implementation.
- Multimedia signal processing is highly intensive in terms of computational and memory resources. As a result, most practical work in this area involves programming in a native language (typically C or C++), sometimes in tandem with the development of dedicated hardware (FPGA's initially). In view of this, the practical aspects of this course emphasize native implementation and resource management methodologies.

- The course covers significant fundamental material of a theoretical nature. In order to provide an efficient and balanced learning experience, laboratory sessions are designed to closely follow the relevant developments in lectures. A portion of each laboratory session is used to provide practical demonstration of strategies for implementing concepts very recently taught in lectures.
- Independent thinking and problem solving are very important aspects of this course, since it is only by independently tackling a challenging problem that the student becomes confident in his/her understanding. A second portion of most laboratory sessions is devoted to the completion and interactive assessment of multimedia processing solutions, which students must have designed in their own time, based on a thorough understanding of the lecture materials.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes			
Assessment	**1**	**2**	**3**	**4**
Laboratory and practical projects	✓	✓	✓	✓
Mid-term exam	✓	✓	✓	-
Final exam	✓	✓	✓	-

Course schedule (tentative)

Week	**Tut / Test / Lab**	**Lecture Topic(s)**
W1 *3h Tue + 1h Wed*	Lab	Continuous and discrete LSI systems + review of native programming in C + memory organization and management + multi-dimensional filtering
W2 *3h Tue + 1h Wed*	Tut (2nd 2 hours only)	Imaging systems, aliasing, resampling and intro to multi-dimensional filter design
W3 *3h Tue + 1h Wed*	Lab	Multi-dimensional filter design, correlation and Discrete Fourier Transforms in multiple resolutions
W4 *3h Tue + 1h Wed*	Tut (2nd 2 hours only)	Multi-resolution processing and transforms
W5 *3h Tue*	Lab (Proj-1 due) Midterm Test	Shape and morphological processing
W6 *no lectures*	Lab	
W7 *3h Tue*	Tut (2nd 2 hours only)	Segmentation and image feature analysis
W8 *3h Tue*	Lab (Proj-2 due)	Colour processing, conversion and analysis
W9 *3h Tue*	Tut (2nd 2 hours only)	Motion and optical flow
W10 *3h Tue*	Lab (Proj-3 due)	Introduction to media compression

Course Resources

Textbooks

Prescribed:

- A complete set of typeset lecture notes for the course, written by Prof. Taubman, are available via the course web-site. 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.

On-line resources

All course materials, project descriptions, problem sets and so forth will appear on the course Moodle page.

A full set of live recorded video lectures from the 2019 instantiation of the course are also available at: http://eemedia.ee.unsw.edu.au/ELEC4622/index.htm

Announcements:

Announcements concerning course information will be given in the lectures and/or via Moodle. You might also be sent email with important announcements, which will be sent to your student email address via Moodle.

Other Matters

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.

In this subject, a particularly concerning form of plagiarism is the use of code written by third parties (including other students from current or previous years) for any of the course projects. If you are not very familiar with native programming, you may find yourself tempted to resort to this, but giving into this temptation would be a very serious mistake.

You will be interrogated concerning your understanding of your work, during the lab, and students who cannot explain how individual parts of their solution work or why they were adopted will receive zero marks for the entire project. You are welcome and encouraged to exchange ideas with other students, but not solutions. You will also be required to submit electronic copies of your project solutions to allow for machine inspection, which may be run at any time, including after you have received your initial mark.

The laboratory demonstrators are highly experienced and able to help you to build your understanding and confidence, especially in the early laboratories, so you should take full advantage of this resource to get the most out of the course and prepare for the projects that have a diversity of solutions.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies and particular attention is drawn to the following:

Workload

It is expected that you will spend approximately **fifteen hours per week** studying a 6 UoC course, averaged over the 10 week term, 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

Based on past experience, the students who struggle most with the material in this subject are those who fail to attend all lectures. While video recordings may be made available, the regularity and environment of the lecture itself are much more conducive to learning, asking questions and keeping in touch with the material and your peers.

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.

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 attend all examinations scheduled for your course, including in-class tests. You must also submit all assessable laboratory projects for assessment in the designated laboratory session and week, allowing adequate time for laboratory demonstrators to mark your work. You should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be lodged **within 3 working days of the relevant assessment**, in accordance with the policy at: https://student.unsw.edu.au/special-consideration.

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 Course and Teaching Evaluation and Improvement Process. You can also provide feedback to ELSOC who can raise your concerns or positive feedback 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.

We are expecially interested in your feedback concerning this first instantiation of the course within the UNSW 3+ term model.

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

APPENDICES

Appendix A: 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.

Appendix B: 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.

Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

	Program Intended Learning Outcomes	
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	✓
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	✓
	PE1.3 In-depth understanding of specialist bodies of knowledge	✓
	PE1.4 Discernment of knowledge development and research directions	
	PE1.5 Knowledge of engineering design practice	✓
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice	
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex 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	
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	
	PE3.2 Effective oral and written communication (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	