School of Electrical Engineering and Telecommunications

Semester 2, 2017
Course Outline

ELEC4622
Multimedia Signal Processing

COURSE STAFF

Course Convener: Dr. Reji Mathew, MSEB Room 722,reji@unsw.edu.au
Tutor: Mr. Sean Young, sean.young@student.unsw.edu.au
Laboratory Contact: TBA

Consultations: You are encouraged to ask questions on the course material, after the lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during lectures. ALL email enquiries should be made from your student email address with ELEC4622 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 the subject website – this subject uses the School of EE&T's subjects repository at https://subjects.ee.unsw.edu.au/elec4622. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

COURSE SUMMARY

Contact Hours

The course consists of 2 hours of lectures every week with a 2-hour tutorial and a 3-hour laboratory session scheduled for every two weeks.

	Day	Time	Location
Lectures	Monday	4pm - 6pm	Ainsworth 102 (K-J17-102)
Tutorials	Monday	1pm – 3pm either odd or even week	Ainsworth 101 (K-J17-101)
Labs	Tuesday	10am – 1pm either odd or even week	Electrical Eng 214 (K-G17-214)

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.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Continuous and discrete LSI systems
Week 2	Multi-dimensional filtering, memory organization and management
Week 3	Imaging systems, resampling and aliasing considerations in 2 and 3 dimensions
Week 4	Multidimensional Filter design
Week 5	Correlation and Discrete Fourier transforms
Week 6	Multi-resolution processing
Week 7	**Mid-session test** + Introduction to shape and morphological processing
Break	
Week 8	Segmentation and texture analysis
Week 9	Introduction to Colour
Week 10	**Monday is a public holiday**
Week 11	Introduction to motion estimation
Week 12	Introduction to Image Compression

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 2	Lab 1
Week 3	Lab 1
Week 4	Lab 2
Week 5	Lab 2
Week 6	Lab Project 1
Week 7	Lab Project 1
Break	
Week 8	Lab Project 1
Week 9	Lab Project 1
Week 10	Lab Project 2
Week 11	Lab Project 2
Week 12	Lab Project 3
Week 13	Lab Project 3

Assessment

Final exam: 60%
Midterm test/quiz (taken during the pre-tutorial hour of Week 8): 10%
Three laboratory projects (assessed in Labs in Weeks 5-13): 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.

COURSE DETAILS

Credits

This is a 6 UoC course and the expected workload is 10–12 hours per week throughout the 13 week semester.

Relationship to Other Courses

This is a 4th year undergraduate course in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed 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.

Learning outcomes

After successful completion of this course, you should be able to:

1. Explain and describe the core aspects of multimedia signal representations, acquisition, file formats and standards;
2. Apply and appropriately utilise Fourier transforms, power spectra, convolution and other key signal processing concepts for multi-dimensional signals;
3. Design filters and other algorithms to enhance and extract important features from multimedia signals;
4. Implement multimedia signal processing algorithms in C/C++.

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in ***Appendix A***. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in ***Appendix B***). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in ***Appendix C***.

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. 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.

TEACHING STRATEGIES

Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures provide detailed explanations and examples that help in the learning of fundamental and significant components of the course that are theoretical in nature.
- Tutorials provide exercises in problem solving and allow time for you to resolve problems in understanding of the lecture material;
- Laboratory sessions support the formal lecture material and also provide you with practical design, implementation and debugging skills. A portion of each laboratory session is used to provide practical demonstrations of strategies for implementing concepts very recently taught in lectures. A second portion of most laboratory sessions is devoted to the completion and interactive assessment of multimedia processing solutions, which students must design in their own time, based on a thorough understanding of the lecture materials.

Learning in this course

You are expected to attend all lectures, tutorials, labs, and mid-semester exams in order to maximise learning. You must prepare well for your laboratory classes and your lab work will be assessed. Group learning is also

encouraged. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

Tutorial classes

You should attempt all of your problem sheet questions in advance of attending the tutorial classes. The importance of adequate preparation prior to each tutorial cannot be overemphasized, as the effectiveness and usefulness of the tutorial depends to a large extent on this preparation. Group learning is encouraged. Answers for these questions will be discussed during the tutorial class and the tutor will cover the more complex questions in the tutorial class. In addition, during the tutorial class, 1-2 new questions that are not in your notes may be provided by the tutor, for you to try in class. These questions and solutions may not be made available on the web, so it is worthwhile for you to attend your tutorial classes to gain maximum benefit from this course.

Laboratory program

The laboratory schedule is deliberately designed to provide practical, hands-on exposure to the concepts conveyed in lectures soon after they are covered in class. You are required to attend laboratory from Week 2 to Week 13 (odd or even weeks). Laboratory attendance WILL be kept, and you MUST attend the labs for your projects to be assessed.

Laboratory Exemption

There is no laboratory exemption for this course. Regardless of whether equivalent labs have been completed in previous courses, all students enrolled in this course must take the labs. If, for medical reasons, (note that a valid medical certificate must be provided) you are unable to attend a lab, you will need to apply for a catch-up lab during another lab time, as agreed by the laboratory coordinator.

ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through the lab projects and the mid-session test (quiz).

Laboratory Assessment

Laboratories are primarily about learning, and the laboratory assessment is designed mainly to check your knowledge as you progress through each stage of the laboratory tasks. In total there are 3 lab projects which will be assessed.

It is essential that you complete (or make considerable progress towards completing) the laboratory project before coming to the lab. During the lab sessions your work will be assessed by the laboratory demonstrator. This is an interactive assessment of the multimedia processing solutions you have implemented.

Assessment marks will be awarded according to the set project tasks you have completed, your understanding of your implementation, the quality of the code you have written and your understanding of the theoretical topics that relate to your design or implementation.

Mid-Semester Test

The mid-session test (or quiz) examines 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 course material up to the end of week 6. 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. The mid-semester test is scheduled for week 7.

Final Exam

The exam in this course is a standard closed-book 2 hour written examination, comprising five compulsory questions. 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. *Please note that you must pass the final exam in order to pass the course.*

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes			
Assessment	**1**	**2**	**3**	**4**
Laboratory practical assessments	✓	✓	✓	✓
Mid-semester test (quiz)	✓	✓	✓	-
Final exam	✓	✓	✓	-

COURSE RESOURCES

Textbooks

Prescribed textbook

- A complete set of typeset lecture notes for the course, written by Prof. Taubman, are available via the course website. These might be amended 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

Course Web-site:

For all course materials, project descriptions, problem sets and so forth, the official web-site for this course is at https://subjects.ee.unsw.edu.au/elec4622.

Mailing list

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

OTHER MATTERS

Dates to note

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

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.

Student Responsibilities and Conduct

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

Workload

It is expected that you will spend at least **ten to twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to 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.

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 submit all assignments and attend all examinations scheduled for your course. You should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**, not to course or school staff. For more detail, consult 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 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.

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

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	