ELEC4844

Signal Processing for Software Defined Radio

Session 1, In person-scheduled-weekday, North Ryde 2024

School of Engineering

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General Information

Unit convenor and teaching staff
Convenor
Yiqing Lu
yiqing.lu@mq.edu.au
3MD 137
Fridays 3-5 pm

Credit points
10

Prerequisites
(ELEC2040 and 200cp at 1000 level or above) or Admission to MEngElecEng

Corequisites

Co-badged status
ELEC8844

Unit description
This unit aims to provide students with the theory and hands-on experience in designing and implementing digital signal processing algorithms using software defined radio technology. The unit builds on previous knowledge and skills in signals and systems, and provides an additional foundation in Digital Signal Processing. The unit introduces the software defined radio concept along with various software defined radio architectures and platforms. Topics covered include: sampling and quantisation, low-pass representation of bandpass systems, quadrature-signal representation, frequency translation, sample rate conversion, decimation and interpolation, direct and polyphase interpolator and decimator architectures, half-band FIR filters, digital up and down converters, matched filters and the software defined radio architectures and platforms. The unit culminates in a project where students develop a software defined radio technology-based solution from high-level functional specifications through to design, implementation and testing on real hardware.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Describe what a software defined radio platform is and its constituent functional

components.

ULO2: Convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.

ULO3: Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations.

ULO4: Design, implement and test digital signal processing algorithms.

ULO5: Prepare design documents and reports and communicate and explain design decisions.

General Assessment Information

Requirements to Pass this Unit

The entire assessment in this Unit consists of 10 weekly submissions during practical classes, Assignment 1 Report, Assignment 1 Oral Defense, Assignment 2 Report, Assignment 2 Oral Defense, and Semester Project report and oral presentation. Passing this Unit requires an **overall Mark of 50 out of 100**. There is no Final Examination, and therefore there is no Supplemental Examination. There are no hurdle requirements.

Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or presentation assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. The submission time for all uploaded assessments is **11:55 pm Sydney Time**. A 1-hour grace period will be provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration.

Resubmission of work is not allowed.

Assessments where Late Submissions will be accepted

Assignment/Project Reports - Yes, Standard Late Penalty applies

Defences - No, unless Special Consideration is Granted

If assessments are missed due to illness or misadventure, students should apply for Special Consideration.

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the

convenor and submit a Special Consideration request through ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due	Groupwork/Individual	Short Extension	AI Approach
Practical Tasks	20%	No	weekly, till Week 12		No	
Assignment 1	10%	No	Week 5		No	
Defence 1	10%	No	Week 5		No	
Assignment 2	10%	No	Week 9		No	
Defence 2	15%	No	Week 9		No	
Semester Project	35%	No	Week 13		No	

Practical Tasks

Assessment Type [1]: Practice-based task
Indicative Time on Task [2]: 10 hours
Due: **weekly, till Week 12**
Weighting: **20%**
Groupwork/Individual:
Short extension [3]: No
AI Approach:

Tasks carried out during the practical classes

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations.
- Design, implement and test digital signal processing algorithms.

Assignment 1

Assessment Type [1]: Report
Indicative Time on Task [2]: 15 hours
Due: **Week 5**
Weighting: **10%**
Groupwork/Individual:
Short extension [3]: No
AI Approach:

Assignment 1 Report (1000 word equivalent)

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations.
- Design, implement and test digital signal processing algorithms.
- Prepare design documents and reports and communicate and explain design decisions.

Defence 1

Assessment Type [1]: Viva/oral examination
Indicative Time on Task [2]: 5 hours
Due: **Week 5**
Weighting: **10%**
Groupwork/Individual:
Short extension [3]: No
AI Approach:

An oral examination on the first part of the unit

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.

- Convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations.
- Design, implement and test digital signal processing algorithms.

Assignment 2

Assessment Type [1]: Report
Indicative Time on Task [2]: 15 hours
Due: **Week 9**
Weighting: **10%**
Groupwork/Individual:
Short extension [3]: No
AI Approach:

Assignment 2 Report (1000 word equivalent)

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations.
- Design, implement and test digital signal processing algorithms.
- Prepare design documents and reports and communicate and explain design decisions.

Defence 2

Assessment Type [1]: Viva/oral examination
Indicative Time on Task [2]: 5 hours
Due: **Week 9**
Weighting: **15%**
Groupwork/Individual:
Short extension [3]: No
AI Approach:

An oral examination on the second part of the unit

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations.
- Design, implement and test digital signal processing algorithms.

Semester Project

Assessment Type [1]: Project
Indicative Time on Task [2]: 35 hours
Due: **Week 13**
Weighting: **35%**
Groupwork/Individual:
Short extension [3]: No
AI Approach:

Project report (2000-word equivalent) and oral examination of the outcomes

On successful completion you will be able to:

- Describe what a software defined radio platform is and its constituent functional components.
- Convey the advantages and limitations of various software-defined-radio-specific digital signal processing algorithms and their efficient implementations.
- Undertake quantitative performance analysis and contrast various digital signal processing algorithms and their implementations.
- Design, implement and test digital signal processing algorithms.
- Prepare design documents and reports and communicate and explain design decisions.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment

- Academic Success for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation.

[3] An automatic short extension is available for some assessments. Apply through the Service Connect Portal.

Delivery and Resources

The Unit will be delivered with a two-hour lecture and a three-hour practical for each week, both on-campus and starting in Week 1. If students have difficulty in attending on-campus classes, they should contact the Unit Convenor as soon as possible.

The unit requires some project work with RTL-SDR devices manufactured by Nooelec, which are USB plugins for computers. **Students are required to purchase their own RTL-SDR devices.**

The software required is MATLAB and Simulink, which can be downloaded by Macquarie University students from the Mathworks Website for free.

Methods of Communication

We will communicate with you via your university email or through announcements on iLearn. Queries to convenors can either be placed on the iLearn discussion forum or sent to yiqing.liu@mq.edu.au from your **university email** address.

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit connect.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study

- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via the Service Connect Portal, or contact Service Connect.

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Engineers Australia Competency Mapping

EA Competency Standard		Unit Learning Outcomes
Knowledge and Skill Base	1.1 Comprehensive, theory-based understanding of the underpinning fundamentals applicable to the engineering discipline.	UL01, UL02, UL03, UL04, UL05
	1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing.	UL02, UL03, UL04
	1.3 In-depth understanding of specialist bodies of knowledge	UL01, UL02, UL03
	1.4 Discernment of knowledge development and research directions	UL01, UL02, UL03
	1.5 Knowledge of engineering design practice	UL01, UL02
	1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice.	UL01, UL02, UL03, UL04, UL05
Engineering Application Ability	2.1 Application of established engineering methods to complex problem solving	UL01, UL02, UL03, UL04, UL05
	2.2 Fluent application of engineering techniques, tools and resources.	UL01, UL02, UL03, UL04, UL05
	2.3 Application of systematic engineering synthesis and design processes.	UL02, UL03, UL04
	2.4 Application of systematic approaches to the conduct and management of engineering projects.	UL03, UL04, UL05

Professional and Personal Attributes	3.1 Ethical conduct and professional accountability.	UL05
	3.2 Effective oral and written communication in professional and lay domains.	UL05
	3.3 Creative, innovative and pro-active demeanour.	UL02, UL05
	3.4 Professional use and management of information.	UL02, UL05
	3.5 Orderly management of self, and professional conduct.	UL04, UL05
	3.6 Effective team membership and team leadership	UL05

Unit information based on version 2024.02 of the Handbook