LECTURE 01

Welcome to ENGN6612 & ENGN4612 Digital Signal Processing & Control

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Lecture Overview

- Introduction to ENGN4612/6612
- Course Outline and Assessment Schedule

ENGN4612/6612 Who's Who

- **Lecturers**
  - **Dr. Salman Durrani**
    - Email: salman.durrani@anu.edu.au
    - Office E237 Engineering Bldg, Tel: 6125 6573
    - http://engnet.anu.edu.au/DEpeople/Salman.Durrani/
  - **Dr. Cassius D'Helon**
    - Email: cassius.dhelon@anu.edu.au
    - Office E203 Engineering Bldg, Tel: 6125 8134
- **Lab Demonstrator**
  - **Mr. Hendra Nurdin**
    - Tel: 58685

ENGN4612/6612 Course Info.

- **Course Web-site**
  - http://engnet.anu.edu.au/DEcourses/engn6612/
- **Notes**
  - http://engnet.anu.edu.au/DEcourses/engn6612/notes/
- **Useful References**
  - **Alan V. Oppenheim and R.W. Schafer, *Discrete-time signal processing*, Englewood Cliffs, N.J. : Prentice Hall, c1989 TK5102.5.O2452 1989**
  - **Alan V. Oppenheim, Alan S. Willsky, with S. Hamid Nawab, *Signals & systems*, Prentice Hall, 1997 Edition 2nd ed. QA402.O63 1997**
  - **Ken Steiglitz, *A DSP primer : with applications to digital audio and computer music*, Addison-Wesley Pub., c1996 TK5102.9 .S74 1996**
  - **Thomas Kailath, *Linear systems*, Englewood Cliffs N.J : Prentice-hall, c1980 QA402.K317**
  - **O. L. R Jacobs, *Introduction to control theory*, Oxford: Clarendon Press, 1974. QA402.3.J29**
  - **B.D.O. Anderson and J.B. Moore, Optimal Filtering, Prentice-Hall, Englewood Cliffs, NJ, 1979. TK5102.5.A53**

What is this course about?

- **DSPC applications**
  - Telecommunications

    - **Vocoder** (Voice Coder) is a device that usually consists of :-
(a) a speech analyser, which converts analog speech waveforms into digital signals and
(b) and a speech synthesizer, which converts the digital signals into artificial speech sounds.

Table 1: 8.6kbps Vocoder packet structure
(each frame produced by vocoder is 20ms long)

Information [bits]	Signalling [bits]	CRC [bits]	Code tail [bits]	Total [bits]	Bit rate [bps]
171	**1**	**12**	**8**	**192**	**9600**

What is this course about?

- **DSPC applications**
  - Telecommunications
  - Audio
  - Video
  - Photography
  - Automation
- **DSPC Theory**
  - Fundamental principles
  - Optimal methods

How are you going to learn?

- **Applications**
  - Tutorials
  - Self-study
  - Peer-peer learning
  - Report
  - Presentation
- **Theory**
  - Lectures
  - Tutorials
  - Matlab
  - Exercises
  - Self-study

Course structure

Week	ENGN4612 and ENGN6612			ENGN6612 only
	Lectures	*Computer Labs:* Matlab and theory exercises	*Tutorial A:* DSPC technology discussion sessions	*Tutorial B:* DSPC research paper discussion sessions
1 (18Jul-24Jul)	Signals and systems fundamentals			
2 (25Jul-31Jul)		CLAB1-even		
3 (01Aug-07Aug)		CLAB1-odd		
4 (08Aug-14Aug)	State space	CLAB2-even		
5 (15Aug-21Aug)		CLAB2-odd	One page due	
6 (22Aug-28Aug)		CLAB3-even		
7 (29Aug-02Sep)		CLAB3-odd		
8 (19Sep-25Sep)	Optimal filtering	CLAB4-even		
9 (26Sep-02Oct)		CLAB4-odd		
10 (03Oct-09Oct)	Optimal control	CLAB5-even		
11 (10Oct-16Oct)		CLAB5-odd	Report due	
12 (17Oct-23Oct)			Presentations	Presentations & Report due
13 (24Oct-30Oct)	Review			

Proposed Assessment

- **ENGN4612**
  - Computer labs 20%
  - Tutorial report 30%
  - Tutorial presentation 10%
  - Exam 40%
- **ENGN6612**
  - Computer labs 20%
  - Tutorial report 20%
  - Tutorial presentation 10%
  - *Research paper report 10%*
  - *Research paper presentation 10%*
  - Exam 30%

Question

I like high tech applications, programming and building things, what exactly are the DSPC applications?

DSPC Application Keywords

- photograph
- CD
- Digital TV
- DVD
- DVDA
- SACD
- Camera
- Microphone
- Encoder
- Decoder
- Disc recorder
- Disc player
- Amplifier
- Speakers
- Display
- Printer
- Mobile phone
- ADC
- DAC
- Signal model
- Filter
- Photo editor
- controller
- Thermostat
- Avionics
- Sensors
- Actuator
- Digital controller

Question

I’m not crazy about theory,
and can’t do the maths.

Why does this course have theory?

Why Theory?

- Technology would not have developed far without theory (e.g. Shannon's information theory was once considered abstract and now is widely used in digital audio and video compression, mobile phones, etc).
- Theory is essential for significant technical progress.
- Theory and applications drive each other.
- As ANU Engineering graduates, you will want to be at the leading edge of your profession throughout your career.
- **You can do the maths.**
- **It's fun!**

Course Key Words

- Signals
- Systems
- Z-transform
- Fast Fourier transform
- Spectrum
- Digital filter
- Sampling
- State space
- Difference equation
- Controllability
- Observability
- Vector
- Projection
- Riccati equation
- Optimal control
- Performance
- Stability
- Kalman filter

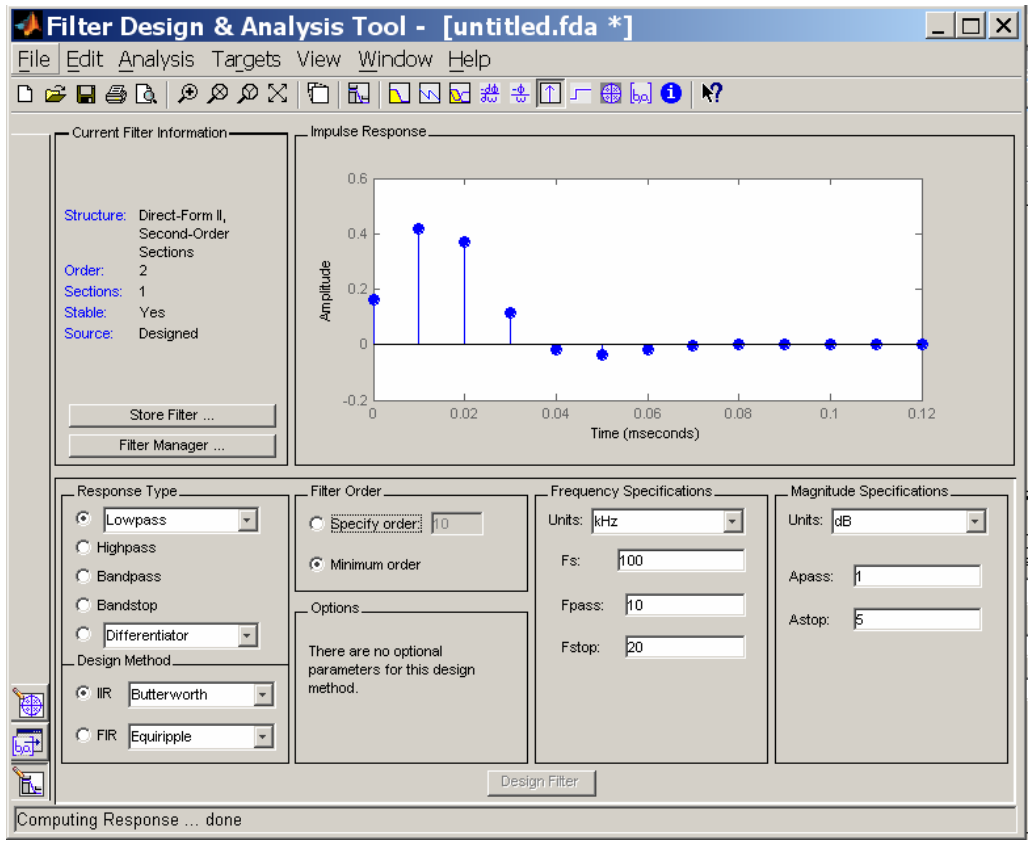
MATLAB!

- **Filter Design and Analysis Tool**

  `fdatool`

- **Signal Processing Tool**

  `sptool`



Announcements

- Please **sign up for** either one of the **Lab sessions**:-
  - Even (Weeks 2,4,6,8,10)
  - Odd (Weeks 3,5,7,9,11)

- Please **sign up for** either one of the DSPC technology **Tutorial A sessions**:
  - Group 1 (Tue 2-3 pm)
  - Group 2 (Wed 2-3 pm)

- Sign Up Sheets available on Department of Engineering 4th year Notice Board.