OUTLINE

ELEC4621: ADVANCED SIGNAL PROCESSING
SESSION 1, 2008

1.1 Subject Objectives

This subject builds upon the material introduced in the third year course (Digital Signal Processing & Transform Methods), focusing exclusively on digital signal processing techniques. By the end of the session, the student should: 1) have a more thorough understanding of the relationship between time and frequency domain interpretations and implementations of signal processing algorithms; 2) understand and be able to implement adaptive signal processing algorithms based on second order statistics; and 3) be familiar with some of the most important advanced signal processing techniques, including multi-rate processing and time-frequency analysis techniques.

1.2 Topics:

- Sampling, aliasing and the relationship between discrete and continuous signals
- Review of Fourier transforms, the Z-transform, FIR and IIR filters, and oscillators
- Filter implementation techniques, structures and numerical round-off effects
- Filter design techniques
- Auto-correlation, cross-correlation, and power spectrum estimation techniques
- Linear prediction
- Wiener filters, LMS adaptive filters, and applications.
- Sub-band decomposition & QMF.
- Time-frequency analysis, the short time Fourier transform, and wavelet transforms.

1.3 Subject Pre-Requisites:

Signal Processing 1 (Elec3004), or equivalent

1.4 Instructor

- Dr. D. Sen
  Room EE306
  E-mail: dsen@ee.unsw.edu.au

- Consultation hours: best time is right after tutorials and lectures.

1.5 Lectures

- Thursdays, 1pm to 3pm; EE-224

1.6 Tutorials

- Wednesdays 3pm-4pm (alternate weeks); EE-225
- You may come to every tutorial if you like. We might not cover exactly the same problems in the odd and even weeks, but you can always ask for specific problems to be covered in your tutorial session.
- No Tutorial in Week 1.

1.7 Labs

- Tuesdays 11am-2pm ; EE214
- No labs in Week 1. Labs assessed from Week 3 onward.
1.8 Assessment

- 15% laboratory (assessed at the end of each lab, from Week 3, ***COME PREPARED***)
- 15% for an in-class quiz (compulsory - exemption granted only with a medical certificate)
- 15% for a second in-class quiz (compulsory - exemption granted only with a medical certificate).
- 55% final exam

Special quiz redemption processing: the lower of either of the quiz marks (as a percentage of the full mark) will be replaced by the maximum of the other quiz/project mark and your exam mark (both as percentages of their respective full marks), whichever is greater.

1.9 Recommended Texts

- Lecture materials, tutorial questions, lab material will be made available over WebCT.
- Recommended Reading:

1.10 Other materials

- Supplementary handouts, including tutorial problems, laboratory assignments, etc will accompany the lectures.

1.11 Academic honesty and plagiarism

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one’s own.* Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, website, Internet, other electronic resource, or another person’s assignment without appropriate acknowledgement;
- paraphrasing another person’s work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.
Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

† Adapted with kind permission from the University of Melbourne.
1.12 Graduate Attributes
The graduate attributes contributed by this course includes:

- The skills involved in scholarly enquiry
- The capacity for analytical and critical thinking and for creative problem-solving
- The ability to engage in independent and reflective learning
- Information literacy - the skills to appropriately locate, evaluate and use relevant information
- The capacity for enterprise, initiative and creativity
- The skills required for collaborative and multidisciplinary work

1.13 Tentative Program

<table>
<thead>
<tr>
<th>Week (Date)</th>
<th>Lab</th>
<th>Tut</th>
<th>Planned Topic(s)</th>
</tr>
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<tbody>
<tr>
<td>0 3/3</td>
<td>(Matlab refresher)</td>
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<tr>
<td>1 10/3</td>
<td>(Matlab refresher) Tut 1</td>
<td>Foundations: Convolution, FT, DTFT, sampling, and discrete vs. continuous time.</td>
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<tr>
<td>2 17/3</td>
<td>Even 1 Tut 1</td>
<td>Z-transforms, filters and oscillators</td>
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<td>- 24/3</td>
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<td>Mid-Session Break</td>
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<tr>
<td>3 31/3</td>
<td>Odd 1 Tut 2</td>
<td>Filter implementation structures and techniques</td>
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<tr>
<td>4 7/4</td>
<td>Even 2 Tut 2</td>
<td>Filter implementation and the DFT</td>
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<tr>
<td>5 14/4</td>
<td>Odd 2 Tut 3</td>
<td>Filter design techniques</td>
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<tr>
<td>6 21/4</td>
<td>Even 3 Tut 3</td>
<td>Random processes</td>
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<tr>
<td>7 28/4</td>
<td>Odd 3 Tut 4</td>
<td>In-class quiz #1; Linear prediction (2nd Hour)</td>
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<tr>
<td>8 5/5</td>
<td>Even 4 Tut 4</td>
<td>Linear prediction (continued)</td>
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<td>9 12/5</td>
<td>Odd 4 Tut 5</td>
<td>Power spectrum estimation</td>
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<td>10 19/5</td>
<td>Even 5 Tut 5</td>
<td>Wiener and adaptive filtering</td>
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<td>11 26/5</td>
<td>Odd 5 Tut 6</td>
<td>In-class quiz #2; Sub-band decomposition/Quadrature Mirror Filters (2nd Hour)</td>
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<tr>
<td>12 2/6</td>
<td>** Tut 6</td>
<td>Wavelet transforms; Time-frequency analysis</td>
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Lectures: Thursdays 1-3 pm;
Labs: Tuesdays 11 am-2 pm; EE214 (**: catchup). Tuts: Wednesdays, 3 pm-4 pm