ELEC 4621

Advanced Digital Signal Processing

Tentative Outline: SESSION 1, 2011
Course staff
Prof. David Taubman
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  Note that email is NOT a real-time or conversational medium. If you have an urgent enquiry, or wish to discuss something, use the phone or knock on the door.
• Consultation times: please arrange consultation at the start or end of lectures, tutorials or laboratory sessions. As a general rule, the best time to ask questions is immediately after the tutorial if your timetable allows.

Course details
• This course is worth 6 Units of Credit
• The first lecture will be held Thursday of Week 1, from 1pm-3pm in EE222
  o NB: this is in place of the Monday lecture listed on the official course timetable.
• Remaining lectures held Mondays in Weeks 2-12, from 9:00-12:00 in OMB145A.
• Laboratories held Thursdays from 1-4pm in EE214 in Weeks 2, 4, 6, 8, 10 and 12.
• Tutorials are held on Thursdays from 1-2pm in Quad G025 in Weeks 3, 5, 7, 9, 11 and 13. The tutorial in Week 13 will be used for feedback on the final quiz and to answer questions in preparation for the exam.

Course aims
This subject builds upon the material introduced in Elec3104, focusing exclusively on digital signal processing techniques. The following topics are covered:
  ➢ 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.
  ➢ Multi-rate signal processing and subband transforms.
  ➢ Time-frequency analysis, the short time Fourier transform, and wavelet transforms.

Students taking this course should have previously taken Elec3104 (Digital Signal Processing) or an equivalent subject. Students are expected to have a familiarity with Matlab.

Student learning outcomes
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.
Assessment
- Final exam: 65%
- Laboratory: 15% (assessed at the end of each lab, from Week 4)
  - You will find that the assessed laboratories require careful preparation, which is best done by reviewing lecture materials to the point where you understand them thoroughly. Although this may seem quite a bit of work, you will find that it pays off in the end, because preparing for the laboratories is one of the most effective study techniques for the course as a whole.
- Two in-class quizzes: 20% (exemption granted only with a medical certificate)
  - Special quiz redemption processing: the lower of your two quiz marks (as a percentage of the full mark) will be replaced by the maximum of the other quiz mark and your exam mark (both as percentages of their respective full marks), whichever is greater.

Recommended Texts and Course Website
- http://subjects.ee.unsw.edu.au/~elec4621
- Complete set of typeset lecture notes for the course, written by Prof. Taubman – these will be made available via the subject web-site. These should be sufficient for your learning needs (they are effectively a textbook). However, you may also find the text below to be helpful.

Course evaluation and development
- Your feedback and suggestions will be most welcome. Such feedback will be considered carefully with a view to acting on it constructively wherever possible. Your feedback is especially important since this is a typically a rather small class.
- An official survey may also be conducted toward the end of the course to obtain more information on your experience of the course.

Tentative Program

<table>
<thead>
<tr>
<th>Week</th>
<th>Begins</th>
<th>Lab/Tut</th>
<th>Topic(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Feb 28</td>
<td>None</td>
<td>Convolution, FT, DTFT, sampling, discrete vs. continuous time</td>
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<tr>
<td>2</td>
<td>Mar 7</td>
<td>Lab 1</td>
<td>Z-transforms, filters and oscillators</td>
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<tr>
<td>3</td>
<td>Mar 14</td>
<td>Tut 1</td>
<td>Filter implementation structures &amp; techniques</td>
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<td>4</td>
<td>Mar 21</td>
<td>Lab 2</td>
<td>Filter implementation: quantization effects + DFT</td>
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<tr>
<td>5</td>
<td>Mar 28</td>
<td>Tut 2</td>
<td>Filter Design Techniques</td>
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<tr>
<td>6</td>
<td>Apr 4</td>
<td>Lab 3</td>
<td>Filter Design Techniques continued</td>
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<tr>
<td>7</td>
<td>Apr 11</td>
<td>Tut 3</td>
<td>In-class quiz #1; Statistics and power spectrum estimation</td>
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<td>8</td>
<td>Apr 18</td>
<td>Lab 4</td>
<td>Quiz #1 review; Linear Prediction</td>
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<td>Apr 25</td>
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<td>Mid-Session Break</td>
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<tr>
<td>9</td>
<td>May 2</td>
<td>Tut 4</td>
<td>Wiener and adaptive filtering</td>
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<td>10</td>
<td>May 9</td>
<td>Lab 5</td>
<td>Multi-rate Processing and Subband transforms</td>
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<td>11</td>
<td>May 16</td>
<td>Tut 5</td>
<td>Subband transforms continued</td>
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<td>12</td>
<td>May 23</td>
<td>Lab 6</td>
<td>In-class quiz #2; Brief intro to time-freq analysis</td>
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<tr>
<td>13</td>
<td>May 30</td>
<td>Tut 6</td>
<td>Quiz #2 review and preparation for exam</td>
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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, web site, 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.