Multimedia Signal Processing

Tentative Outline: SESSION 2, 2008
Contents
• Only for ridiculously long course outlines.

Course staff
A/Prof. David Taubman
• Office: EE303; Phone: 9385-5223; Email: d.taubman@unsw.edu.au
  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: Dr. Taubman will be available to discuss the course from 4pm to 5pm on Tuesdays – i.e., in the hour immediately following lectures.

Course details
• This course is worth 6 Units of Credit
• Lectures are from 2:00-4:00 on Wednesdays (EE224)
• Laboratories are held on Wednesdays from 9-12 in EE214 in Weeks 3, 4, 5, 7, 9 and 11.
• Tutorials are held on Wednesdays at 12:00 in EE218 on Weeks 6, 8, 10 and 12.

Course 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, texture, colour and motion; and
4. Introduction to multimedia formats and compression standards.

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. Students who take this course and ELEC4621 should find that the two courses complement each other well; neither need be taken as a pre-requisite for the other, however. Students interested in studying the Postgraduate Image Processing subject ELEC9722 should find that the present course provides a valuable bridge.

Student learning outcomes
At the successful completion of the course the student should:
1. Be familiar with multimedia signal representations, acquisition, file formats and standards;
2. Be comfortable with Fourier transforms, power spectra, convolution and other signal processing concepts for multi-dimensional signals;
3. Be able to design filters and other algorithms to enhance and extract important features from multimedia signals;
4. Be confident in implementing multimedia signal processing algorithms in both Matlab and C/C++.

The rationale behind your approach to learning and teaching
• Signal processing is an important branch of Electrical Engineering, which is foundational to multimedia processing and telecommunications. The initial mathematical framework for signal processing is introduced in earlier courses in signals and systems and the third year signal processing course ELEC3104. However, many students find that they do not feel confident enough to implement real signal processing algorithms to solve practical problems. In view of this, the present professional elective has been deliberately designed to have a strong emphasis on practical implementation.

• Multimedia signal processing is highly intensive in terms of computational and memory resources. As a result, most practical work in this area involves programming in a native language (typically C or C++), sometimes in tandem with the development of dedicated hardware (FPGA’s initially). In view of this, the practical aspects of this course emphasize native implementation and resource management methodologies.

• The course covers significant fundamental material of a theoretical nature. In order to provide an efficient and balanced learning experience, laboratory sessions are designed to closely follow the relevant developments in lectures. A portion of each laboratory session is used to provide practical demonstration of strategies for implementing concepts very recently taught in lectures.

• Independent thinking and problem solving are very important aspects of this course, since it is only by independently tackling a challenging problem that the student becomes confident in his/her understanding. A second portion of most laboratory sessions is devoted to the completion and interactive assessment of multimedia processing solutions, which students must have designed in their own time, based on a thorough understanding of the lecture materials.

Teaching strategies
• Lectures provide foundational knowledge and are the only efficient way to provide instruction in the theoretical aspects of multimedia signal processing.
• Lectures are supplemented by the provision of typeset written notes (not powerpoint bullets) on the major theoretical topics. Students will need to study these notes in order to realize solutions to practical problems presented to them.
• Laboratory sessions provide practical experience and a forum to demonstrate independent design. Laboratories also provide an excellent opportunity for interaction between the lecturer and students. Students are expected to come highly prepared to laboratory sessions.
• Tutorials focus on the more theoretical aspects of the course, providing a forum to exercise mathematical concepts and obtain further clarification from the lecturer/tutor.

Assessment
• Final exam: 60%
• Mid-session quiz (conducted during the lecture in Week 9): 10%
• Three laboratory projects (assessed in Labs in Weeks 7, 9 and 11): 30% (+ possible bonus marks)
• Participation in tutorials: max 3% bonus per tutorial prior to Week 12
  - To receive a bonus, students must have previously attempted the tut problems
  - The final mark for the subject is \( B + \left(1 - \frac{B}{100}\right) \cdot (E + Q + L) \), where B, E, Q and L are the bonus, exam, quiz and laboratory marks mentioned above.
**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, 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](http://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.
### Course schedule (tentative)

<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>Jul 28</td>
<td></td>
<td>Continuous and discrete LSI systems</td>
</tr>
<tr>
<td>2</td>
<td>Aug 4</td>
<td></td>
<td>Review of native programming (mostly C); memory organization and management for MMSP</td>
</tr>
<tr>
<td>3</td>
<td>Aug 11</td>
<td></td>
<td>Multi-dimensional filtering</td>
</tr>
<tr>
<td>4</td>
<td>Aug 18</td>
<td></td>
<td>Imaging systems, resampling and multi-scale processing</td>
</tr>
<tr>
<td>5</td>
<td>Aug 25</td>
<td></td>
<td>More on filtering, correlation and Discrete Fourier Transforms</td>
</tr>
<tr>
<td>6</td>
<td>Sep 1</td>
<td></td>
<td>Power spectrum estimation and other transforms</td>
</tr>
<tr>
<td>7</td>
<td>Sep 8</td>
<td></td>
<td>Introduction to shape and morphological processing</td>
</tr>
<tr>
<td>8</td>
<td>Sep 15</td>
<td></td>
<td>Motion modeling and estimation</td>
</tr>
<tr>
<td>9</td>
<td>Sep 22</td>
<td></td>
<td>Texture modeling and estimation</td>
</tr>
<tr>
<td></td>
<td>Sep 29</td>
<td>Mid-Session Break</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Oct 6</td>
<td></td>
<td>Compression: quantization and coding</td>
</tr>
<tr>
<td>11</td>
<td>Oct 13</td>
<td></td>
<td>Compression: introduction to selected standards</td>
</tr>
<tr>
<td>12</td>
<td>Oct 20</td>
<td></td>
<td>Wrap-up</td>
</tr>
</tbody>
</table>

TBD means “to be decided together with the students in the class”

### Resources for students

- You will be provided with access to typeset lecture notes, created specifically for this course. Since this is the first time this course has been offered, the lecture notes will be created progressively and made available via the class web-site.
- The web-site for the course is at [http://subjects.ee.unsw.edu.au/~elec4622](http://subjects.ee.unsw.edu.au/~elec4622). The web-site will also be used to disseminate additional materials, such as tutorial problems, media source files and sample code.
- There are no separate required or strongly recommended texts for the course.
- You will find it very helpful to install your own copy of Microsoft Visual C++™ on your own PC. If you do not already have a copy, you may like to download and install the free “Express” version from [http://msdn.microsoft.com/vstudio/express](http://msdn.microsoft.com/vstudio/express); however, we also have pre-burned CD’s which you can use to install a suitable version.

### Course evaluation and development

- Since this is only the second time this course has been offered, and the first time with only a 12 week session, your feedback and suggestions will be most welcome. Such feedback will be considered carefully with a view to acting on it constructively wherever possible.
- An official survey may also be conducted toward the end of the course to obtain more information on your experience of the course.