MONASH University

FIT5012
Data compression techniques

Unit guide

Semester 1, 2009

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FIT5012 Data compression techniques - Semester 1, 2009

Unit leader :

Dr. Peter Tischer

Lecturer(s) :

Clayton

- Dr. Peter Tischer

Introduction

Welcome to FIT5012, Data compression techniques, semester 1, 2009. This 6 point unit is a postgraduate coursework unit in the Faculty of Information Technology. It is designed to provide a comprehensive introduction to the field of image and video coding. Students will gain a good understanding of the principles of image and video coding, entropy coding and international standards for coding audio-visual data.

Unit synopsis

The subject covers many of the following topics:

- Waveform characterisation and representation.
- Human visual systems and vision modelling.
- Transform coding, including the Karhunen Loeve transform, discrete Hadamard transform, discrete Walsh Hadamard transform, and discrete cosine transform.
- Motion estimation and compensation for video coding.
- Hybrid coding algorithms and their applications to image and video encoding and compression.
- Sub-band and wavelet transform coding.
- Vector quantisation.
- Run-length coding.
- Variable-length/entropy coding techniques including Huffman and arithmetic coding.
- Fractal image and video compression.
- Introduction to industrial coding standards for audio-visual signals (JPEG, H.26x, MPEG).
- Implementations and applications of digital video coding systems.
- Transmission of audio and video content (channel coding, DVB, IP).

Learning outcomes

Knowledge and Understanding

At the completion of this unit students will have a theoretical and conceptual understanding of:

the areas for application of audio-visual signal compression the fundamental concepts, theory and techniques of audio-visual signal coding and compression the statistical and psychovisual/psychoacoustic redundancy found in natural audio-visual signals represented digitally the various implementations of both standard and non-standard audio-visual coding and compression techniques the requirements and issues involved in transmission of digital audio-visual signals Attitudes, Values and Beliefs

At the completion of this unit students will have developed attitudes that enable them to:

appreciate the need to compress audio, image and video information recognise the importance of standard methods for audio-visual compression recognise the complexity versus performance paradigm of compression algorithms appreciate the constraints on real-time signal processing in an audio-visual communication system Practical Skills

At the completion of this unit students will have the skills required to:

design parameters for the compression of audio, image and video signals using standard coding techniques apply compression techniques to audio-visual coding tasks design and implement compression algorithms using hardware and/or software Relationships, Communication and TeamWork

At the completion of this unit students will have developed the communication skills needed to:

document a complex signal processing system including its fundamental design and final implementation

Workload

Unit relationships

Prerequisites

Before attempting this unit you must have satisfactorily completed MAT 1811/1812 or MAT 1841 or equivalent, and 2 years or more of study in a computing related course. You should have knowledge of or competence in a high level programming language such as C or C++.

The programming component of this course will require you to implement part of a video encoder/decoder. You will be given sample programs to guide you but you need to be aware that the unit will require you to develop a sizable computer program over the course of the semester.

Relationships

FIT5012 is a level 5 specified elective unit in the Master of Digital Communications Degree (MDC - offered by FIT) and Master of Telecommunications Engineering (MTE - offered by the Faculty of Engineering).

It is also an approved elective for the Masters of Computer Science and may be taken by other coursework masters and honours students with the required pre-requisite knowledge.

Before attempting this unit you must have satisfactorily completed MAT 1811/1812 or MAT 1841 or equivalent, and 2 years or more of study in a computing related course.

Competence in a high level programming language such as C or C++ is required.

You may not study this unit and

CSE5302

in your degree.

Continuous improvement

Monash is committed to 'Excellence in education' (Monash Directions 2025 - http://www.monash.edu.au/about/monash-directions/directions.html) and strives for the highest possible quality in teaching and learning.

To monitor how successful we are in providing quality teaching and learning Monash regularly seeks feedback from students, employers and staff. One of the key formal ways students have to provide feedback is through Unit Evaluation Surveys. The University's Unit Evaluation policy (http://www.policy.monash.edu/policy-bank/academic/education/quality/unit-evaluation-policy.html) requires that every unit offered is evaluated each year. Students are strongly encouraged to complete the surveys as they are an important avenue for students to "have their say". The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied and areas for improvement.

Faculties have the option of administering the Unit Evaluation survey online through the my.monash portal or in class. Lecturers will inform students of the method being used for this unit towards the end of the semester.

Student Evaluations

If you wish to view how previous students rated this unit, please go to http://www.adm.monash.edu.au/cheq/evaluations/unit-evaluations/

Unit staff - contact details

Unit leader

Dr. Peter Tischer

Lecturer(s) :

Dr. Peter Tischer

Teaching and learning method

There will be a double lecture every week with an optional practice class that follows the double lecture immediately. The main focus in the practice class sessions is on helping students with the assignment work.

Communication, participation and feedback

Monash aims to provide a learning environment in which students receive a range of ongoing feedback throughout their studies. You will receive feedback on your work and progress in this unit. This may take the form of group feedback, individual feedback, peer feedback, self-comparison, verbal and written feedback, discussions (on line and in class) as well as more formal feedback related to assignment marks and grades. You are encouraged to draw on a variety of feedback to enhance your learning.

It is essential that you take action immediately if you realise that you have a problem that is affecting your study. Semesters are short, so we can help you best if you let us know as soon as problems arise. Regardless of whether the problem is related directly to your progress in the unit, if it is likely to interfere with your progress you should discuss it with your lecturer or a Community Service counsellor as soon as possible.

Unit Schedule

Week	Topic	Key dates
1	Introduction	
2	DPCM and Quantisation	
3	Motion Compensation	
4	Transform Coding	
5	Transform Coding	
6	Entropy Coding	Interim demonstrations: Wednesday, April 8 and Thursday, April 9
Mid semester break		
7	Entropy Coding	
8	Coding Standards	
9	Discussion relevant to programming assignment	
10	Vector Quantisation	
11	Subband Coding	
12	Fractal Coding	
13	Revision	Final demonstrations: Thursday, June 4 and Friday, June 5

Unit Resources

Prescribed text(s) and readings

There are no prescribed text books for this unit.

Recommended text(s) and readings

- K. R. Rao and J. J. Jwang, "Techniques and Standards for Image, Video and Audio Coding", Prentice Hall, 1996.
- Arun N. Netravali and Barry G. Haskell, "Digital Picture-Representation, Compression, and Standards", 2nd Edition, Plenum Press, 1995.
- N.S. Jayant and P. Noll, "Digital Coding of Waveforms", Prentice-Hall, Inc., 1984.
- R. J. Clarke, "Digital Compression of Still Images and Video", Academic Press Ltd, 1995.
- R.J. Clarke, "Transform Coding of Images", Academic Press Inc., 1985.
- A.K. Jain, "Fundamentals of Digital Image Processing", Prentice-Hall, Inc., 1989.

Required software and/or hardware

Source for C programs which can access images and frames of a video sequence will be made available via the FIT5012 MUSO website. This code is written in such a way that it should run correctly in either a Unix or a Microsoft environment.

Equipment and consumables required or provided

Students studying off-campus are required to have the minimum system configuration specified by the Faculty as a condition of accepting admission, and regular Internet access.On-campus students, and those studying at supported study locations may use the facilities available in the computing labs.Information about computer use for students is available from the ITS Student Resource Guide in the Monash University Handbook.You will need to allocate at least 3 hours per week for use of a computer, including time for newsgroups/discussion groups.

Study resources

Study resources we will provide for your study are:

Library access

The Monash University Library site contains details about borrowing rights and catalogue searching. To learn more about the library and the various resources available, please go to http://www.lib.monash.edu.au.

The Educational Library and Media Resources (LMR) is also a very resourceful place to visit at http://www.education.monash.edu.au/library/

Monash University Studies Online (MUSO)

All unit and lecture materials are available through MUSO (Monash University Studies Online). Blackboard is the primary application used to deliver your unit resources. Some units will be piloted in Moodle. If your unit is piloted in Moodle, you will see a link from your Blackboard unit to Moodle (http://moodle.monash.edu.au) and can bookmark this link to access directly. In Moodle, from the Faculty of Information Technology category, click on the link for your unit.

You can access MUSO and Blackboard via the portal: http://my.monash.edu.au

Click on the Study and enrolment tab, then Blackboard under the MUSO learning systems.

In order for your Blackboard unit(s) to function correctly, your computer needs to be correctly configured.

For example:

- Blackboard supported browser
- Supported Java runtime environment

For more information, please visit: http://www.monash.edu.au/muso/support/students/downloadables-student.html

You can contact the MUSO Support by phone : (+61 3) 9903 1268

For further contact information including operational hours, please visit:
http://www.monash.edu.au/muso/support/students/contact.html

Further information can be obtained from the MUSO support site:
http://www.monash.edu.au/muso/support/index.html

Assessment

Unit assessment policy

The unit assessment will involve 50% for the practical assignment and 50% for the final examination. The 50% for the practical assignment will be split into 10% for an interim project demonstration, 10% for the final project demonstration and 30% for the final project submission.

You will need to achieve a hurdle of at least 40% of the available marks for the practical assignment work as well as 40% of the marks for the final examination in order to pass the unit.

If a student does not achieve 40% or more in the unit examination or the unit non-examination assessment, then a mark of no greater than 44-N will be recorded for the unit.

Assignment tasks

- **Assignment Task**

  Title : Video encoder / decoder implementing motion-compensated transform coding

  Description :

  The programming assignment is to implement a video encoder / decoder which implements motion compensation, transform coding and entropy coding. As part of the assignment students will implement a number of alternative strategies and research the effect that the different strategies have on encoding /decoding performance.
  Weighting : 50% of unit (includes 10% for interim presentation and 10% for final presentation)

  Criteria for assessment :

  Due date : Friday May 30

Examinations

- **Examination 1**

  Weighting : 50% of total unit mark

  Length : 3 hours

  Type (open/closed book) : Closed book

Assignment submission

Assignments will be submitted by **paper** submission to the **Clayton School of IT office.** Students submit the assignment by **Friday, May 30**, with the appropriate cover sheet correctly filled out. Do not email submissions unless prior arrangements have been made with the lecturer.

Assignment coversheets

Please submit with the appropriate cover sheet filled in. Assignment cover sheets can be found via the "Student assignment coversheets" (http://infotech.monash.edu.au/resources/student/assignments/) page on the faculty website.

University and Faculty policy on assessment

Due dates and extensions

The due dates for the submission of assignments are given in the previous section. Please make every effort to submit work by the due dates. It is your responsibility to structure your study program around assignment deadlines, family, work and other commitments. Factors such as normal work pressures, vacations, etc. are seldom regarded as appropriate reasons for granting extensions. Students are advised to NOT assume that granting of an extension is a matter of course.

Late assignment

Assignments received after the due date will be subject to a penalty of **5% per working day late.**

Return dates

Students can expect assignments to be returned within two weeks of the submission date or after receipt, whichever is later.

Assessment for the unit as a whole is in accordance with the provisions of the Monash University Education Policy at http://www.policy.monash.edu/policy-bank/academic/education/assessment/

We will aim to have assignment results made available to you within two weeks after assignment receipt.

Plagiarism, cheating and collusion

Plagiarism and cheating are regarded as very serious offences. In cases where cheating has been confirmed, students have been severely penalised, from losing all marks for an assignment, to facing disciplinary action at the Faculty level. While we would wish that all our students adhere to sound ethical conduct and honesty, I will ask you to acquaint yourself with the University Plagiarism policy and procedure (http://www.policy.monash.edu/policy-bank/academic/education/conduct/plagiarism-procedures.html) which applies to students detected plagiarising.

In this University, cheating means seeking to obtain an unfair advantage in any examination or any other written or practical work to be submitted or completed by a student for assessment. It includes the use, or attempted use, of any means to gain an unfair advantage for any assessable work in the unit, where the means is contrary to the instructions for such work.

When you submit an individual assessment item, such as a program, a report, an essay, assignment or other piece of work, under your name you are understood to be stating that this is your own work. If a submission is identical with, or similar to, someone else's work, an assumption of cheating may arise. If you are planning on working with another student, it is acceptable to undertake research together, and discuss problems, but it is not acceptable to jointly develop or share solutions unless this is specified by your lecturer.

Intentionally providing students with your solutions to assignments is classified as "assisting to cheat" and students who do this may be subject to disciplinary action. You should take reasonable care that your solution is not

accidentally or deliberately obtained by other students. For example, do not leave copies of your work in progress on the hard drives of shared computers, and do not show your work to other students. If you believe this may have happened, please be sure to contact your lecturer as soon as possible.

Cheating also includes taking into an examination any material contrary to the regulations, including any bilingual dictionary, whether or not with the intention of using it to obtain an advantage.

Plagiarism involves the false representation of another person's ideas, or findings, as your own by either copying material or paraphrasing without citing sources. It is both professional and ethical to reference clearly the ideas and information that you have used from another writer. If the source is not identified, then you have plagiarised work of the other author. Plagiarism is a form of dishonesty that is insulting to the reader and grossly unfair to your student colleagues.

Register of counselling about plagiarism

The university requires faculties to keep a simple and confidential register to record counselling to students about plagiarism (e.g. warnings). The register is accessible to Associate Deans Teaching (or nominees) and, where requested, students concerned have access to their own details in the register. The register is to serve as a record of counselling about the nature of plagiarism, not as a record of allegations; and no provision of appeals in relation to the register is necessary or applicable.

Non-discriminatory language

The Faculty of Information Technology is committed to the use of non-discriminatory language in all forms of communication. Discriminatory language is that which refers in abusive terms to gender, race, age, sexual orientation, citizenship or nationality, ethnic or language background, physical or mental ability, or political or religious views, or which stereotypes groups in an adverse manner. This is not meant to preclude or inhibit legitimate academic debate on any issue; however, the language used in such debate should be non-discriminatory and sensitive to these matters. It is important to avoid the use of discriminatory language in your communications and written work. The most common form of discriminatory language in academic work tends to be in the area of gender inclusiveness. You are, therefore, requested to check for this and to ensure your work and communications are non-discriminatory in all respects.

Students with disabilities

Students with disabilities that may disadvantage them in assessment should seek advice from one of the following before completing assessment tasks and examinations:

- Faculty of Information Technology Student Service staff, and / or
- your Unit Coordinator, or
- Disabilities Liaison Unit

Deferred assessment and special consideration

Deferred assessment (not to be confused with an extension for submission of an assignment) may be granted in cases of extenuating personal circumstances such as serious personal illness or bereavement. Information and forms for Special Consideration and deferred assessment applications are available at http://www.monash.edu.au/exams/special-consideration.html. Contact the Faculty's Student Services staff at your campus for further information and advice.