

UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2003

BEng Honours Degree in Computing Part III
MSc in Computing Science
BEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part III
MEng Honours Degree in Information Systems Engineering Part IV
for Internal Students of the Imperial College of Science, Technology and Medicine

*This paper is also taken for the relevant examinations for the
Associateship of the City and Guilds of London Institute*

PAPER C346=I3.12

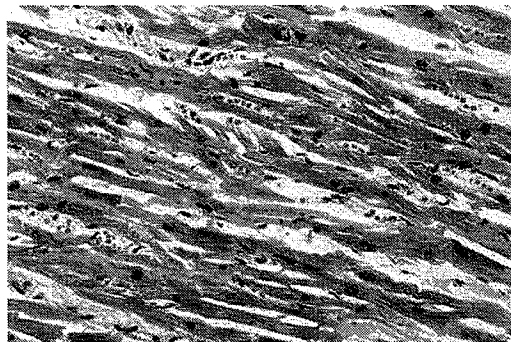
MULTIMEDIA SYSTEMS

Thursday 1 May 2003, 10:00
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions
Calculators required

- 1a
- i) What are the attributes that contribute to human brain's determination of the location of a sound?
 - ii) Sketch a diagram to explain the term *spectral masking* in audio compression, and briefly explain how psycho-acoustic models are used in MPEG audio compression.
- b
- i) List and briefly describe the processing steps involved in JPEG image compression. For each step, explain how it contributes towards the overall compression ratio.
 - ii) For each of the two following compression schemes, explain in detail which parameters of the algorithm can be adjusted to control the compression ratio.
 - IFS fractal compression of a greyscale image
 - MPEG compression of moving colour images
- c
- You are asked to develop a technique that has a reasonably high compression ratio for encoding muscle cell images that have the following appearance.



- i) Explain why it is *inappropriate* to adopt JPEG image compression for this purpose.
- ii) Based on the basic principle of JPEG, propose a new compression technique that provides a high image compression ratio without sacrificing image details that are essential to these images.

The three parts carry, respectively, 30%, 40%, 30% of the marks.

- 2a A small ASCII file contains only the following characters with frequencies:
E = 36%, S = 19%, A = 17%, D = 14%, Z = 10%, R = 4%.
- i) Construct a Huffman tree for the above text and list the corresponding Huffman codes.
 - ii) Calculate the average code word length and the compression ratio achieved.
- b
- i) Briefly describe how block matching is used for translational motion estimation and list its main limitations.
 - ii) Explain how a hierarchical approach is used for improving the computational efficiency and accuracy.
 - iii) Explain the key differences between block-matching and optical flow in deriving motion fields.
- c
- i) Explain the terms *global* and *local* motion in processing video image sequences.
 - ii) Design a method of separating *global* and *local* motion, and explain the key steps involved.

The three parts carry, respectively, 25%, 35%, 40% of the marks.

- 3a
- i) Ten seconds of raw uncompressed PAL video will fill as much as 300 Megabytes of digital storage. How is this figure arrived at?
 - ii) Explain how using chroma subsampling will result in significant compression being achieved. Include the amount of storage that the clip would require in this format
 - iii) Describe how the picture information for analogue television is transmitted. Why is this format the most appropriate for the medium?
 - iv) If there is no more room in the electromagnetic spectrum for additional analogue television channels to be broadcast, explain how digital television channels can be accommodated. Include why it is possible to have so many more in the same bandwidth.
- b
- i) Differentiate between a Quality of Service Guarantee and a Priority Mechanism. Include what circumstances dictate whether either might be available and why.
 - ii) Discuss how Quality of Service requirements can be addressed at each level of the TCP/IP protocol stack. Give an example at each level, with any limitations of the technique.

The two parts carry, respectively, 40%, 60% of the marks.

- 4a
- i) CCIR (ITU-R) Recommendation 601 for digital video specifies a sampling frequency of 13.5 MHz. Explain how this frequency was determined and how it simplifies the conversion process between North American and European video standards.
 - ii) How are CIF and QCIF derived from Recommendation 601? Include in your answer why the horizontal resolution is slightly reduced for H.261/H.263-based applications.
 - iii) How many QCIF frames can be sent per second over the two B channels of a Basic Rate Interface ISDN link with a compression rate of 20:1?
- b
- You are commissioned to develop a system for distributing live audio/video of seminars taking place in the Systems Engineering Studios to PCs on the Department's computer network.
- i) Discuss the requirements of such a system and how you would implement it, including any additional hardware and software required.
 - ii) How would your approach differ if the live audio/video were to be distributed to other UK universities? Explain why this is the case.
 - iii) It is suggested that the seminars also be recorded for later streaming on demand to any Internet-connected computer. Outline any differences in the service provided and how you would implement it.

The two parts carry, respectively, 40%, 60% of the marks.