

UNIVERSITY OF LONDON
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 2000

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
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 4 May 2000, 14:30
Duration: 120 minutes

Answer THREE questions

Paper contains 4 questions

- 1a
- i) How do the requirements of real-time network applications, such as the delivery of audio and video, differ from those of traditional data communications?
 - ii) What factors affect network delivery of audio and video data? Explain why different categories of network audio/video applications are affected differently.
 - iii) Compact Disk was originally designed for digital audio, but is now also used on computers for storage, including multimedia data. Explain how the hardware characteristics of CDs and their drives affect their suitability for this new role.
- b Explain the resource requirements of both end-nodes for
- i) Streamed video over the Internet.
 - ii) BRI ISDN-based videotelephony.

Include in your answers how the different nature of the two networks affects the potential quality of the transmissions in each case.

- c
- i) What is the difference between a Quality of Service Guarantee and a Priority Mechanism? Include in your answer what circumstances dictate whether either might be available and why.
 - ii) Describe how Quality of Service requirements can be addressed at each layer of the TCP/IP protocol stack. Include any limitations in each case.

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

- 2a 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 List and briefly describe the processing steps involved in JPEG image compression. For each step, explain how it contributes towards the overall compression ratio.
- c For compressing a 512x512 still image with JPEG, would it be an advantage if we choose to use four 256x256 pixel blocks rather than many 8x8 pixel blocks? Give a detailed explanation.
- d You are asked to modify the existing JPEG standard for encoding stereo images, *i.e.*, a pair of images produced from observing the same static object from two slightly different horizontal locations.
- i) Rather than encode the two images separately, what would be your method for achieving a much higher compression ratio?
 - ii) Explain all the necessary steps involved in your method, and state why it helps to improve the compression ratio.

The four parts carry, respectively, 20%, 35%, 15%, 30% of the marks.

- 3a Name three different colour spaces and give an example of a use for which each is appropriate, stating why.
- b
- i) Outline the problems encountered in converting between North American and European broadcast television standards. How does ITU Recommendation 601's prescribed sampling frequency of 13.5 MHz for digital video simplify the conversion process?
 - ii) Explain why H.261 uses a different number of pixels per line for CIF and QCIF than the original standards derived from Recommendation 601.
 - iii) Assuming a compression ratio of 12:1, how many QCIF frames can be transmitted per second using both B channels of a Basic Rate Interface ISDN link?
- c
- i) MPEG-1 and MPEG-2 use B-frames in addition to the I-frames and P-frames used by H.261. Explain the function of each of these frame types and how they relate to each other.

Consider the following Group of Pictures in an MPEG video stream.

Display Order:

Type of Frame	B	B	I	B	B	P	B	B	P	B	B	P
Number of Frame	0	1	2	3	4	5	6	7	8	9	10	11

- ii) What is the corresponding decoding order with minimal buffering?
- iii) How would you alter the frame types used in the group to improve random access to the video stream? How would your solution affect the compression level?

The three parts carry, respectively, 20%, 40%, 40% of the marks.

- 4a i) Explain the terms *global* and *local* motion in processing video image sequences.
- ii) Briefly describe how block matching is used for translational motion estimation and list its main limitations.
- iii) Explain how a hierarchical approach is used for improving the computational efficiency and accuracy.
- b i) List the processing steps involved in IFS fractal compression by using Jacquin's approach, and explain its strength and limitations. In fractal image decompression, how does the seed image affect the final decompressed result?
- ii) Identify the common process that is used in Jacquin's IFS fractal compression and block based motion estimation. What are the differences in the way this process is carried out?
- c i) How would you modify the IFS fractal compression technique such that it is computationally practical for recovering general motion for human gesture recognition?
- ii) Design a method of separating *global* and *local* motion, and explain the key steps involved.

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