Theory of Image Processing 2007

Review Project

Video data compression

Theory of Image Processing is a 16 lecture course with a short review project which in undertaken in the latter section of first semester. The deadline for this review project is:

12.00 on Friday 23nd November

Projects submitted after this date will be subject to a 5% per day late submission penalty.

This project counts 20% towards the final degree examination in this course, with the examination contributing 80%.

Introduction

Digital images contains large amounts of data, with for example a typical full colour high definition TV images containing $1280 \times 1024 \times 3$ bytes which is 3.75 Mb, being more than twice the capacity of the old style "floppy disc". This is also a significant problem is image transmission particularly with WEB systems, where large amounts of data can dramatically slow page download. To combat this problem a range of *data compression* techniques have been developed that try to represent, or encode the image in a more compact format than simply *three bytes per pixel*.

Single Images Compression

There are two main types of compression that can be applied to a single image, these being:

Lossless Compression

Where *all* the information in the image in encoded in a compacted form using differences in the statistical occurrence of the byte values to form an compacted encoding scheme. Typical schemes are based on Huffman encoding, or more commonly Lempel-Ziv or Lempel-Ziv-Welch compression being implemented in the standard Unix utilities of PACK, GZIP and COMPRESS. These schemes are optimised for text and graphics files where the scheme *must* be fully reversible. When applied to images the typical compressions are of the order of 25%.

Criteria Compression

Here *not all* the image information is retained in the compression process so the reconstructed, or decompressed, image is *not* identical to the original. Theses schemes rely on the there being spatially redundant information in the image, for example areas of constant intensity (or colour), that can be encoded in less than three bytes per pixel and reconstructed "closely enough" that the image is not visually altered. Note unlike most other computer stored information, very small differences between the original and decompressed image has little effect.

The most successful of these criteria schemes is JPEG compression where the images is divided into small square blocks with the amount of compression being determined by the spatial content of each block.

Image Stream Compression

When the data is a stream of continious changing images, for example a video system, satellite communitations link or video telephone, the main redundancy is between frames, where typically *most* of the image background does not change; the most obvious example is a video telephone where only part of the users face move, with most of the background being stationary. Here most successful compression schemes aim to update only the parts of the image that have changed from the previous frame with a "whole new frame" only been send when required. These schemes also use a spatial compression scheme, similar in concept to JPEG to take advantages of the spatial redunancy in both the transmission of the inter frame changed areas and when it is required to update the whole frame. There is a whole range of these schemes, with the currentlty most successful, or a least most widely used, being MPEG.

Aim of Review Project

The project is to research and explain the MPEG compression scheme as applied dititally store video images, the report should contain:

1. An explanation of the MPEG scheme and why it results in compression.
2. An discusson of the pratcicality of the scheme, and in particular the type of image degradation that occurs when very high data compression is used.
3. Scope for improvement, or prospect or replacement with alternative, better scheme.

Report Format

The report is expected to be approximately 6 pages (sides), including illustrative images, diagrams and , typically 1,500 words and must be word processed with figures and images integrated into the report. The source of information must be correctly cited, especially WEB based references, which must include the full URL.

This report is an assessed part of this course and is covered by the The University of Edinburgh Examination Regulations, in particular it *must* be your own work and the submitted report *must* contain the declaration page as specified in your course information guide.

The report should be handed in to the *Institute for Meteorology* office or the MSc *Programme Coordinator*.

WJ Hossack
October 2007