Chapter 48
Survey of Medical Image Compression Techniques and Comparative Analysis

P. Geetha
Anna University Chennai, India

ABSTRACT

Today digital imaging is widely used in every application around us like Internet, High Definition TeleVision (HDTV), satellite communications, fax transmission, and digital storage of movies and more, because it provide superior resolution and quality. Recently, medical imaging has begun to take advantage of digital technology, opening the way for advanced medical imaging and teleradiology. However, medical imaging requires storing, communicating and manipulating large amounts of digital data. Applying image compression reduces the storage requirements, network traffic, and therefore improves efficiency. This chapter provides the need for medical image compression; different approaches to image compression, emerging wavelet based lossy-lossless compression techniques, how the existing recent compression techniques work and also comparison of results. After completing this chapter, the reader should have an idea of how to increase the compression ratio and at the same time maintain the PSNR level compared to the existing techniques, desirable features of standard compression techniques such as embededness and progressive transmission, how these are very useful and much needed in the interactive teleradiology, telemedicine and telebrowsing applications.

INTRODUCTION

Medical images are widely used in disease diagnosis. Currently, the following modalities such as 1) Computerized Tomography (CT); 2) Magnetic Resonance Imaging (MRI); 3) Positron Emission Tomography (PET) and 4) X radiographs, etc are used to produce images in digital form. Those modalities provide flexible means for viewing anatomical cross sections and physiological states. The improvement of diagnosis and the development of interventional procedures have been facilitated by digital enhanced displays and immediate reviewing. However, medical images have large storage requirements. Medical

DOI: 10.4018/978-1-5225-0571-6.ch048

diagnostic digital data produced by hospitals have increased exponentially. In an average-sized hospital, many terabytes of digital data are generated each year, almost all of which have to be kept and archived, which require a large amount of memory storage. Transmitting such an image over a network could take minutes to transfer; because it may be slow for interactive teleradiology, telemedicine and telebrowsing applications. Therefore there is a need to reduce the storage and the transmission requirements with the help of image compression techniques. So, Image compression plays a critical role in telematics applications and especially in telemedicine and teleradiology. The two basic types of compression techniques are

1. Lossless Compression
2. Lossy Compression

The lossless compression technique allows for perfect reconstruction of the original image and yields a modest compression rate of at most two. The lossy compression technique yields higher compression rates, but the resulting image is only approximately similar to the original image where the quality of the image is measured in terms of Peak Signal to Noise Ratio (PSNR). Several lossless and lossy compression techniques with different compression rates have been developed.

Measuring Compression Effectiveness

The effectiveness of compression schemes can be described using a relative measure, Compression Ratio (CR) or by describing an absolute measure, the Bit Rate of an image, PSNR, and complexity. The bit rate is the average number of bits required to encode a pixel and is computed from the total number of bits encoded divided by the number of pixels. Such a value is useful when comparing different schemes applied to one image, or multiple images with the same bit depth. Accordingly, a relative measure, the compression ratios are computed from comparing the number of bits in the uncompressed image to the number of bits in the encoded image.

$$\text{Compression ratio} = \frac{\text{size of the original file}}{\text{size of the compressed file}} = \frac{N \cdot k}{C} \tag{1}$$

$$\text{Bit rate} = \frac{\text{size of the compressed file}}{\text{pixels in the image}} = \frac{C}{N} \text{ (bits per pixel)} \tag{2}$$

The other parameter used for comparison is peak signal to noise ratio and it is defined as follows:

$$\text{MSE} = \frac{1}{N}\sum_{i=1}^{N}\left(y_i - x_i\right)^2 \tag{3}$$

Where