ABSTRACT

Medical imaging modalities have become an integral part in the field of medicine, aiding diagnosis and treating ailments. Popular imaging modalities like Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), X-rays, Ultrasound scans generate huge amount of medical data in hospitals. These data are of high resolution and voluminous, which need to be stored for future archival and/or transmitted for implementation of e-health, teleradiology, tele-consultation, telemedicine and telematics. Storage and transmission of these data in raw state incurs high storage capacity, large transmission bandwidth and long transmission time. Though increasing the storage capability and bandwidth is a possible solution, the associated high cost makes this solution less attractive. So, to mitigate these problems compression algorithms adapted to these applications are required for creating data files with reduced memory size. In the past, many compression algorithms were proposed for medical images. Two dimensional medical image compression algorithms can be extended to three dimensional medical image stacks by applying it to individual slices, but doing so will not exploit the three-dimensional nature of the stacks in order to improve compression performance.
This thesis has proposed and implemented three different compression schemes with first two focusing on compressing three dimensional medical images and third with focus on Region of Interest (ROI) based compression (hybrid compression). As the amount of compression can be improved by employing efficient transform and proper quantization algorithm, in the first scheme a new compression algorithm compatible with three dimensional wavelet transformation is proposed. In the second scheme, to improve compression further three dimensional multiwavelets are introduced and the proposed encoder is adapted for multiwavelet data structure. In these two schemes attention is directed towards Magnetic Resonance and Computed Tomography stacks.

Third scheme is based on segmentation of arbitrary shaped diagnostically important region known as Region of Interest (ROI) from medical image to support JPEG 2000 encoder with ROI functionality. JPEG 2000 encoder along with ROI shape information encodes the ROI at higher quality than the background even at low bit rates and transmits the ROI with higher priority. CT slices of human brain with hemorrhage (ROI) are considered for this scheme. For each algorithm the experimental results presented in this thesis clearly demonstrates its efficiency compared to other state of the art encoding approaches within this context. Advantages of the schemes and future enhancements are also discussed.