Abstract

Stroke is one of the leading causes of death and disability in the world. Early detection of Stroke (both hemorrhagic and ischemic) is very important as it can ensure up to full recovery. Timely detection of stroke, especially ischemic stroke is difficult as the changes in abnormal tissue only become visible after the damage has already been done. The detection is even more difficult on CT scan compared to other imaging modalities but the dependence of a large fraction of population on CT, makes the need to find a solution to the problem even more imperative. Though the detection accuracy of radiologists for early stroke depends on various factors like experience, available technology, etc., earlier estimates put the accuracy around 10% [45]. Even with considerable advancement in CT technology the performance has still only increased to around 70% or thereabouts [21]. Any kind of assistance to radiologists which can improve their detection accuracy would therefore be much appreciated. This thesis presents a framework for automatic detection and classification of different types of stroke. We characterize stroke as a distortion in the otherwise contralaterally similar distribution of brain tissue. Classification depends on the severity of the distortion with hemorrhage and chronic infarcts exhibiting the maximum distortion and hyperacute stroke showing the minimum. The detection work on hemorrhagic stroke and early ischemic stroke has clinical value whereas the work on later stages of ischemic stroke has mainly academic use. The automatic detection approach was tested on a dataset containing 19 normal (291 slices) and 23 abnormal (181 slices) datasets. The algorithm gave a high recall rate for hemorrhage (80%), chronic (95%), acute (91.80%) and hyperacute (82.22%) stroke at slice level. The corresponding precision figures were 93.3%, 90.47%, 87.5% and 69.81% respectively. The performance of the system in a normal vs. stroke-affected scenario was 83.95% precision and 86.74% recall. The lower precision value in case of hyperacute scans is because of large number of normal slices with slight disturbances in contra-lateral symmetry being identified as stroke cases. We also present a novel approach for enhancement of early ischemic stroke regions using image-adaptive window parameters, to aid the radiologists in the manual detection of early ischemic stroke. The enhancement approach increased the average accuracy of radiologists in clinical conditions from around 71% to around 90% ($p=0.02$, two tailed student's t test) with the inexperienced radiologists benefitting more from the enhancement. The average reviewing time of the scans was also reduced from about 9 to 6 seconds per slice. Out of the two approaches, automatic detection and enhancement, results show the enhancement process to be more promising.