ABSTRACT

This research focuses on segmentation of medical images obtained from the magnetic resonance imaging (MRI) scanner. The transverse magnetic resonance (MR) image slices are that of the human femur (thighbone). The objective of the research is to extract the bone from transverse MRI images of the human thigh using a semi-automated method that exploits the power of wavelet transform (WT) and self-organizing map (SOM).

Magnetic resonance images are known for their complexity, hence providing much detail information to the doctor for diagnosis and therapy planning. For segmentation of the bone slices using MR images, the presence of details of different types of tissues poses a challenging segmentation problem.

Due to the complexity of the MR images, a region of interest (ROI) was defined manually and segmentation was performed within the boundary. This trade-off of reduced complexity, at the cost of manual intervention, is necessary for superior classification of the bone slices.

A hybrid algorithm, an outcome of the WT and a SOM neural network, was explored for the purpose of segmentation of the bone. Every slice in a data set is processed sequentially using the algorithm. Multiresolution WT is initially applied on the ROI so

as to reduce the dimensionality of the ROI segment. Femur extraction from the lowpass band of the resultant image is done using a SOM neural network. In order to enrich the set of pixels constituting the bone, extracted from the lowpass band, a statistical classification of the residual high frequency bands belonging to the isolated image, was performed. The distributed pixels scattered in the high frequency bands, belonging to fragments of the femur was compiled through statistical classification. Median filtering is applied on the results to remove artifacts. This technique provides encouraging results for images with "thick" bone regions. The results exhibit high precision of bone extraction, comparable to those of hand-tracing. The bone regions extracted match near perfectly with its original images. However, "thin" bone regions produced partial bone extraction.

The segmentation technique contributed to the preliminary works of automating femur extraction from MRI images. Modelling of the segmented femur volume using rapid prototyping (RP) technology would accelerate and enhance the customization of femur implants.