Detection of postmenopausal alteration of bone structure in digitized X-rays

C. Vertan[1], I. Ştefan[2], Laura Florea[1]

Image Processing and Analysis Laboratory
"Politehnica" University of Bucharest
Romania

and

Baia Mare County Hospital, Romania

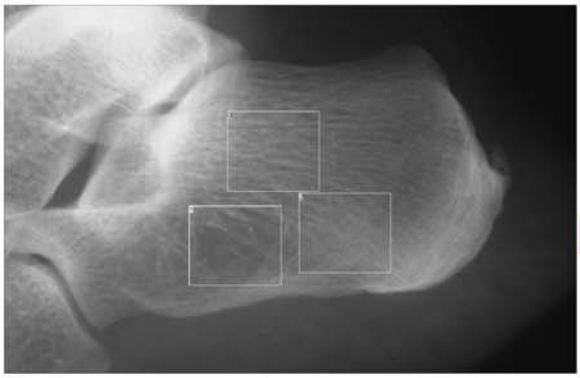
Objective

We investigate an automatic digital X-ray image processing system for the detection of the menopausal condition from lateral calcaneal X-ray images, acquired during the radiological investigation of casual foot trauma. The clinical decision is based on the bone structure analysis.

Material

24 plain lateral X-ray images of the calcaneus, acquired during the radiological investigation of casual foot trauma. There are 12 post-menopausal condition cases and 12 pre-menopausal condition cases.

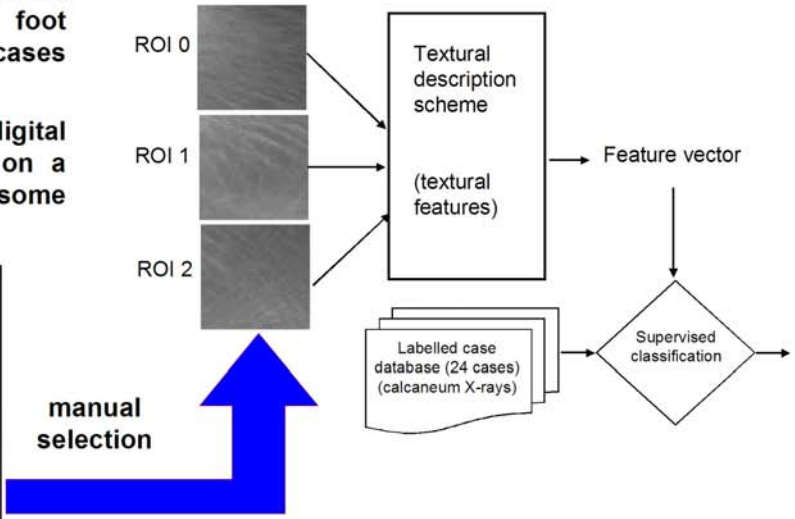
Digital images were acquired with a consumer digital camera from the original X-ray films exposed on a standard negatoscope, yielding a resolution of some 300 pixels per inch.



Method

Three regions of interest (ROI) of 150 x 150 pixels, located within the thalamic region, the Ward triangle region and the region of intersection of the thalamic group with the posterior plantar group

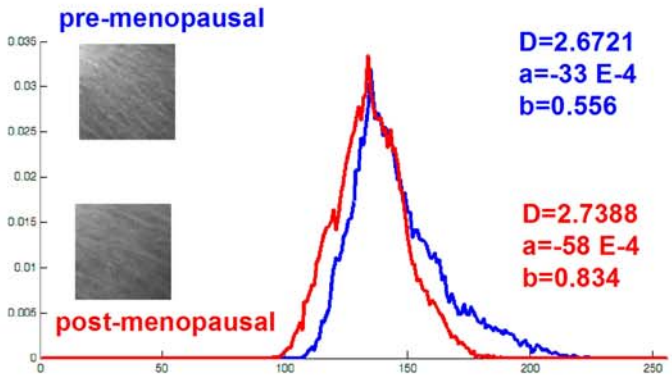
The decision on the presence/absence of menopausal condition is performed by a leave-one-out, three nearest-neighbor classification scheme.



Textural features

fractal dimension (Hurst coefficient)

parameters of the exponential model for the region histogram ($h(x) = exp(ax^2+bx+c)$)



Classification results

The proposed approach yields a performance of:

91.67% correct detection rate of postmenopausal condition (1 missed case) and

16.66% false alarm rate (2 false alarm cases)

87.50% overall performance rate.

Best choice: fractal dimension for ROI2, histogram model for ROI0 and ROI1.

The performance is stable with respect to the choice of the regions of interest: the results do not change for variations of the ROI placement up to 50% of its size. The results compare favorably to classical multi-fractal bone description.

Conclusions

The presence of the post-menopausal condition is correlated to the textural appearance of the calcaneal trabecular structure, as described and measured by simple texture descriptors. The described approach can be used as automated screening during casual X-ray investigation of foot trauma.

Acknowledgments

This work was supported by the CEEX VIASAN grant 69/ 2006.