

PERFORMANCE OF SIMPLE NEURAL NETWORKS IN THE DETECTION OF RECTAL TUMORS

Edib Dobardžić¹, Ivana Mišković², Bećko Kasalica¹, Mladen Marinković², Aleksandra Bibić^{3*}

¹University of Belgrade, Faculty of Physics, Cara Dušana 13, 11000 Belgrade, Serbia,
edib.dobardzic@ff.bg.ac.rs, kasalica@ff.bg.ac.rs

²Clinic for Radiation Oncology, Institute of Oncology and Radiology of Serbia, Pasterova 14, 11000 Belgrade, Serbia, aainv.m@gmail.com, mladen309@gmail.com

³University of Belgrade, Faculty of Medicine, dr Subotića starijeg, 11000 Belgrade, Serbia,
aleksandra.bibic@med.bg.ac.rs

ABSTRACT

This study investigated the application of neural networks for detecting rectal tumor regions in patients using computed tomography (CT) images. The study included 138 patients, while two CT scans with a healthy rectum were included to balance the dataset, resulting in a total of 3566 images. For each image, pixel values along the contour and within the rectal region were extracted, and tissue mass density values were obtained using calibration curves. To account for variations in rectal volume, statistical distribution functions of tissue density were used. The most relevant features were selected using Mutual Information (MI) and Principal Component Analysis (PCA). These data were then used to train different neural network architectures, including layer configurations such as $n-2n-n-1$ and $n-2n-4n-2n-n-1$, where n represents the number of input features, which ranged from three to seven. We trained the networks with batch sizes of 1, 11, 107, and 1069, and evaluated their performance based on sensitivity and specificity. We observed the highest accuracy (~79%) with a $4-8-4-1$ network, batch size 1069, and 4 PCA-selected features. The highest sensitivity (~85%) was achieved with $6-12-24-12-6-1$ and $4-16-8-4-1$ networks (batch size 1), using 6 PCA-selected features in the first and 4 MI-selected features in the second. We recorded the highest specificity (~80%) for the $4-8-4-1$ network with batch size 1069 and 4 PCA-selected features.

Keywords: neural networks, rectal tumor detection, computed tomography, feature selection, Mutual Information, Principal Component Analysis.