Image processing techniques applied in imaging diagnosis

Author:
Ing. Adriana MOLDER (MILĂȘAN)

ABSTRACT

Digital image processing techniques applied in diagnostic imaging are essential for improving image quality and extracting relevant information from medical images. These techniques are critical for the detection, diagnosis and monitoring of various medical conditions.

Current digital medical image processing techniques are used to improve their interpretation and provide detailed information that can help doctors in the diagnosis and treatment of patients. These advanced techniques, as well as artificial intelligence-based techniques, continue to improve the quality and accuracy of diagnostic imaging.

The aim of this thesis was the development, improvement and evaluation of advanced algorithms and methods of digital medical image processing, with the aim of contributing to a more accurate and efficient diagnosis of associated diseases. The research focused on the identification and implementation of innovative techniques to improve the accuracy, speed and reliability of digital processing of images obtained through various types of medical imaging.

The first part of the study evaluated filtering techniques applied on ultrasonographic images of the bifurcation of the carotid artery, a critical area for stroke risk assessment. Several techniques were considered, such as linear filters, nonlinear filters, diffusion filters, and wavelet filters, all aimed at reducing speckle noise and other artifacts without compromising anatomical details. Each method was evaluated based on its ability to remove noise and preserve details essential for diagnosis. The optimal filter for highlighting the contours of atheroma plaques was determined, considering the next segmentation step. The techniques were validated on a database consisting of real medical data initially validated by histopathological examinations. Various techniques were implemented to segment atheroma plaques in ultrasonographic images of the carotid artery bifurcation, as well as techniques to extract features from segmented regions, such as: echogenicity, texture and surface of atheroma plaques. These features were processed to identify the composition and internal structure of atheroma plaques. Based on the extracted features, atheroma plaques were quantitatively described and classified according to the level of risk, with an emphasis on the importance of these classifications for diagnosis and treatment.

Subsequently, artificial intelligence algorithms were implemented and evaluated for the automatic diagnosis of celiac disease based on endoscopic images. Decisional fusion algorithms applied to duodenal images classifiers are implemented to assess the degree of intestinal villus atrophy. They emphasize the importance of these algorithms for clinical decision support and discuss future directions for the refinement of computer-aided diagnostic techniques in endoscopic imaging. All these evaluations were performed using a database of endoscopic images composed of clinically validated real medical data.