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AUTOMATIC DETECTION AND THREE DIMENSIONAL RECONSTRUCTION OF CEREBRAL VESSELS FOR MORPHOLOGICAL ANALYSIS AND ANEURYSM TREATMENT

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Abstract

The evolution of computer technology has undergone an exponential development which has made possible the execution of programming codes, of a statistical and evolutionary nature, capable of reproducing, with a careful simplicity, the development methods of many systems present in nature . In this sense, the digital analysis of medical images has made a substantial contribution in recent decades to the optimization processes of diagnostic techniques, becoming a now necessary tool to support medical personnel during the most critical and decision-making phases.

One of the most contrasting areas and, therefore, most attentive to the technological implications of scientific research is linked to the identification and evaluation of a cerebral aneurysm, a pathological phenomenon that annually affects about 5% of the world population (Rinkel et al., 1998), (Ujiie et al., 1993). The rupture of a cerebral aneurysm is today one of the ten primary causes of death in the world. The reason for these numbers lies in the fact that, at the time of clinical observation of the phenomenon, more than 80% of aneurysms are already ruptured and for many of them an attempt at surgery is even in vain (Dhar et al., 2008). .

In this sense, there is the need to study the anatomical and hemodynamic phenomena that cause the formation and development of an intracranial aneurysm, in order to be able to take advantage of the most modern computational techniques, capable of reproducing and analyzing the anatomical region of interest and submit it to evaluation analyzes that give the most reliable result in terms of predictiveness of aneurysm rupture, allowing medical personnel to promptly provide a diagnosis and appropriate interventional treatment.

The present research work concerns the development and configuration of a computational processing system for the automatic detection and three-dimensional reconstruction of cerebral vessels affected by aneurysms, possibly present, within the intracranial region.

The high mortality rate resulting from the hemorrhagic phenomenon (ESA) associated with the rupture of an aneurysm, equal to 8-15% in the first 24 hours and 66% in 1-2 months, determines the high complexity associated with the pathological treatment both in the diagnostic phase and in preoperative planning. Preventive measures of the hemorrhagic phenomenon, suggested by national and international neurosurgery societies, push towards an investigation of recognition and timely treatment, able to detect the presence of aneurysms not yet ruptured (ISUIA). In fact, it is estimated that about 6% of the population is affected by cerebral aneurysm pathologies, often associated with a total absence of symptoms.

The core of this work involved the use of topological recognition functions, capable of identifying any alterations in the local configuration of the morphology of the vessels, appropriately isolated from the neighboring anatomical regions and subjected to three-dimensional reconstruction.