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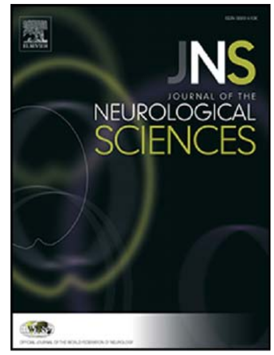

Analysis of neoplastic lesions in magnetic resonance imaging using self-organizing maps

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ANALYSIS OF NEOPLASTIC LESIONS IN MAGNETIC RESONANCE IMAGING USING SELF-ORGANIZING MAPS

KEYWORDS: SELF ORGANIZING MAPS, SOM, MAGNETIC RESONANCE IMAGING, MRI, NEOPLASTIC, BRAIN, TUMORS

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1. Introduction:

Inter and intra- examiner variability and inconsistency for interpretation of different lesions in the Central Nervous System (CNS), such as tumors, among others (demyelinating, inflammatory, vascular) are routine factors in neuroradiology. Such inconsistencies may lead to wrong diagnoses and inadequate decisions in treatment, which has been discussed by various authors. [2,3]

Tumefactive lesions, either intra or extra axial, found on brain Magnetic Resonance Imaging (MRI), usually represent a challenge for both the neurologist and the neuroradiologist. Lesion representation on ordinary T1, T2 and FLAIR acquisitions, will depend of histologic nature. For example, intra-axial lesions, glial tumors tend to be hypointense on T1-weighted and hyperintense on T2-weighted, while cerebral lymphomas tend to have isointensity on both T1 and on T2 acquisitions. Isointensity of signal is also the most prevalent aspect on meningiomas, the most common extra-axial lesions. Due to limitations of these routinely-acquired MRI images, and in many cases the lack of diagnostic specificity, the use of complementary advanced methods, such as MRI spectroscopy, perfusion and diffusion weighted MRI are necessary.

A better definition of the margins of a primary lesion would allow better precision for its surgical excision, with less damage to healthy adjacent tissue. Precise extraction being so important for an organ where preservation of millimeters can potentially preserve noble neurological functions. Additionally, better planning of complementary treatment, such as radiation therapy, could be planned. In this context, certain methods of non-visual, automatic classification could assist on the correct nosological classification of diseases.

Self-Organizing Maps (SOM) is an unsupervised, exploratory data analysis tool, which can automatically domain an image into self-similar regions or clusters, using the principles of vector quantization and measures of vector similarity[8,9]. In a SOM analysis, samples are treated as n-dimensional (nD) vectors in a data space defined by their variables[4]. A reduced number of seed vectors is then typically randomly distributed throughout the nD data space, and these “seeds” are subsequently “trained” via competitive and collaborative processes, over both coarse and fine training cycles (iterations), to represent the structure of the input data. The trained “seed vectors” (now known as best matching units - BMUs) are then projected as nodes onto a typically two-dimensional rectilinear map, in such a manner as to maintain, as best possible, their topological relationships in nD space. The resulting “Self Organized Map” is a two dimensional, rectilinear representation of the input multi-dimensional data set. Each node on the “map” may then represent a number of similar input samples; and nodes or groups of adjacent nodes, may represent natural clusters or domains within the original data set.

SOM has gained widespread acceptance for the analysis and integration of disparate data in many diverse fields, in a way that provides extra significance to the interpretation. SOM has been used for