Current research on automated brain segmentation is largely directed toward normal adult MRI. However, segmentation may also be clinically necessary for MRI in cases of neurological pathology as well as for CT data. Image segmentation for application to CT images remains exceedingly important, given that much of the developing world does not have access to MRI. Additionally, much emergency imaging and many critical vascular studies in industrialized countries are done with CT.

The study of Mandell et al.represents the first use of a particle filter as an edge tracker in image segmentation, and offers a semiautomatic method to segment both pediatric and adult brain data from MR and CT images [1].

Segmentation with Osirix

https://www.youtube.com/watch?v=9-FHUvl9NE4

Fully automated segmentation via unsupervised classification with fuzzy c-means clustering was used to analyze AVM nidus on T2-weighted magnetic resonance imaging. The proportions of vasculature, brain parenchyma, and cerebrospinal fluid (CSF) were quantified. This was compared to manual segmentation. Association between brain parenchyma component and radiation-induced changes (RICs) development was assessed.

The proposed algorithm was applied to 39 unruptured AVMs. This included 17 female and 22 male patients with a median age of 27 years. The median percentages of the constituents were as follows: vasculature (31.3%), brain parenchyma (48.4%), and CSF (16.8%). RICs were identified in 17 (43.6%) of 39 patients. Compared to manual segmentation, the automated algorithm was able to achieve a Dice similarity index of 79.5% (sensitivity=73.5% and specificity=85.5%). RICs were associated with higher proportions of intervening nidal brain parenchyma (52.0% vs. 45.3%, p=0.015). Obliteration was not associated with a higher proportions of nidal vasculature (36.0% vs. 31.2%, p=0.152).

The automated segmentation algorithm was able to achieve classification of AVM nidus components with relative accuracy. Higher proportions of intervening nidal brain parenchyma were associated with RICs [2]

1)
Mandell JG, Langelaan JW, Webb AG, Schiff SJ. Volumetric brain analysis in neurosurgery: Part 1. Particle filter segmentation of brain and cerebrospinal fluid growth dynamics from MRI and CT images. J Neurosurg Pediatr. 2015 Feb;15(2):113-24. doi: 10.3171/2014.9.PEDS12426. Epub 2014 Nov 28. PubMed PMID: 25431902.
2)
Lee CC, Yang HC, Lin CJ, Chen CJ, Wu HM, Shiau CY, Guo WY, Hung-Chi Pan D, Liu KD, Chung WY, Peng SJ. Intervening nidal brain parenchyma and risk of radiation-induced changes after radiosurgery for brain arteriovenous malformation: a study using unsupervised machine learning algorithm. World Neurosurg. 2019 Jan 21. pii: S1878-8750(19)30103-2. doi: 10.1016/j.wneu.2018.12.220. [Epub ahead of print] PubMed PMID: 30677586.

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