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Abstract.

Brain tumor characterization is very useful for patients treatment, but it can be time-consuming for medical experts. Furthermore, the reference method to characterize tissues is biopsy which is a local and invasive technique. Because of this, there is a huge interest for automatic and non-invasive approaches in order to characterize tumor.

In this study we use a statistical model-based method to classify multiparametric MRI of brain rat tumors, which allows data quality control with atypical observations detection, and may provide a dictionary of tumor signatures.

A previous study, [1], used a Gaussian mixture model to characterize pixels inside tumors. With this model, the observations are gathered into classes resulting from Gaussian distributions. However, this model is sensitive to outliers which degrade the relevance of the obtained groups. And inside a tumor, there could be a huge variability and so a lot of outliers.

To account for this biological variability, we propose to use generalized Student distributions : the multivariate multi-scaled Student distributions (MMSD, [2]). The MMSD distribution extends the standard multivariate Student distribution by using the Gaussian scale mixture representation of Student distributions. This representation allows us to introduce multi-dimensional weights, which control different tail thickness of the distribution for each dimension, and provide a way to detect outlier data. In this way, we obtain a finer regulation of the influence of atypical data on the groups shapes, and so a greater flexibility of the clustering model.

We use an Expectation-Maximization algorithm (EM) to adjust a MMSD mixture on brain tumor MRI. The number of classes inside the mixture is selected by minimizing the Bayesian information criterion (BIC).

Our sample consists of healthy rats (n=8) and 4 groups of rats bearing a brain tumor model (n=8 per group), and 5 quantitative MRI parameter maps for each rat. We adjust a MMSD mixture on the healthy sample to detect tumor area in the tumor sample through the multi-dimensional weights. Then we characterize the tumor areas with another MMSD mixture and build a tumor dictionary which discriminates the 4 tumor.

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