



Central European Institute of Technology
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Texture Analysis in Morphometry

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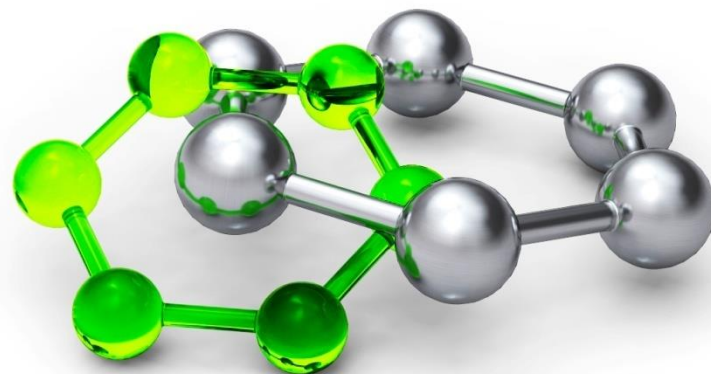
Brno, November 14th 2016



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Limitations of VBM

- VBM is a general method suitable for use a priori
- Compares images voxel by voxel (simplified)
- However, the two compared images are never the same, i.e. they must be smoothed and the result thresholded
- In this step, we potentially lose information in smoothed details or in patterns hidden covered behind significance level

Alternative - A posteriori approach

- Sometimes, we have information of what exactly we are looking for
- This information can be used to design a method looking for a specific image feature
- The proposed method may have higher sensitivity and specificity than the general a priori methods

Approaches to design appropriate methods

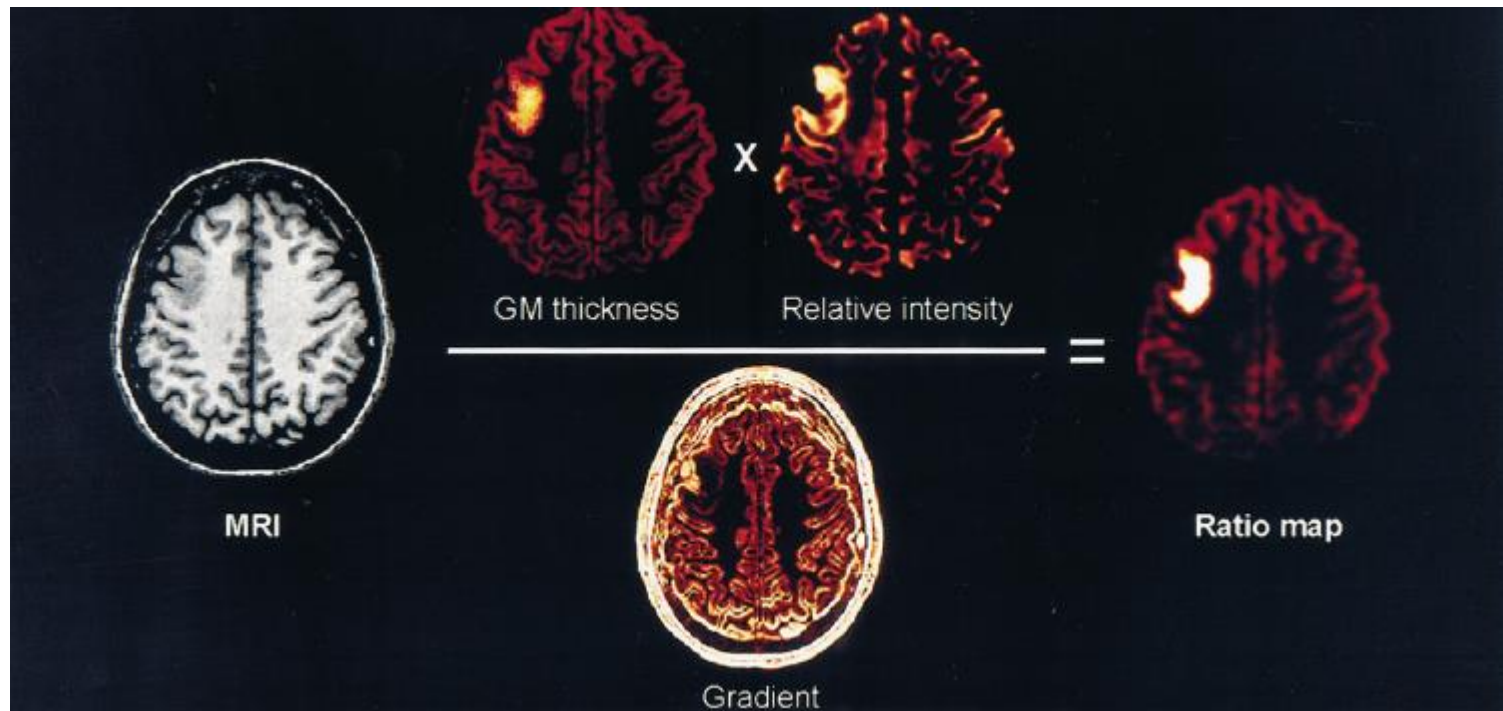
1. Based on knowledge of the issue, we can manually script the desired method
2. Data-Driven Approach - predictive model can be assembled using machine learning techniques

1. Manual design

- Flexible (any image processing method) but time-consuming
- It requires detailed knowledge of the issue
- For example, we know that FCD (Focal cortical dysplasia – epilepsy) is mainly characterized by:
 - variable degrees of cortical thickening
 - poorly defined transition between GM and WM
 - hyperintense signal

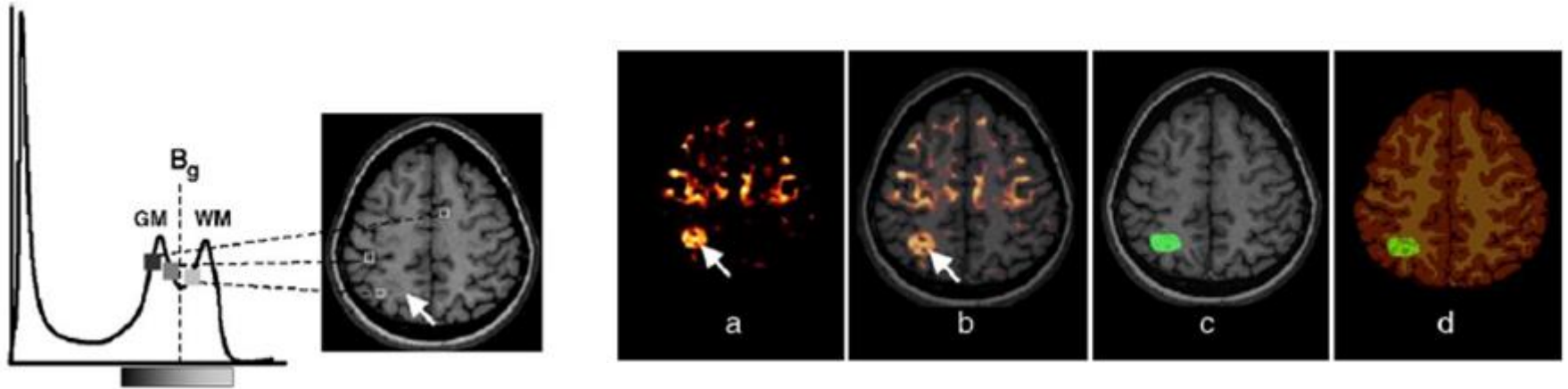
1. Manual design – detecting FCD

- We can design a methods that detect each required feature



Andrea Bernasconi et al.: Texture Analysis and Morphological Processing of Magnetic Resonance Imaging Assist Detection of Focal Cortical Dysplasia in Extra-Temporal Partial Epilepsy

1. Manual design - relative intensity computation



O. Colliot et al. / NeuroImage 29 (2006) 162– 171

- The result is a method of detecting specific features (disease) which should have higher sensitivity and specificity.

1. Manual design – texture analysis

What is image texture?

- We may also use the classic texture analysis
- Generally speaking, textures are complex visual patterns composed of entities or subpatterns that have characteristic brightness, colour, slope, size...



1. How texture analysis works?

- We detect many simple features from the image
 - 1st order statistics, histogram analysis, entropy
 - Co-occurrence matrix
 - Fourier analysis, wavelet analysis
 - Subpatterns repeating, autocorrelation, directivity
 - Correlation with prepared masks
- The combination of these features distinguishes the area of interest from background

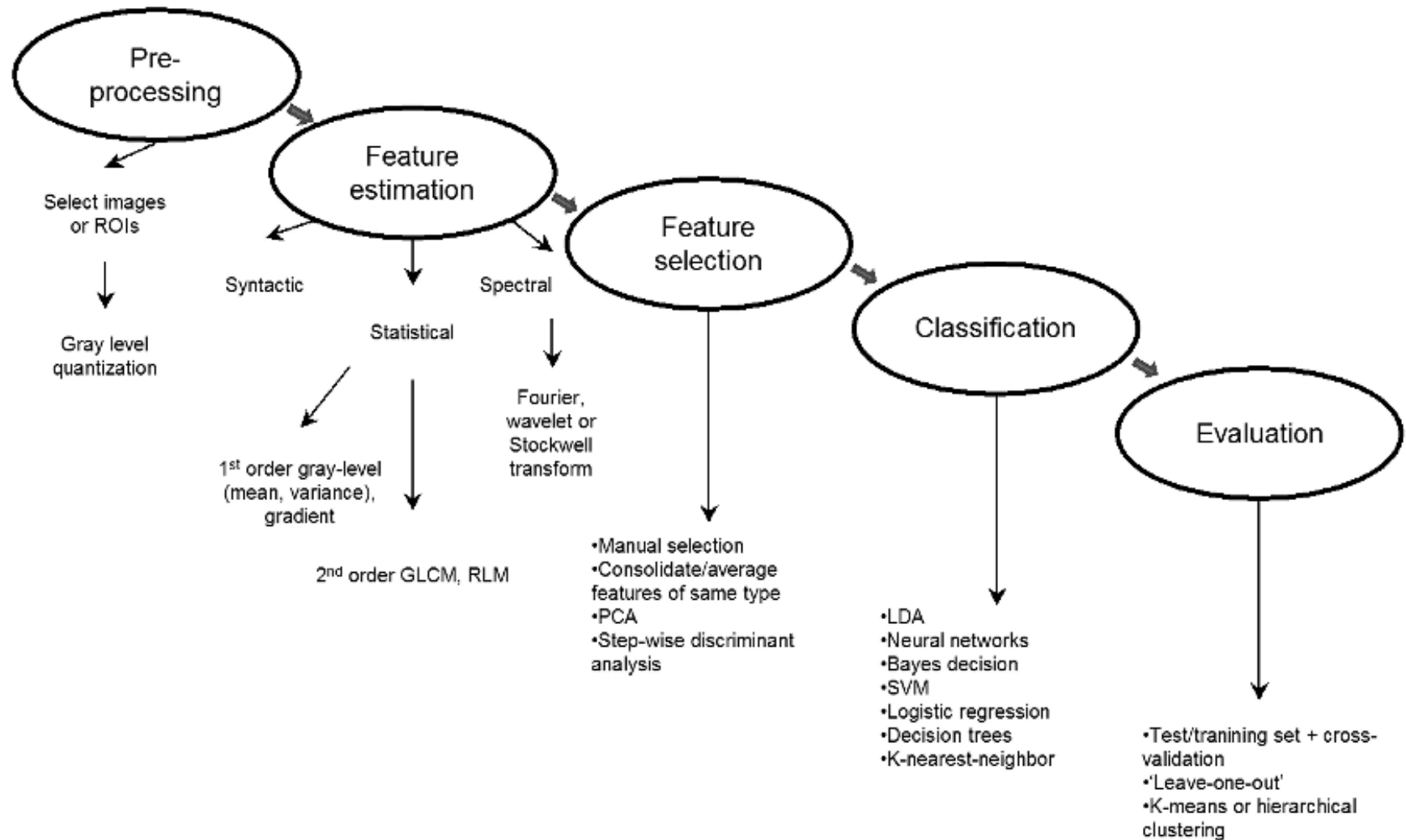
2. Machine learning 1/4

- No need of manual script image processing method
- We only mark ROI of searched area and ROI control area
- The predictive model is built automatically by machine learning methods – SVM, neural networks
- After creating a model, we can search desired features in the new scans

2. Machine learning 2/4

- Less flexible
- For the processing a limited set of functions that extract the interesting features is used
- Image textures may be used as these features
- For example, those methods are used for detecting edema, tumors, lesions, etc.

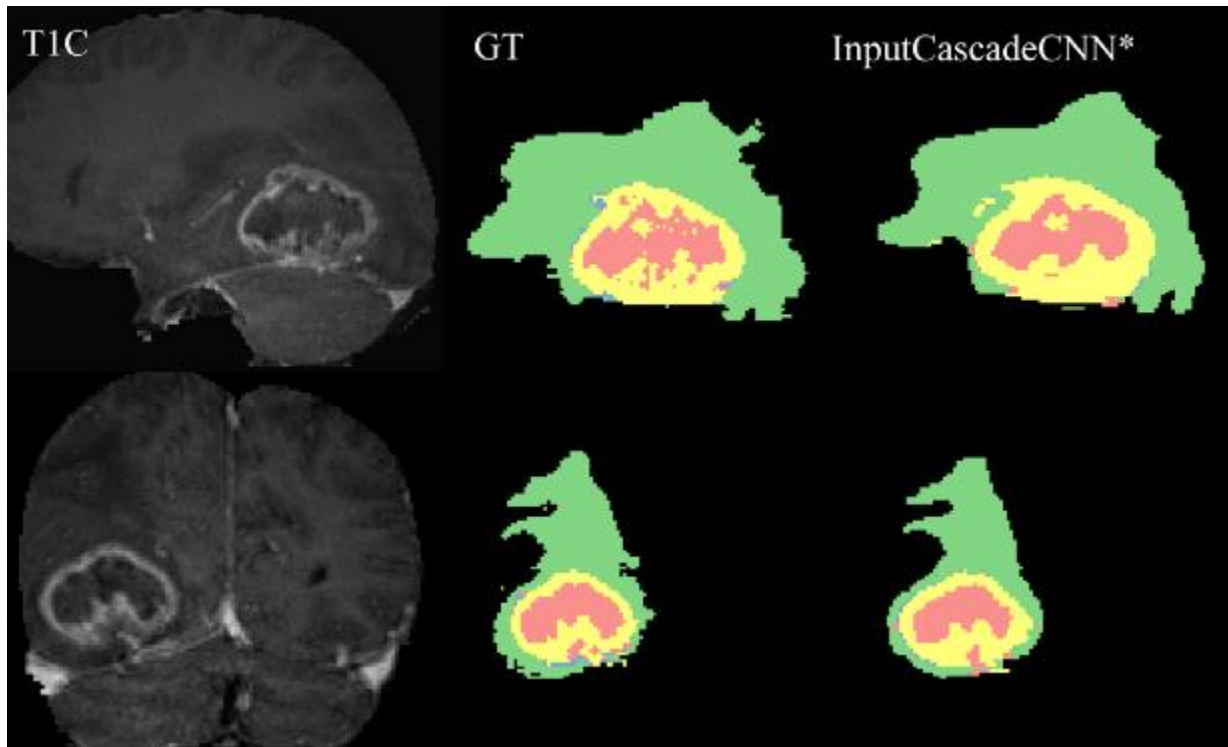
2. Machine learning 3/4 – pipeline example



A.Kassner, R.E.Thornhill: Neuroradiol 31 (2010) 809-16

2. Machine learning 4/4 – result example

- Example of segmentation brain tumor using Convolutional neural networks



Mohammad Havaei et al.: Brain tumor segmentation with Deep Neural Networks (2016)

Conclusion

- We can achieve higher sensitivity and specificity by using methods specific for some issue
- By using machine learning techniques we can also search the patterns that we can not precisely define

Thank you for your attention



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