



Image Segmentation using Statistical Models

Application to internal brain structures extraction from 3D Brain MRI

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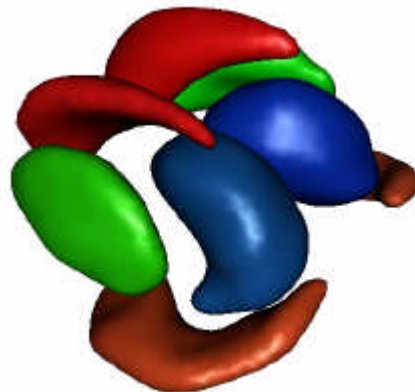
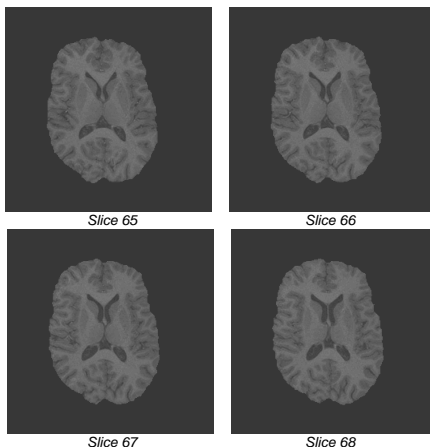
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Target:

Automatic segmentation of internal structures from a Brain MRI volume



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Purpose of segmentation:

□ Volume quantification of anatomic structures:

Several diseases can be detected in measuring structure volumes:
e.g Parkinson's disease related to Hippocampus volume.

□ Digital anatomic atlas:

- collect statistical data about shape / volume of structures
- associate activation data to the anatomical structure where signals occur

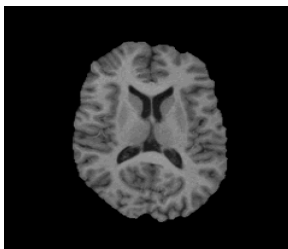


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Main difficulty

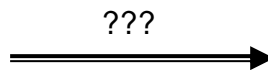


A sample MRI slice



Associated gradient image (Sobel)

Standard segmentation methods require good image contrast around objects of interest



In our case, **a priori information** is required to guide the process.

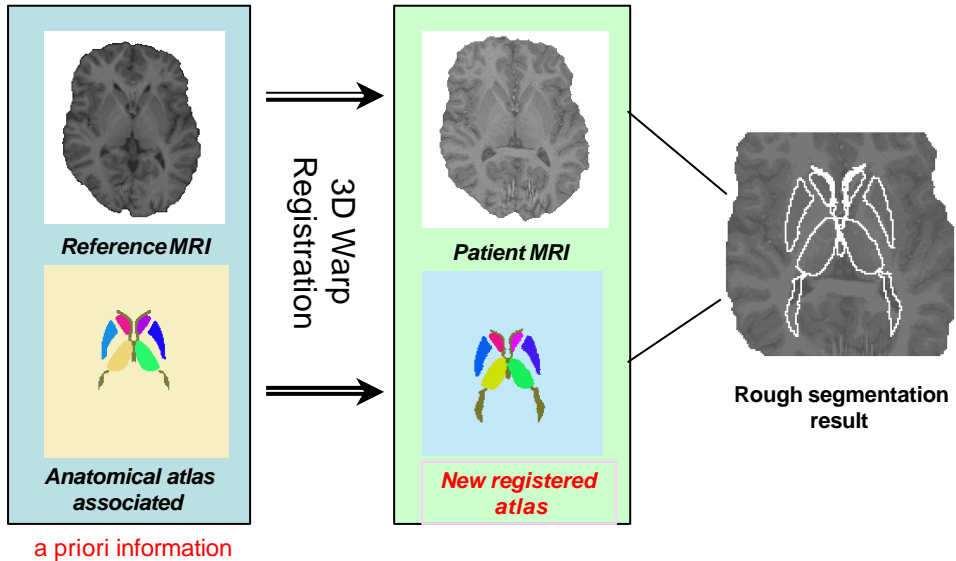
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Preliminary work:

Step 1: atlas registration



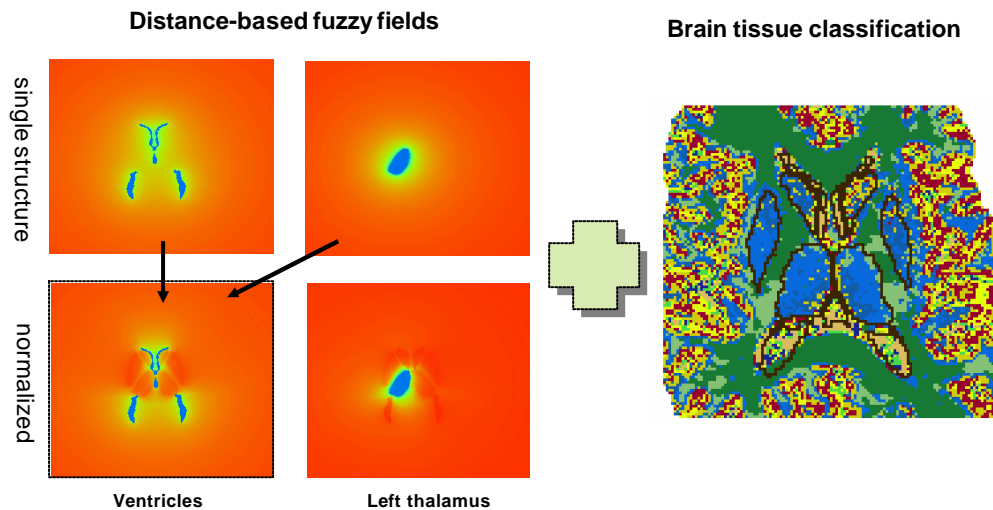
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Preliminary work:

Step 2: fuzzy data conjunction



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Preliminary work:

Step 3: results & comments



- + • region coverage correct
- + • good positioning
- • poor shape contour similarity with the reference

➔ **Need for a *shape model* enforcing explicit *geometric constraints***

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Point Distribution Model

Step 1: shape learning

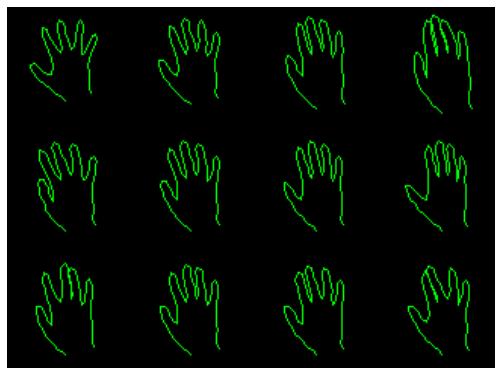


Input data: a training set of instances of a given shape

Output: a *shape model*

- generating infinitely many shape instances.
- determining whether an unseen instance belongs to the current training set

first mode



2nd mode

3rd mode

➔ **explicit geometric constraints**

pictures from Pr. Tim Cootes

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Point Distribution Model

❑ a wide training set of *correct* shape instances contours.

❑ annotation of these instances by *corresponding* landmarks:

- **in 2D:** time-consuming, subjective.
- **in 3D:** not practicable manually.

Step 2: requirements



pictures from Dr. Mikkel Stegmann 9

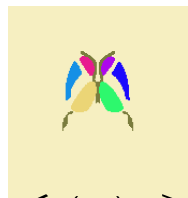
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Automatic PDM Building

Step 1: providing shape instances

anatomical atlas
registration to sets of
patient MRI volumes



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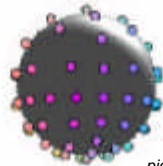
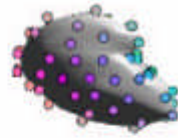
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Automatic PDM Building

Step 2: landmarking

Landmarking considered as a global optimization process:

- shape landmarks arbitrarily displaced.
- current model evaluated using Minimum Description Length (MDL) principle.



picture from Dr. Rhodri Davies

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Automatic PDM Building

Step 3: first results

input training set:



inferred landmarks :



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The end...

Thank you for your attention.

Further questions about this talk are welcome!