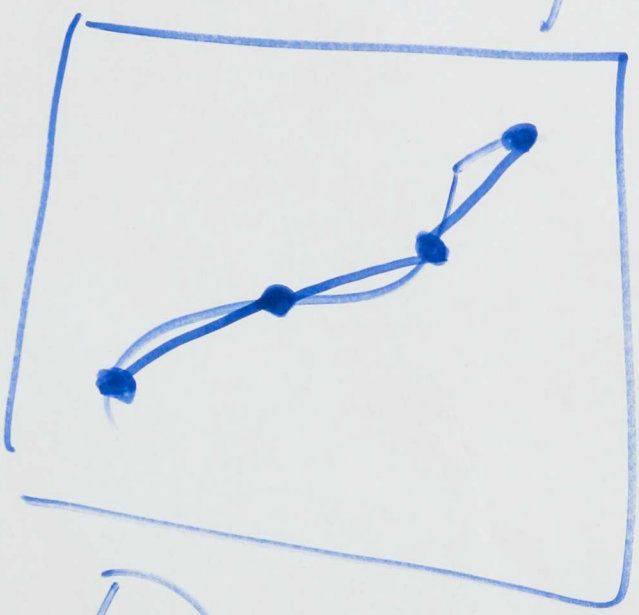
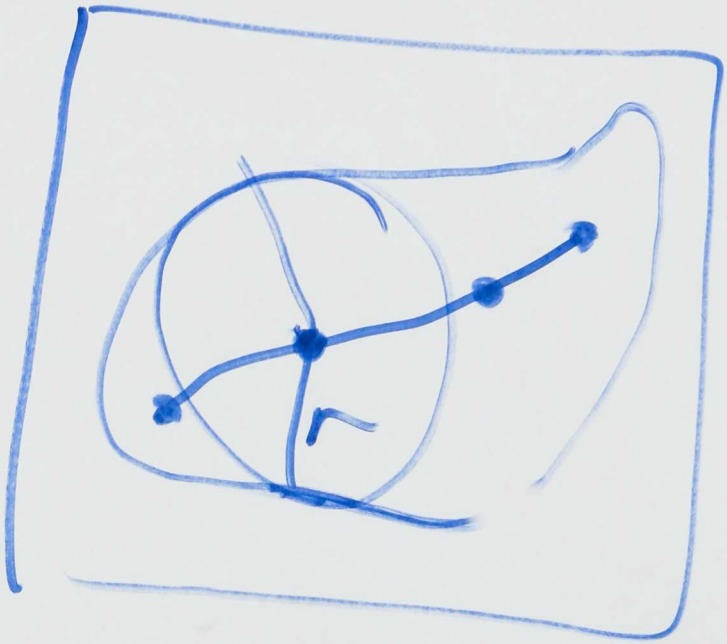
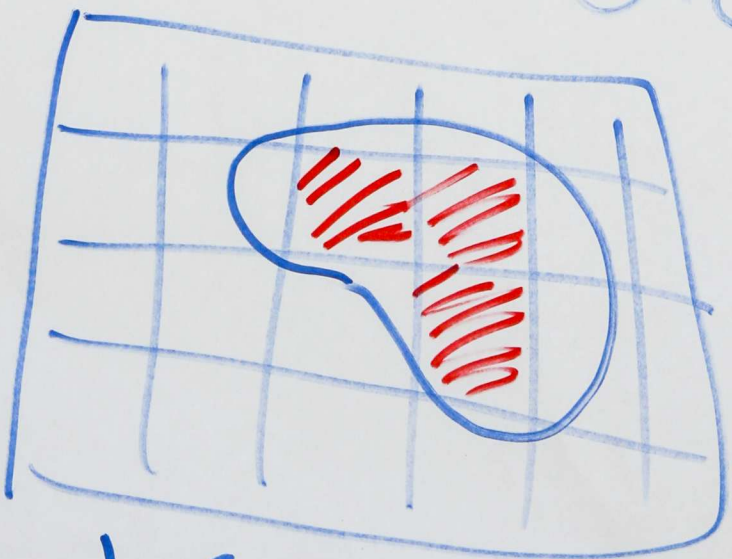
1. Represent



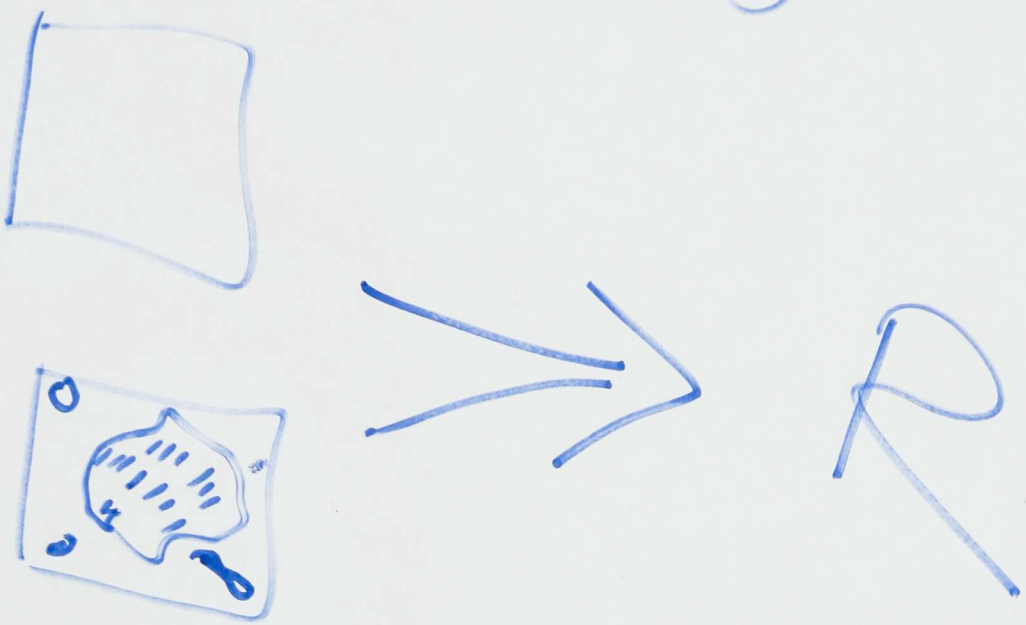


- Boundary



- Voxel-Based Volumetric

2. Quality Measure



Data Term +

Image

+ Smoothness

Prior

Regularization

Energy Based

$$\mathcal{E} = \mathcal{E}_{im} + \mathcal{E}_{r/s/p}$$

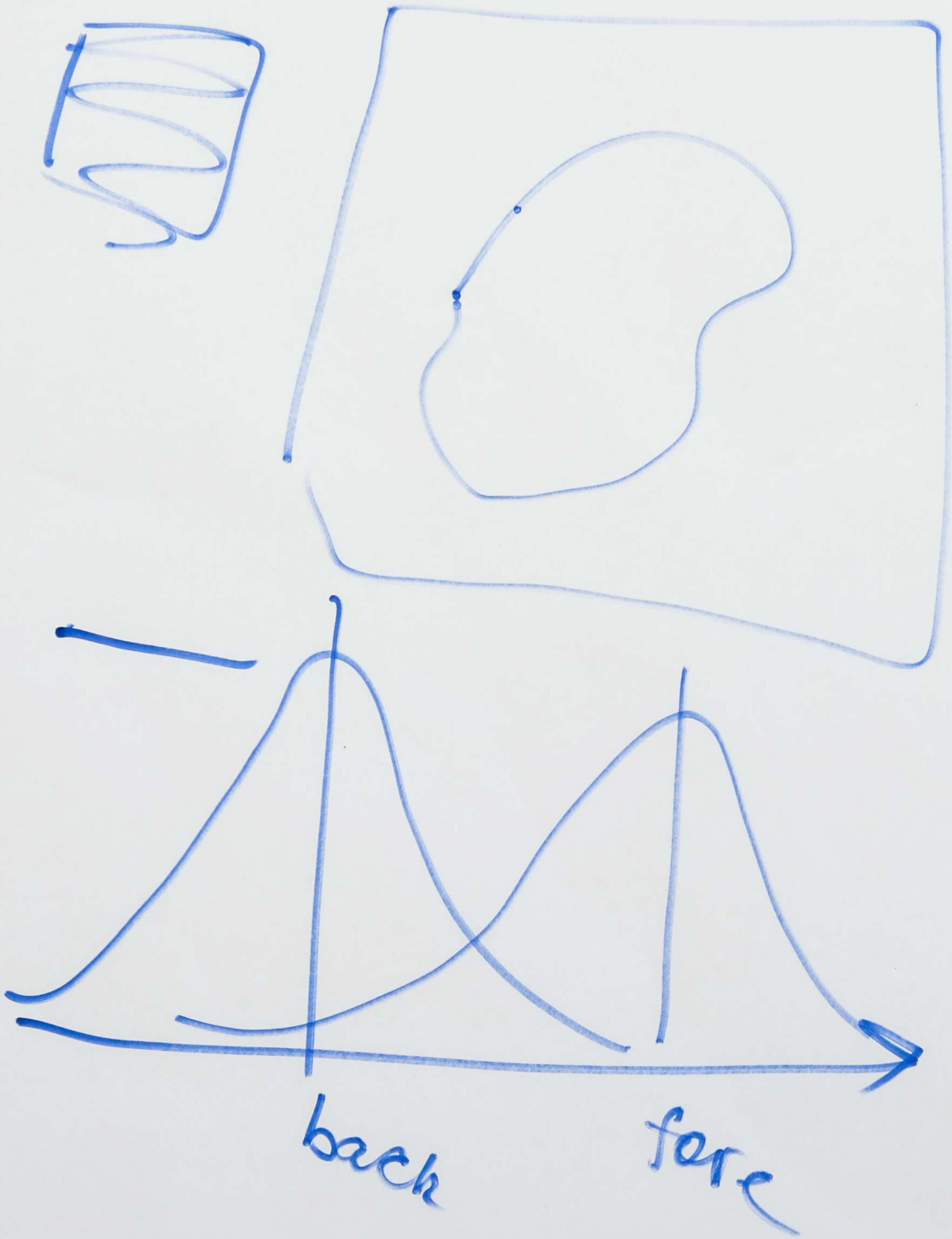
$$\min_{param} \left(\mathcal{E}_{im} + \mathcal{E}_{r} \right)$$

Probably

$$P = \underbrace{P(I|S)}\, \underbrace{P(S)}$$

$$\max_{params} P$$

Intensity term



Chen-Vesse

$$\sum_x \frac{\left(I(x) - \mu_{c_x}\right)^2}{\sigma_{c_x}^2}$$

EM-segmentor

Wells van Leemput

$$\prod_x \sum_{e_x} \underbrace{p(I(x) \mid e_x) p(e_x)}_{e^{-\left(\frac{I-\mu}{2\sigma^2}\right)^2}}$$

Prior Term - Boundary

1. Smoothness
   - first derivatives
   - second
2. From examples:

$$\underline{S} = \underline{\mu} + \underline{V}\underline{p} \quad \underline{p} \sim N(0, \underline{\Sigma})$$

- $\underline{V}$: eigen-shapes
- $\underline{\Sigma}$: diag.

Cootes & Taylor

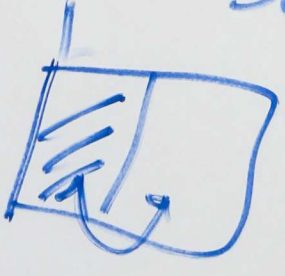
Prior - Volumetric

1. Smoothness

MRFs

$$\Phi(\ell_x, \ell_y) \sim e^{-\alpha(\ell_x \neq \ell_y)}$$

x, y - neighboors



van Leemput

Kapur

Davi Geiger

From Examples

- Prob. Atlas

$$\prod_x \prod_e \{p_e(x)\}^{L(x)}$$

$$L \in \{0,1\}$$

$p(x)$

$$p(L(x)) = \begin{cases} p_{object}, & L=1 \\ p_{background}, & L=0 \end{cases}$$

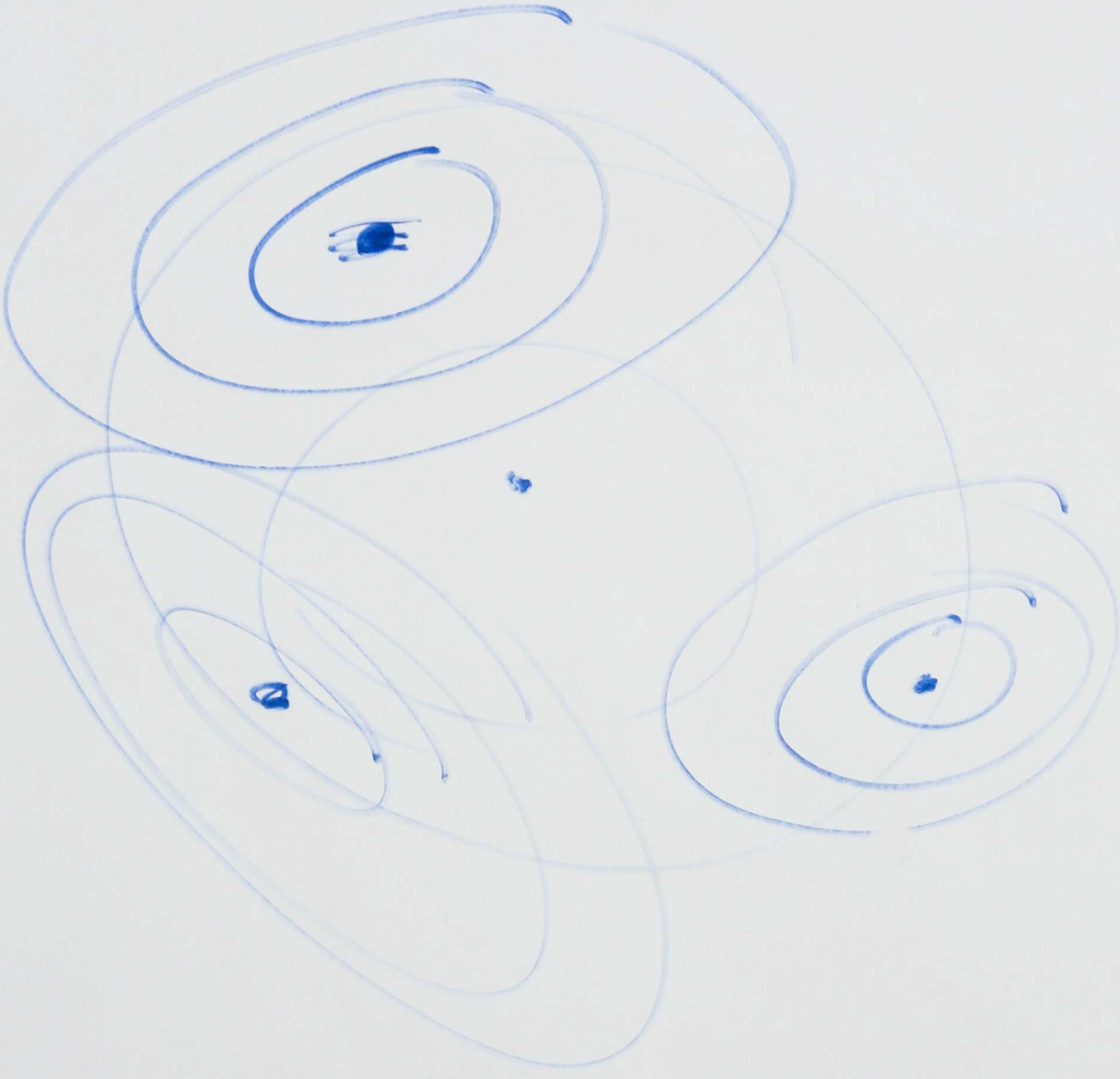
Registration - voxels

Correspondence - boundary

- Davies, Taylor, et al
  boundary
- Van Leemput
  volume

MDL

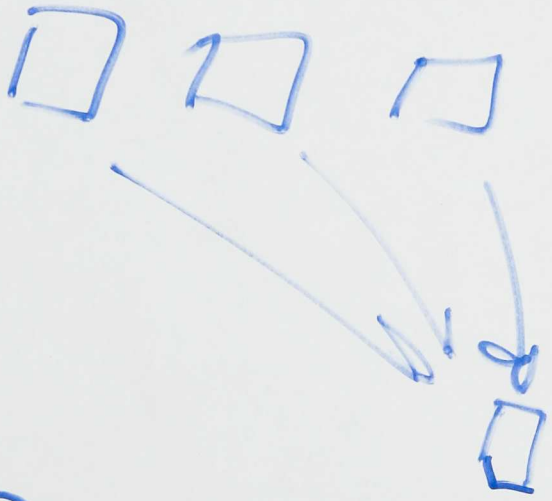
Joint Segmentation Registration



- Multi-atlas label-fusion

Rueckert

Sabuncu



Patch-Based