Contracting Curve Density Algorithm

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Outline

Contracting Curve Density (CCD) Algorithm

- a model-based image segmentation method
- fits a parametric curve model (prior knowledge) to an image

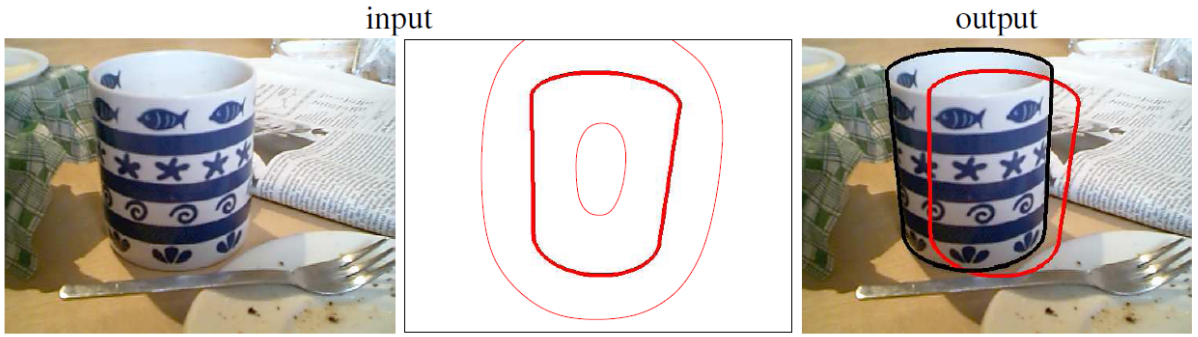

Figure: A curve fitting problem

Bayesian theorem

given the prior distribution of model parameters $p(\phi)$, and likelihood of the model parameters given the image data $p(I^*|\phi)$ (here I^* is the image data), the goal is maximum a posteriori estimation (MAP)

$$\mathcal{X}^2(\phi) = \text{argmin}_\phi p(\phi|I^*)$$

where

$$p(\phi|I^*) = \frac{p(I^*|\phi)p(\phi)}{p(I^*)}$$

Fuzzy assignment

use a probabilistic way to compute the weight ω of pixels assigned to respective side (A and B)

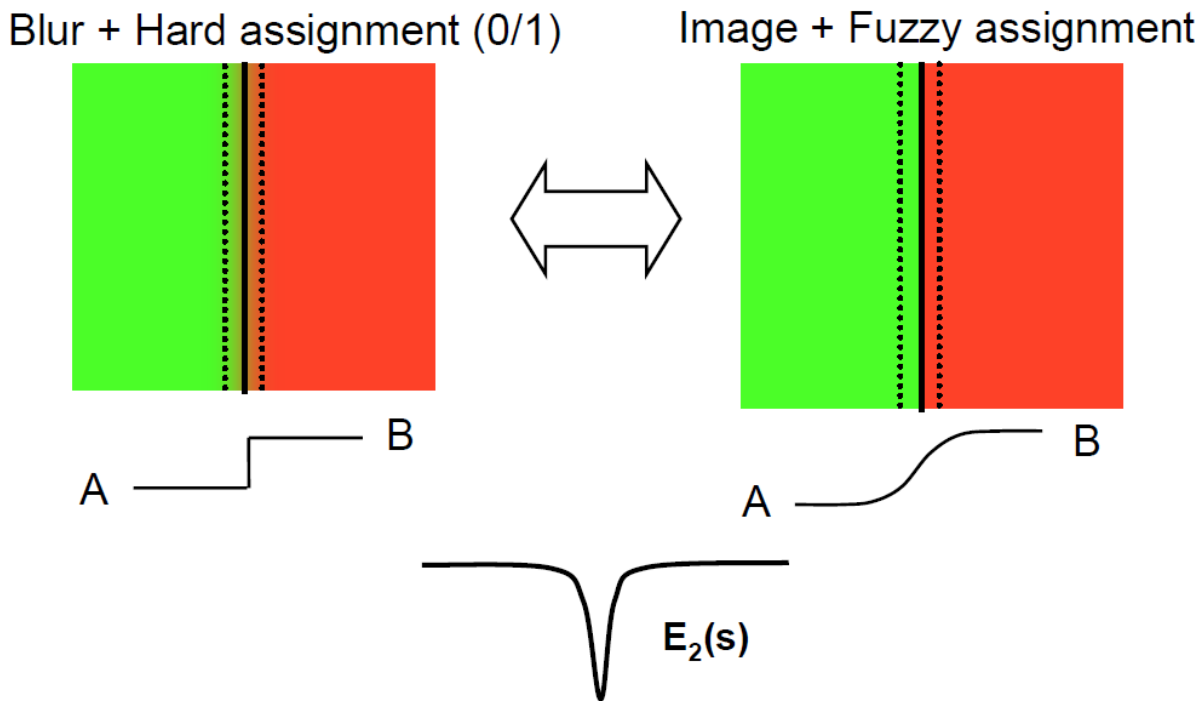

Figure: Fuzzy assignment

Steps of CCD algorithms

repeat these two steps until convergence

- Learn local statistics
  compute the pixel values and its statistics information $(I_v(\omega), m_v(\omega), \Sigma_v(\omega))$ from the vicinity of the expected curve based on the current mean vector m_ϕ and the current covariance matrix Σ_ϕ
- Refine the estimate of the model parameter vector

  a) Update the mean vector m_ϕ using a maximum a posteriori (MAP) criterion derived from the local statistics b) Update the covariance matrix Σ_ϕ based on the Hessian of the objective function used in a)

Advantages and disadvantages

advantages

- robust to clutter, occlusions etc
- sub-pixel scale optimization
- fast

disadvantages

- need to initialize the hypothesis manually
- not work for objects with holes

Application

- Segmentation
- Tracking