Questions about CCD

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Contents

1 How to initialize the model parameters' mean and covariance matrix?

How to give reasonable values for m_ϕ and Σ_ϕ

2 The fixed distance h along normal directions on both sides of the curve

$$h^2 = [\det(\Sigma_\phi)]^{1/N}$$

In the first iteration step, h depends on the initial value of Σ_ϕ

3 About fuzzy assignment

$$a_1(d) = \frac{1}{2}[\operatorname{erf}\left(\frac{d}{\sqrt{2}\sigma}\right) + 1]$$

$$\hat{\sigma} = \max[\frac{h}{\sqrt{2}\gamma_2}, \gamma_4]$$

$$\sigma = \frac{1}{\sigma_3}\hat{\sigma}$$

4 cost function E_2 and its gradient

$$E_2 = \sum_k^K \sum_l^L \left(\mathbf{I}_{kl} - \hat{\mathbf{I}}_{kl}(\phi)\right)^T \hat{\Sigma}_{kl}^{-1} \left(\mathbf{I}_{kl} - \hat{\mathbf{I}}_{kl}(\phi)\right)$$

$$\nabla_\phi E_2 = -\sum_k^K \sum_l^L \mathbf{J}_{a_1}^T \hat{\Sigma}_{kl}^{-1} \left(\mathbf{I}_{kl} - \hat{\mathbf{I}}_{kl}(\phi)\right)$$

$$\mathbf{J}_{\mathbf{a_1}}(\phi, v_{kl}) = \left(\bar{\mathbf{I}}_k^{(1)} - \bar{\mathbf{I}}_k^{(2)}\right)(\nabla_\phi a_1(d_{k,l}))^T$$

here, I think $\nabla_\phi a_1(d_{k,l}) = 0$ because $a_1(d_{k,l})$ is not a function about ϕ. However, whether can we factorize it as

$$\nabla_\phi a_1(d_{k,l}) = \frac{\partial a_1(d_{k,l})}{\partial d_{k,l}} \left(\frac{\partial d_{k,l}}{\partial x}\mathbf{J}_\phi(p_{k,l}(x)) + \frac{\partial d_{k,l}}{\partial y}\mathbf{J}_\phi(p_{k,l}(y))\right)$$

where $p_{k,l}(x)$, $p_{k,l}(y)$ are the coordinates of point k

$$d_{k,l} = (x_{k,l} - x_k) * n_x + (y_{k,l} - y_k) * n_y$$

$$\frac{\partial d_{k,l}}{\partial x_{k,l}} = n_x, \frac{\partial d_{k,l}}{\partial y_{k,l}} = n_y,$$

$$\frac{\partial a(d_{k,l})}{\partial d_{k,l}} = \frac{1}{\sqrt{2\pi}\sigma}\exp\left\{-\frac{d_{k,l}^2}{2\sigma^2}\right\}$$

$$\nabla_\phi a_1(d_{k,l}) = \frac{1}{\sqrt{2\pi}\sigma}\exp\left\{-\frac{d_{k,l}^2}{2\sigma^2}\right\}(n_x * \mathbf{J}_\phi(p_{k,l}(x)) + n_y * \mathbf{J}_\phi(p_{k,l}(y)))$$

$$\nabla_\phi a_1(d_{k,l}) = \frac{1}{\sqrt{2\pi}\sigma}\exp\left\{-\frac{d_{k,l}^2}{2\sigma^2}\right\}(n_x * U_k W_x + n_y * U_k W_y)$$

$$p_{k,l}(x) = U_k * W_x \phi + U_k * Q_0(y) + \Delta_l * n_x, p_{k,l}(y) = U_k * W_y \phi + U_k * Q_0(y) + \Delta_l * n_y$$

$$p_{k,l}(x) = \phi_0 \sum_i^n U_{k,i} + (1 + \phi_2) \sum_i^n U_{k,i} * x_{k,i} + \phi_5 \sum_i^n U_{k,i} y_{k,i} + \Delta_l * n_x$$

$$p_{k,l}(y) = \phi_1 \sum_i^n U_{k,i} + (1 + \phi_3) \sum_i^n U_{k,i} * y_{k,i} + \phi_4 \sum_i^n U_{k,i} y_{k,i} + \Delta_l * n_y$$

5 How do you calculate the $\hat{\Sigma}_{kl}$?

$$\hat{\Sigma}_{kl} = \frac{1}{2}\left[(1+\operatorname{sign}(d_l))\bar{\Sigma}_k^{(1)} + (1-\operatorname{sign}(d_l))\bar{\Sigma}_k^{(2)}\right]$$

does it make sense?

6 What does the "blurred model" mean?

I think "blurred model" means using the fuzzy assignment

7 How do you use the distance along the curve?

8 When we minimize the cost function

If converging to some local minima, how to make it converge to the global one?