

Mean-shift tracking - Bhattacharya coefficient



model, coordinates \mathbf{x}_i^* centered at $\mathbf{0}$:

$$q_u = C \sum_{i=1}^n k(\|\mathbf{x}_i^*\|^2) \delta(b(\mathbf{x}_i^*) - u)$$

target candidate centered at \mathbf{y} :

$$p_u(\mathbf{y}) = C_h \sum_{i=1}^{n_h} k\left(\left\|\frac{\mathbf{y} - \mathbf{x}_i}{h}\right\|^2\right) \delta(b(\mathbf{x}_i) - u)$$

target candidate centered at \mathbf{y} :

$$p_u(\mathbf{y}) = C_h \sum_{i=1}^{n_h} k\left(\left\|\frac{\mathbf{y} - \mathbf{x}_i}{h}\right\|^2\right) \delta(b(\mathbf{x}_i) - u) \quad (1)$$

Bhattacharya coefficient:

$$s(\mathbf{y}) = \sum_{u=1}^m \sqrt{p_u(\mathbf{y})q_u}$$

linearize around to \mathbf{y}_0

$$s(\mathbf{y}) \approx \sum_{u=1}^m \sqrt{p_u(\mathbf{y}_0)q_u} + \frac{1}{2} \sum_{u=1}^m \sqrt{\frac{q_u}{p_u(\mathbf{y}_0)}} (p_u(\mathbf{y}) - p_u(\mathbf{y}_0))$$

can be simplified to:

$$s(\mathbf{y}) \approx \frac{1}{2} \sum_{u=1}^m \sqrt{p_u(\mathbf{y}_0)q_u} + \frac{1}{2} \sum_{u=1}^m \sqrt{\frac{q_u}{p_u(\mathbf{y}_0)}} (p_u(\mathbf{y}))$$

in which we insert (1)

$$s(\mathbf{y}) \approx \frac{C_h}{2} \sum_{u=1}^m \sqrt{p_u(\mathbf{y}_0)q_u} + \frac{1}{2} \sum_{u=1}^m \sqrt{\frac{q_u}{p_u(\mathbf{y}_0)}} \sum_{i=1}^{n_h} k\left(\left\|\frac{\mathbf{y} - \mathbf{x}_i}{h}\right\|^2\right) \delta(b(\mathbf{x}_i) - u)$$

as we are looking for a local extrema of the Bhattacharya coefficient we derive the above according to \mathbf{y} which finally leads to the usual equation for the shift in position \mathbf{y} where the pixel weights are computed by

$$w_i = \sum_{u=1}^m \delta(b(\mathbf{x}_i) - u) \sqrt{\frac{q_u}{p_u(\mathbf{y}_0)}}$$

see [1] for the complete derivation. Note that evaluating histograms can be done very efficiently by using a look-up table [5, chapter 16.5]

References



Mean-shift originally from [3].

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References

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