东南大学
网络空间安全学院

模糊方法实验

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Course: 图象分析与理解 – Professor: 季续
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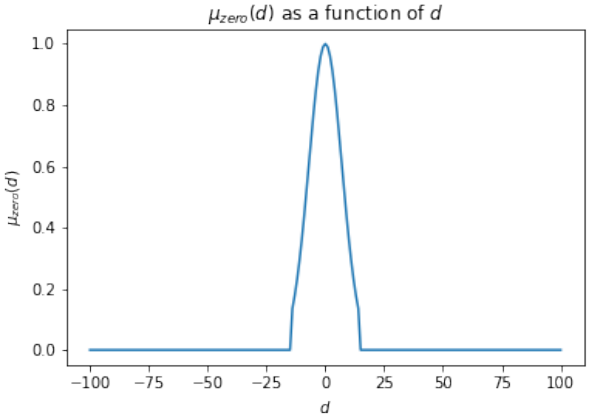
1. 模糊边界提取

Solution.

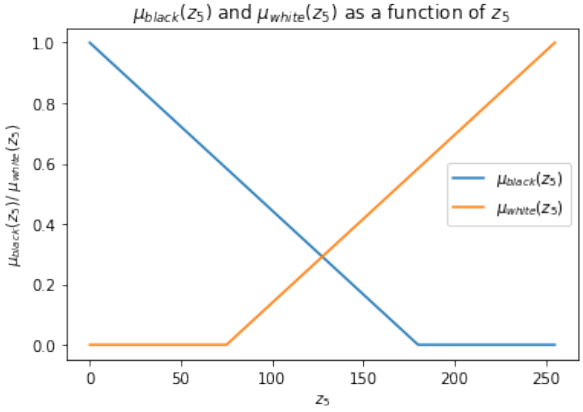
1. Definitions of membership functions

   (a) The change of $\mu_{zero}(d)$ with respect to d is shown in Figure 1a.

   (b) The change of $\mu_{black}(z_5)$ and $\mu_{white}(z_5)$ as a function of z_5 is shown in Figure 1b.



(a) Membership function of the fuzzy set *zero*



(b) Membership functions of the fuzzy sets *black* and *white*

Figure 1: Membership functions

2. Rule-based Inference

   (a) Results of fuzzy spatial filtering are shown in Figure 2.

   (b) When σ of the input membership function is changed to 10, the corresponding boundaries are less obvious. The bandwidth of the truncated Gaussian is wider, which recognizes neighbours with larger intensity differences as a uniform area.

(a) Boundary extraction ($\sigma = 7$)

(b) Boundary extraction ($\sigma = 10$)

Figure 2: Results of fuzzy spatial filtering

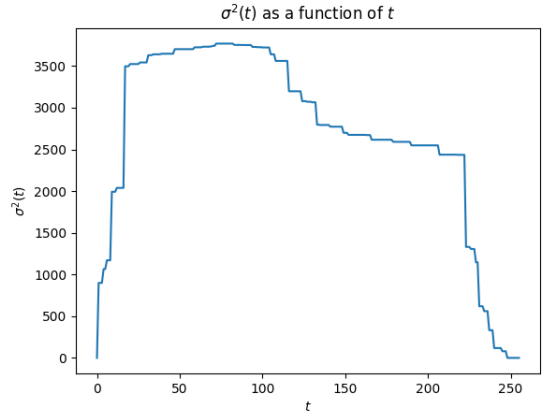
2. 阈值分割

Solution.

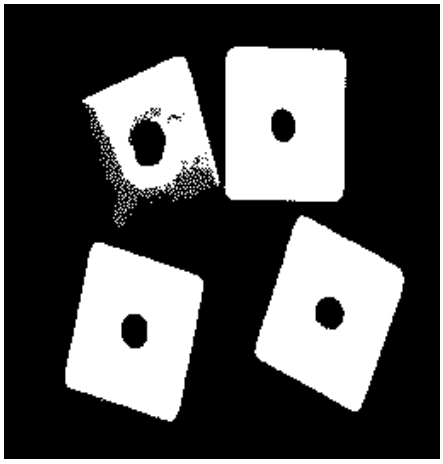
1. Otsu's Binarization

   (a) The change of $\sigma^2(t)$ with respect to t is shown in Figure 3a.

   (b) As is shown in Figure 3b, the result after Otsu thresholding is barely satisfactory where the top-left square is not well determined.



(a) between-class variance $\sigma^2(t)$ with respect to t



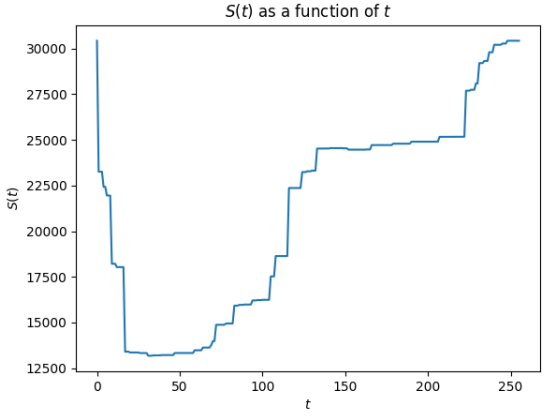
(b) thresholded by Otsu algorithm

Figure 3: Illustration of Otsu's Binarization

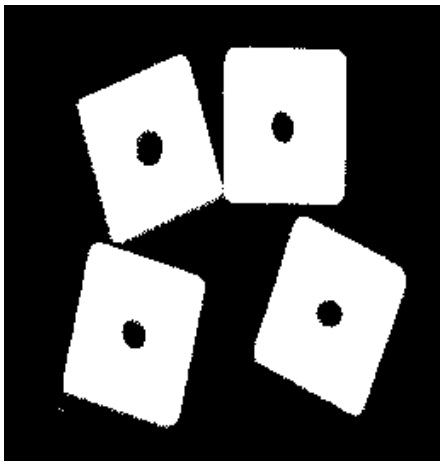
2. Fuzzy thresholding method

   (a) The change of sum of all pixels' entropy $S(t)$ with respect to threshold t is shown in Figure 4a.

   (b) As is shown in Figure 4b, the result after fuzzy thresholding is satisfactory where all the four squares are well segmented from the background.



(a) Entropy $S(t)$ with respect to t



(b) thresholded by fuzzy method

Figure 4: Illustration of fuzzy thresholding