

Homework 1: Fast Local Filtering

Due date: Apr 2, 2017 (Delay due: 2pm Apr 5, 2017)

Submission files:

- 1) Source code: the code should work well with no modification. Provide 'readme.txt' and an interface for easily setting input images and parameters used in the code.
- 2) Technical report including all results and analysis

Programming tools: C (C++) or MATLAB depending on your preference

1. Histogram matching

When two greyscale images are given, perform the histogram matching of one image by using another as a reference.

2. 2D Integral image

Perform $O(1)$ time box filtering with 2D integral image. The total runtime should be unchanged when the window size varies. There are two possible implementations as follows. Show two methods produce the same results, but one of the two run a bit faster.

Input: $I(x, y)$

Output: $I_o(x, y) = \frac{1}{N} \sum_{s=-a}^a \sum_{t=-b}^b I(x + s, y + t) \quad N = (2a + 1)(2b + 1)$

* Method 1

- 1) Compute $S(x, y) = \sum_{k=0}^x \sum_{l=0}^y I(k, l)$ in a separable manner.
- 2) Compute $I_o(x, y) = S(x + a, y + b) - S(x - a - 1, y + b) - S(x + a, y - b - 1) + S(x - a - 1, y - b - 1)$
- 3) $I_o(x, y) \leftarrow I_o(x, y) / N$

* Method 2

- 1) Compute $S_1(x, y) = \sum_{l=0}^y I(x, l)$.
- 2) Compute $I_1(x, y) = S_1(x, y + b) - S_1(x, y - b - 1)$.
- 3) Compute $S_2(x, y) = \sum_{k=0}^x I_1(k, y)$.
- 4) Compute $I_o(x, y) = S_2(x, y + b) - S_2(x, y - b - 1)$.
- 5) $I_o(x, y) \leftarrow I_o(x, y) / N$

3. 2D Gaussian filtering.

3-1. Perform $O(1)$ time 2D Gaussian filtering using the recursive implementation explained in p90-p91 of the lecture note 'AIP-02-Intensity-v2.pdf'

3-2. Perform 2D Gaussian filtering by repeatedly applying 2D integral image. Show that two results from 3-1 and 3-2 are approximately similar. Here, explain how many iterations of 2D integral image are typically needed.

4. 2D Median filter

Perform $O(1)$ time 2D median filtering using integral histogram. Refer to the paper in p92 of the lecture note 'AIP-02-Intensity.pdf'

*** Note**

In technical report, you should include the following three things.

- 1) Description of your algorithm
- 2) The reason of the parameter setting you chose in your source code.
- 3) Show the results of your algorithm using various images which you want to use.