Final Project: Haze Removal

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Well, your DIP course is drawing to a close. Congratulations to all of you for surviving from all the tasks. We hope you enjoy this journal and have learned something useful. At last, we are going to develop a traditional but interesting application – Image Smoothing/Enhancement. This project will take up a bigger portion of your final score, compared with your mid-term exam. Hence please take it seriously. (˙ - ˙)

1 Introduction

As we learned in Chapter 3, one of the side-effects of the conventional smoothing filters, e.g. averaging filters, Gaussian filter, is the loss of details. However, in some cases, we want to smooth the annoying noises (e.g. freckles) but preserve some important edges (e.g. hair, edge of face), which is a very crutial property in the selfie applications.

Figure 1: *A baby with freckles.*

Here comes a problem. Suppose that you are a fan of selfie but not a master of PS, how can you take a perfect photo smoothing all the flaws in your face and also preseving the edges? Well, one pleasant thing is, you have taken part in the DIP course, so you can develop an image processing tool to achieve that goal!

In ECCV 2010 (one of the top conferences in Computer Vision), Kaiming He (currently a researcher in Facebook) designed a simple but powerful approach to perform as an edge-preserving smoothing operator, called Guided Image Filer. This operator is proposed as a smoothing operator, but moreover, it is effective and efficient in a great variety of computer vision and graphics applications, including details enhancement, HDR compression, image matting/feathering, etc. This approach has been included in Matlab 2014 and OpenCV 3.0 as a basic function. Considering its easy implementation, you are going to reproduce it in the final project.

2 Requirement

Please download the supplement material "guided_image_filtering_eccv2010.pdf". This is our reference paper.

2.1 Basic Task

1. Implement the approach described in the paper, **without** considering Matting (Section 3.5). For your quick reference: the approach is mainly discussed in Section 3, and Equations in 3.1 of the paper summarize the whole framework.

2. Evaluate your implementation by conducting experiments. You are requested to complete both the edge-preserving filtering and the detail enhancement tasks. Figure 1 and Figure 6 in the paper have provided good templates. At least, you should take all test cases of smoothing and enhancement included in "dataset.zip" as inputs, write down the values of all the parameters in your implementation, and report your processing results plus some analyses.

3. Explore the disadvantages of the paper by experiments, and try to handle those issues. Note: Improving the paper is quite a challenging task. If you can't find anyway to overcome those disadvantages, that is fine, but you should write down your idea for potential solutions.

2.2 Advanced Task (Optional)

1. Although the time complexity of the "Guided Image Filter" is O(N), it can be further accelerated. We welcome you to check another paper "Faster Guided Filter" (again, written by Kaiming He) and implement the faster solution.

2. Compare the running time of the faster guided filter to the original one on both smoothing and enhancement tasks respectively, also paste your processing results in your report.

2.3 Language

You can select the language as you like, but any behaviors of plagiarizing materials from the Internet, existing functions in Matlab and OpenCV are forbidden.

2.4 Submission

1. Well-documented codes.

2. A project report, at least including 1) introduction of the approach described in the paper, 2) your implementation details, 3) your experimental settings, results and related analyses, 4) discussions of the disadvantages of the paper, and your improvements / potential solutions.