Assignment 6: Image Quality Assessment

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1 Introduction

Image Quality Assessment (IQA) is one of the basic techniques in image processing. It mainly analyzes the characteristics of the image and then evaluates the image quality (image distortion level). Image quality evaluation plays an important role in the analysis and comparison of algorithms and system performance evaluation in image processing systems. In recent years, with the extensive research in the field of digital imaging, the research of image quality assessment has attracted more and more attention from researchers. Many indicators and methods for image quality evaluation have been proposed and improved.

In this assignment, you will implement four tasks for Image Quality Assessment and compare the performance of different Image Quality Assessment methods by using four evaluation measures. The more tasks you accomplish, the higher score you will get.

2 Image Quality Assessment Dataset

2.1 Tampere Image Database 2013 (TID2013) [3]

The TID2013 contains 25 reference images and 3000 distorted images (25 reference images and 24 types of distortions and 5 levels of distortions). Reference images are obtained by cropping from Kodak Lossless True Color Image Suite. All images are saved in database in Bitmap format without any compression. File names are organized in such a manner that they indicate a number of the reference image, then a number of distortion's type, and, finally, a number of distortion's level: "iXX_YY_Z.bmp".

The file "mos.txt" contains the Mean Opinion Score (MOS) for each distorted image. The MOS was obtained from the results of 971 experiments carried out by observers from five countries: Finland, France, Italy, Ukraine and USA (116 experiments have been carried out in Finland, 72 in France, 80 in Italy, 602 in Ukraine, and 101 in USA). Totally, the 971 observers have performed 524340 comparisons of visual quality of distorted images or 1048680 evaluations of relative visual quality in image pairs. Higer value of MOS (0 - minimal, 9 - maximal, MSE of each score is 0.018) corresponds to higer visual quality of the image.

3 Tasks

3.1 Task 1: Traditional FR-IQA Algorithm

In this task, you will implement Image Quality Assessment using a traditional full-reference image qualtiy assessment (FR-IQA) algorithm. The traditional FR-IQA algorithm is Structural

Similarity Index (SSIM) [4]. You will use SSIM [4] to implement image quality assessment on the entire TID2013 [3] dataset.

- Read the paper [4] to understand the process of SSIM assessment.
- We will learn how to get a image quality score by a method called SSIM [4].

You can choose any programming language to implement this task, including Python, MATLAB, C or C++, etc.

The dataset used in this task is the entire TID2013 dataset, and use Spearman rank order correlation coefficient (SROCC), Kendall rank order correlation coefficient (KROCC), Pearson product-moment correclation coefficient (PLCC) and Root mean squared error (RMSE) for IQA algorithm evaluation. Put your code, datasets, experiment results, and evaluation results into a folder named Task1_YourName.

3.2 Task 2: Traditional NR-IQA Algorithm

In this task, you will implement Image Quality Assessment using a traditional no-reference image qualtiy assessment (NR-IQA) algorithm. The traditional NR-IQA algorithm is the Natural Image Quality Evaluator (NIQE) [2]. You will use NIQE [2] to implement image quality assessment on the entire TID2013 [3] dataset.

- Read the paper [2] to understand the process of NIQE assessment.
- We will learn how to get a image quality score by a method called NIQE [2].

You can choose any programming language to implement this task, including Python, MATLAB, C or C++, etc.

The dataset used in this task is the entire TID2013 dataset, and use SROCC, KROCC, PLCC and RMSE for IQA algorithm evaluation. Put your code, datasets, experiment results, and evaluation results into a folder named Task2_YourName.

3.3 Task 3: Convolutional Neural Networks-Based FR-IQA

In this task, you will implement Image Quality Assessment using a convolutional neural networks based FR-IQA model, named Weighted Average Deep Image Quality Measure for FR-IQA (WaDIQaM-FR) [1]. You need to personally train your own FR-IQA model.

Task 3 is divided into three steps:

1. Read the paper [1] to understand the process of WaDIQaM-FR assessment.
2. Divide TID2013 [3] dataset (3000 images) into three parts: 1800 images as the training set, 600 images as the cross-validation set and 600 images as the test set.
3. You have to set two hyperparameters: n_patches = 2, n_epochs = 100.
4. Put your code (including the code which divide the datasets), datasets, experiment results, and evaluation results into a folder named Task3_ YourName.

3.4 Task 4: Convolutional Neural Networks-Based NR-IQA

In this task, you will implement Image Quality Assessment using a convolutional neural networks based NR-IQA model, named Weighted Average Deep Image Quality Measure for NR-IQA (WaDIQaM-NR) [1]. You need to personally train your own NR-IQA model.

Task 3 is divided into four steps:

1. Read the paper [1] to understand the process of WaDIQaM-NR assessment.
2. Divide TID2013 [3] dataset (3000 images) into three parts: 1800 images as the training set, 600 images as the cross-validation set and 600 images as the test set.
3. You have to set two hyperparameters: n_patches = 2, n_epochs = 100.
4. Put your code (including the code which divide the datasets), datasets, experiment results, and evaluation results into a folder named Task4_ YourName.

Congratulations on completing all your Image Quality Assessment tasks!

4 Evaluation

In this part, you will compare the merits and demerits of Image Quality Assessment methods using four evaluation measures.

- RMSE
- PLCC
- SROCC
- KROCC

Compare all Image Quality Assessment results on each evaluation measure. You can choose Python or MATLAB to implement these four evalution measures. Put your code into a folder named Evaluation_YourName.

5 Submission and Grading

After various parts of the assignment are completed, the following files including:

1. Your codes.
2. Your results.
3. A PDF report containing your results and the analysis of your experiments.

Zip all your files and submit your assignment to ouceccv@163.com with the subject: YourName_ Assignment6.zip. The name if your zip file should be the same as the email subject.

Be sure to finish and submit Assignment6 before the due date July 07, 2018. Then I will grade your assignment based on your files. Table 1 is a breakdown of how each part of this assignment is scored:

Assignment 6	
Part	Points
Task 1	10 points
Task 2	10 points
Task 3	30 points
Task 4	30 points
RMSE	5 points
PLCC	5 points
SROCC	5 points
KROCC	5 points
Total points	100 points

Table 1: The score of this assignment.

If you have any questions, you can contact guozemin@stu.ouc.edu.cn.

References

[1] S. Bosse, D. Maniry, K.-R. Müller, T. Wiegand, and W. Samek. Deep neural networks for no-reference and full-reference image quality assessment. *IEEE TIP*, 27(1):206–219, 2018.

[2] A. Mittal, R. Soundararajan, and A. C. Bovik. Making a completely blind image quality analyzer. *IEEE SPL*, 20(3):209–212, 2013.

[3] N. Ponomarenko, O. Ieremeiev, V. Lukin, K. Egiazarian, L. Jin, J. Astola, B. Vozel, K. Chehdi, M. Carli, F. Battisti, et al. Color image database TID2013: Peculiarities and preliminary results. In *4th European Workshop on Visual Information Processing (EUVIP)*, pages 106–111, 2013.

[4] Z. Wang, A. C. Bovik, H. R. Sheikh, and E. P. Simoncelli. Image quality assessment: from error visibility to structural similarity. *IEEE TIP*, 13(4):600–612, 2004.