Practical One – Report

Jordan McDonald (40063974)

**Analysis/Conclusions of Experiments**

\*see the tables of results below

\*I used the PSNR file you provided

1. **Experiment Two:**

In this experiment the original and watermarked images served as input, the goal was to determine the fidelity of the watermarked images in comparison to the original. Ideally this value should be quite low to indicate a perceptual similarity between the images, and often a manual inspection the images are very similar and the PSNR for all values is very close to 0 (which would indicate the values are indicate). In summary experiment one shows excellent fidelity and this is reflected in the difference images, as a side note the image polarbear512, is larger than the two others, so the difference images has ‘tighter’ pixels. It should also be considered that fidelity competes with robustness, so potentially these images may not be as robust as possible.

1. **Experiment Three**

If we consider the results from this experiment we can see that the bit error rate for all three images is zero. This indicates that the watermark extractor has successfully obtained the watermark from the watermarked image and that the original watermark matches it perfectly. This highlights a good baseline for robustness (due to a precise extraction) and that the embedder effectiveness is accurate (due to a successful embed). These results can be verified in a manual inspection of the two watermarked images, to my vision, the images are identical reinforcing the BER value attained.

1. **Experiment Four**

Experiment four focuses on getting the BER and PSNR after the image has been attacked by a Gaussian filter, which could simulate a communication channel, noise or an enemy attacking the image. If we consider the fidelity of the watermarked and original images, it is obvious that the baboon and rice images post attack have sustained significant blurring while the other image is not immediately noticeable. If the standard deviation of the filter was increased, there would be much more of a blur effect. Next we will consider the PSNR measurement, from this a pattern has emerged (still focusing on fidelity and Gaussian attack)

1. The PSNR value is much greater after the attack, this is due to the filter significantly altering the pixel values of the watermarked image.
2. The PSNR increases the more textured the image is, this is evident when comparing the polar bear (smooth) and the baboon (very textured). This could be a product of the baboon having the greatest variation in gray level pixel values, while in comparison the polar bear would deviate towards the 255 gray level. This contributes to making the blurring less noticeable in the polar bear and more noticeable in the baboon, while the rice is centralized in this spread.

The table also conveys that the BER has increased for all images after the Gaussian attack, which indicates that the watermark has been impacted by the Gaussian filter. This will have an impact on robustness and the detectors ability to find the watermark in an image. In summary this experiment highlights the relationship between fidelity, robustness and an attack. Greater robustness equates to less fidelity and vice versa and the ability of the watermark to withstand an attack also impacts a detectors effectiveness.

**Experiment 2 Results**

|  |  |  |
| --- | --- | --- |
| Watermarked image | Difference image | Results |
|  |  | PSNR = 2.95884462917936 |
|  |  | PSNR = 0.501052856445313 |
|  |  | PSNR =  0.500762939453125 |

**Experiment 3 Results**

|  |  |  |
| --- | --- | --- |
| Original Watermark | Extracted Watermark | BER |
| RICE |  | BER = 0 |
| POLAR BEAR |  | BER = 0 |
| BABOON |  | BER = 0 |

**Experiment 4 results**

|  |  |  |
| --- | --- | --- |
| Watermark image | Attacked Image | PSNR + BER |
|  |  | PSNR = 85.962753295898440  BER = 0.001983642578125 |
|  |  | PSNR = -37.208267211914060  BER = 9.765625000000000e-04 |
|  |  | PSNR = 201.680175781250  BER = 0.002166748046875 |