**image:** images/area.tiff

**Without attack output:**

Host vs Watermarked: *PSNR* – 40.306, *SSIM* – 0.999  
 Host vs Reconstructed Host: *PSNR* – 48.131, *SSIM* – 1.000

NC: 0.994

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.996 | 0.999 | 0.965 |
| **1** | 42.905 | 0.996 | 0.965 |
| **3** | 37.592 | 0.967 | 0.965 |
| **5** | 33.768 | 0.919 | 0.965 |
| **7** | 31.033 | 0.861 | 0.965 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 36.369 | 0.957 | 0.968 |
| **20** | 38.749 | 0.977 | 0.967 |
| **30** | 39.963 | 0.984 | 0.966 |
| **40** | 40.717 | 0.988 | 0.966 |
| **50** | 41.253 | 0.990 | 0.966 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 35.246 | 0.980 | 0.995 |
| **0.002** | 32.600 | 0.962 | 0.995 |
| **0.003** | 30.761 | 0.944 | 0.995 |
| **0.004** | 29.276 | 0.924 | 0.995 |
| **0.005** | 28.293 | 0.906 | 0.994 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.881 | 0.944 | 0.965 |
| **0.002** | 32.118 | 0.904 | 0.964 |
| **0.003** | 30.447 | 0.870 | 0.964 |
| **0.004** | 29.247 | 0.841 | 0.963 |
| **0.005** | 28.316 | 0.816 | 0.963 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 42.467 | 0.999 | 0.993 |
| **0.007** | 40.272 | 0.999 | 0.993 |
| **0.01** | 37.628 | 0.997 | 0.992 |
| **0.02** | 32.695 | 0.990 | 0.977 |
| **0.03** | 29.518 | 0.976 | 0.956 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 46.670 | 1.000 | 0.994 |
| **-0.05** | 37.873 | 0.988 | 0.994 |
| **-0.1** | 32.481 | 0.958 | 0.993 |
| **-0.3** | 24.264 | 0.764 | 0.975 |
| **-0.5** | 21.413 | 0.614 | 0.938 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 46.654 | 1.000 | 0.994 |
| **0.05** | 37.883 | 0.988 | 0.995 |
| **0.1** | 32.482 | 0.958 | 0.993 |
| **0.3** | 24.258 | 0.764 | 0.975 |
| **0.5** | 21.382 | 0.614 | 0.939 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 30.002 | 0.895 | 0.998 |
| **0.6** | 31.222 | 0.919 | 0.997 |
| **0.7** | 32.825 | 0.942 | 0.997 |
| **0.8** | 34.286 | 0.958 | 0.997 |
| **0.9** | 35.547 | 0.969 | 0.997 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 31.392 | 0.899 | 0.993 |
| **50** | 32.120 | 0.913 | 0.992 |
| **60** | 32.851 | 0.924 | 0.993 |
| **70** | 33.831 | 0.937 | 0.993 |
| **80** | 35.265 | 0.952 | 0.993 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.116 | 1.000 | 0.994 |
| **0.5** | 37.504 | 0.983 | 0.997 |
| **0.7** | 32.416 | 0.941 | 0.994 |
| **1** | 30.581 | 0.908 | 0.988 |
| **1.5** | 29.753 | 0.889 | 0.983 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.116 | 1.000 | 0.994 |
| **0.5** | 37.504 | 0.983 | 0.997 |
| **0.7** | 32.051 | 0.937 | 0.992 |
| **0.8** | 30.602 | 0.912 | 0.983 |
| **1** | 28.847 | 0.870 | 0.959 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 30.649 | 0.895 | 0.980 |
| **5** | 26.366 | 0.757 | 0.905 |
| **7** | 24.422 | 0.657 | 0.766 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 29.236 | 0.874 | 0.979 |
| **5** | 25.244 | 0.718 | 0.765 |
| **7** | 23.389 | 0.601 | 0.360 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 31.264 | 0.899 | 0.964 |
| **0.5** | **50** | 31.982 | 0.913 | 0.965 |
| **0.5** | **60** | 32.686 | 0.924 | 0.965 |
| **0.5** | **70** | 33.616 | 0.937 | 0.965 |
| **0.5** | **80** | 34.965 | 0.951 | 0.965 |
| **1** | **40** | 31.244 | 0.898 | 0.965 |
| **1** | **50** | 31.953 | 0.912 | 0.965 |
| **1** | **60** | 32.651 | 0.923 | 0.965 |
| **1** | **70** | 33.567 | 0.936 | 0.964 |
| **1** | **80** | 34.879 | 0.950 | 0.965 |
| **3** | **40** | 31.013 | 0.892 | 0.964 |
| **3** | **50** | 31.653 | 0.904 | 0.965 |
| **3** | **60** | 32.260 | 0.914 | 0.965 |
| **3** | **70** | 33.023 | 0.925 | 0.965 |
| **3** | **80** | 33.991 | 0.936 | 0.964 |
| **5** | **40** | 30.529 | 0.877 | 0.964 |
| **5** | **50** | 31.055 | 0.887 | 0.963 |
| **5** | **60** | 31.495 | 0.894 | 0.965 |
| **5** | **70** | 31.970 | 0.900 | 0.964 |
| **5** | **80** | 32.344 | 0.903 | 0.964 |
| **7** | **40** | 29.842 | 0.852 | 0.961 |
| **7** | **50** | 30.199 | 0.860 | 0.963 |
| **7** | **60** | 30.410 | 0.862 | 0.963 |
| **7** | **70** | 30.498 | 0.860 | 0.965 |
| **7** | **80** | 30.281 | 0.848 | 0.964 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 35.419 | 0.980 | 0.995 |
| **0.001** | **-0.05** | 34.535 | 0.971 | 0.995 |
| **0.001** | **-0.1** | 31.553 | 0.944 | 0.994 |
| **0.001** | **-0.3** | 24.115 | 0.753 | 0.976 |
| **0.001** | **-0.5** | 21.339 | 0.605 | 0.940 |
| **0.002** | **-0.01** | 32.820 | 0.963 | 0.995 |
| **0.002** | **-0.05** | 32.850 | 0.957 | 0.995 |
| **0.002** | **-0.1** | 30.869 | 0.931 | 0.994 |
| **0.002** | **-0.3** | 23.981 | 0.743 | 0.976 |
| **0.002** | **-0.5** | 21.271 | 0.597 | 0.939 |
| **0.003** | **-0.01** | 30.994 | 0.945 | 0.996 |
| **0.003** | **-0.05** | 31.440 | 0.941 | 0.996 |
| **0.003** | **-0.1** | 30.170 | 0.918 | 0.995 |
| **0.003** | **-0.3** | 23.841 | 0.733 | 0.977 |
| **0.003** | **-0.5** | 21.195 | 0.588 | 0.943 |
| **0.004** | **-0.01** | 29.506 | 0.925 | 0.995 |
| **0.004** | **-0.05** | 30.212 | 0.923 | 0.995 |
| **0.004** | **-0.1** | 29.468 | 0.903 | 0.994 |
| **0.004** | **-0.3** | 23.687 | 0.721 | 0.975 |
| **0.004** | **-0.5** | 21.113 | 0.579 | 0.941 |
| **0.005** | **-0.01** | 28.534 | 0.908 | 0.995 |
| **0.005** | **-0.05** | 29.376 | 0.908 | 0.996 |
| **0.005** | **-0.1** | 28.941 | 0.891 | 0.995 |
| **0.005** | **-0.3** | 23.552 | 0.712 | 0.976 |
| **0.005** | **-0.5** | 21.041 | 0.571 | 0.941 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 35.426 | 0.980 | 0.995 |
| **0.001** | **0.05** | 34.538 | 0.971 | 0.996 |
| **0.001** | **0.1** | 31.549 | 0.944 | 0.994 |
| **0.001** | **0.3** | 24.105 | 0.753 | 0.975 |
| **0.001** | **0.5** | 21.306 | 0.605 | 0.940 |
| **0.002** | **0.01** | 32.821 | 0.963 | 0.995 |
| **0.002** | **0.05** | 32.854 | 0.957 | 0.995 |
| **0.002** | **0.1** | 30.869 | 0.931 | 0.994 |
| **0.002** | **0.3** | 23.975 | 0.743 | 0.977 |
| **0.002** | **0.5** | 21.241 | 0.597 | 0.943 |
| **0.003** | **0.01** | 30.992 | 0.945 | 0.995 |
| **0.003** | **0.05** | 31.441 | 0.941 | 0.996 |
| **0.003** | **0.1** | 30.171 | 0.918 | 0.994 |
| **0.003** | **0.3** | 23.839 | 0.733 | 0.979 |
| **0.003** | **0.5** | 21.168 | 0.588 | 0.946 |
| **0.004** | **0.01** | 29.507 | 0.925 | 0.995 |
| **0.004** | **0.05** | 30.200 | 0.923 | 0.995 |
| **0.004** | **0.1** | 29.450 | 0.903 | 0.993 |
| **0.004** | **0.3** | 23.678 | 0.720 | 0.979 |
| **0.004** | **0.5** | 21.084 | 0.578 | 0.948 |
| **0.005** | **0.01** | 28.533 | 0.908 | 0.995 |
| **0.005** | **0.05** | 29.364 | 0.908 | 0.995 |
| **0.005** | **0.1** | 28.926 | 0.890 | 0.994 |
| **0.005** | **0.3** | 23.541 | 0.711 | 0.981 |
| **0.005** | **0.5** | 21.011 | 0.570 | 0.948 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.321 | 0.980 | 0.995 |
| **0.001** | **0.5** | 35.237 | 0.969 | 0.998 |
| **0.001** | **0.7** | 32.027 | 0.932 | 0.994 |
| **0.001** | **1** | 30.394 | 0.902 | 0.988 |
| **0.001** | **1.5** | 29.612 | 0.883 | 0.983 |
| **0.002** | **0.3** | 32.676 | 0.963 | 0.995 |
| **0.002** | **0.5** | 33.925 | 0.957 | 0.998 |
| **0.002** | **0.7** | 31.721 | 0.925 | 0.994 |
| **0.002** | **1** | 30.241 | 0.896 | 0.987 |
| **0.002** | **1.5** | 29.493 | 0.878 | 0.982 |
| **0.003** | **0.3** | 30.836 | 0.945 | 0.995 |
| **0.003** | **0.5** | 32.766 | 0.945 | 0.998 |
| **0.003** | **0.7** | 31.385 | 0.917 | 0.994 |
| **0.003** | **1** | 30.068 | 0.890 | 0.986 |
| **0.003** | **1.5** | 29.361 | 0.872 | 0.981 |
| **0.004** | **0.3** | 29.345 | 0.924 | 0.995 |
| **0.004** | **0.5** | 31.683 | 0.929 | 0.997 |
| **0.004** | **0.7** | 30.996 | 0.908 | 0.992 |
| **0.004** | **1** | 29.854 | 0.882 | 0.984 |
| **0.004** | **1.5** | 29.195 | 0.865 | 0.978 |
| **0.005** | **0.3** | 28.362 | 0.907 | 0.994 |
| **0.005** | **0.5** | 30.917 | 0.917 | 0.996 |
| **0.005** | **0.7** | 30.679 | 0.900 | 0.990 |
| **0.005** | **1** | 29.671 | 0.877 | 0.981 |
| **0.005** | **1.5** | 29.051 | 0.860 | 0.974 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.321 | 0.980 | 0.995 |
| **0.001** | **0.5** | 35.237 | 0.969 | 0.998 |
| **0.001** | **0.7** | 31.709 | 0.928 | 0.992 |
| **0.001** | **0.8** | 30.414 | 0.905 | 0.983 |
| **0.001** | **1** | 28.759 | 0.865 | 0.958 |
| **0.002** | **0.3** | 32.676 | 0.963 | 0.995 |
| **0.002** | **0.5** | 33.925 | 0.957 | 0.998 |
| **0.002** | **0.7** | 31.439 | 0.922 | 0.992 |
| **0.002** | **0.8** | 30.261 | 0.900 | 0.982 |
| **0.002** | **1** | 28.685 | 0.862 | 0.957 |
| **0.003** | **0.3** | 30.836 | 0.945 | 0.995 |
| **0.003** | **0.5** | 32.766 | 0.945 | 0.998 |
| **0.003** | **0.7** | 31.140 | 0.914 | 0.991 |
| **0.003** | **0.8** | 30.086 | 0.894 | 0.982 |
| **0.003** | **1** | 28.600 | 0.857 | 0.955 |
| **0.004** | **0.3** | 29.345 | 0.924 | 0.995 |
| **0.004** | **0.5** | 31.683 | 0.929 | 0.997 |
| **0.004** | **0.7** | 30.790 | 0.904 | 0.989 |
| **0.004** | **0.8** | 29.871 | 0.886 | 0.978 |
| **0.004** | **1** | 28.491 | 0.852 | 0.949 |
| **0.005** | **0.3** | 28.362 | 0.907 | 0.994 |
| **0.005** | **0.5** | 30.917 | 0.917 | 0.996 |
| **0.005** | **0.7** | 30.501 | 0.897 | 0.987 |
| **0.005** | **0.8** | 29.688 | 0.880 | 0.975 |
| **0.005** | **1** | 28.395 | 0.848 | 0.944 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 31.190 | 0.899 | 0.993 |
| **0.005** | **50** | 31.868 | 0.912 | 0.992 |
| **0.005** | **60** | 32.549 | 0.924 | 0.992 |
| **0.005** | **70** | 33.442 | 0.937 | 0.993 |
| **0.005** | **80** | 34.727 | 0.951 | 0.992 |
| **0.007** | **40** | 30.984 | 0.898 | 0.993 |
| **0.007** | **50** | 31.628 | 0.912 | 0.992 |
| **0.007** | **60** | 32.278 | 0.923 | 0.992 |
| **0.007** | **70** | 33.114 | 0.936 | 0.993 |
| **0.007** | **80** | 34.277 | 0.951 | 0.993 |
| **0.01** | **40** | 30.604 | 0.897 | 0.991 |
| **0.01** | **50** | 31.188 | 0.911 | 0.990 |
| **0.01** | **60** | 31.755 | 0.922 | 0.991 |
| **0.01** | **70** | 32.491 | 0.935 | 0.992 |
| **0.01** | **80** | 33.463 | 0.950 | 0.991 |
| **0.02** | **40** | 29.153 | 0.892 | 0.976 |
| **0.02** | **50** | 29.544 | 0.905 | 0.975 |
| **0.02** | **60** | 29.918 | 0.916 | 0.975 |
| **0.02** | **70** | 30.371 | 0.929 | 0.977 |
| **0.02** | **80** | 30.921 | 0.943 | 0.976 |
| **0.03** | **40** | 27.494 | 0.879 | 0.956 |
| **0.03** | **50** | 27.758 | 0.893 | 0.955 |
| **0.03** | **60** | 27.987 | 0.904 | 0.955 |
| **0.03** | **70** | 28.261 | 0.916 | 0.956 |
| **0.03** | **80** | 28.588 | 0.930 | 0.955 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 32.161 | 0.926 | 0.968 |
| **0.001** | **0.002** | 30.662 | 0.911 | 0.969 |
| **0.001** | **0.003** | 29.400 | 0.894 | 0.971 |
| **0.001** | **0.004** | 28.269 | 0.876 | 0.970 |
| **0.001** | **0.005** | 27.473 | 0.860 | 0.972 |
| **0.002** | **0.001** | 30.472 | 0.887 | 0.967 |
| **0.002** | **0.002** | 29.404 | 0.872 | 0.968 |
| **0.002** | **0.003** | 28.428 | 0.857 | 0.970 |
| **0.002** | **0.004** | 27.502 | 0.840 | 0.969 |
| **0.002** | **0.005** | 26.825 | 0.825 | 0.971 |
| **0.003** | **0.001** | 29.263 | 0.854 | 0.967 |
| **0.003** | **0.002** | 28.432 | 0.841 | 0.968 |
| **0.003** | **0.003** | 27.635 | 0.827 | 0.970 |
| **0.003** | **0.004** | 26.851 | 0.811 | 0.969 |
| **0.003** | **0.005** | 26.264 | 0.797 | 0.970 |
| **0.004** | **0.001** | 28.322 | 0.827 | 0.967 |
| **0.004** | **0.002** | 27.642 | 0.814 | 0.967 |
| **0.004** | **0.003** | 26.969 | 0.801 | 0.969 |
| **0.004** | **0.004** | 26.289 | 0.786 | 0.968 |
| **0.004** | **0.005** | 25.769 | 0.773 | 0.970 |
| **0.005** | **0.001** | 27.555 | 0.802 | 0.966 |
| **0.005** | **0.002** | 26.978 | 0.790 | 0.967 |
| **0.005** | **0.003** | 26.395 | 0.778 | 0.968 |
| **0.005** | **0.004** | 25.794 | 0.763 | 0.968 |
| **0.005** | **0.005** | 25.327 | 0.751 | 0.969 |

**image:** images/brain.jpeg

**Without attack output:**

Host vs Watermarked: *PSNR* – 40.752, *SSIM* – 0.997  
 Host vs Reconstructed Host: *PSNR* – 47.086, *SSIM* – 0.999

NC: 0.999

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.989 | 0.998 | 0.990 |
| **1** | 43.056 | 0.995 | 0.991 |
| **3** | 38.127 | 0.951 | 0.989 |
| **5** | 34.379 | 0.867 | 0.976 |
| **7** | 31.667 | 0.774 | 0.952 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 38.338 | 0.972 | 0.992 |
| **20** | 40.323 | 0.985 | 0.991 |
| **30** | 41.263 | 0.989 | 0.991 |
| **40** | 41.833 | 0.992 | 0.991 |
| **50** | 42.221 | 0.993 | 0.991 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.189 | 0.975 | 0.998 |
| **0.002** | 31.338 | 0.954 | 0.996 |
| **0.003** | 29.828 | 0.935 | 0.995 |
| **0.004** | 28.757 | 0.915 | 0.994 |
| **0.005** | 27.706 | 0.895 | 0.990 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 37.797 | 0.972 | 0.990 |
| **0.002** | 35.392 | 0.949 | 0.986 |
| **0.003** | 33.871 | 0.928 | 0.981 |
| **0.004** | 32.757 | 0.909 | 0.975 |
| **0.005** | 31.876 | 0.892 | 0.967 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 43.326 | 0.999 | 0.998 |
| **0.007** | 43.155 | 0.999 | 0.998 |
| **0.01** | 40.434 | 0.999 | 0.998 |
| **0.02** | 34.915 | 0.997 | 0.988 |
| **0.03** | 28.463 | 0.993 | 0.856 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 46.851 | 0.999 | 0.999 |
| **-0.05** | 43.839 | 0.998 | 0.998 |
| **-0.1** | 40.061 | 0.994 | 0.995 |
| **-0.3** | 31.979 | 0.957 | 0.977 |
| **-0.5** | 28.090 | 0.899 | 0.946 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 46.843 | 0.999 | 0.999 |
| **0.05** | 43.848 | 0.998 | 0.998 |
| **0.1** | 40.077 | 0.994 | 0.994 |
| **0.3** | 32.013 | 0.957 | 0.972 |
| **0.5** | 28.121 | 0.899 | 0.929 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 39.857 | 0.992 | 0.993 |
| **0.6** | 40.611 | 0.994 | 0.994 |
| **0.7** | 42.041 | 0.995 | 0.996 |
| **0.8** | 43.083 | 0.996 | 0.997 |
| **0.9** | 43.757 | 0.997 | 0.998 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 38.330 | 0.970 | 0.991 |
| **50** | 39.229 | 0.981 | 0.997 |
| **60** | 40.026 | 0.985 | 0.997 |
| **70** | 40.921 | 0.983 | 0.992 |
| **80** | 42.099 | 0.991 | 0.998 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 47.085 | 0.999 | 0.999 |
| **0.5** | 44.036 | 0.998 | 0.997 |
| **0.7** | 40.506 | 0.994 | 0.986 |
| **1** | 38.836 | 0.991 | 0.974 |
| **1.5** | 38.023 | 0.989 | 0.965 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 47.085 | 0.999 | .999 |
| **0.5** | 44.036 | 0.998 | 0.997 |
| **0.7** | 39.997 | 0.993 | 0.982 |
| **0.8** | 38.377 | 0.990 | 0.965 |
| **1** | 36.199 | 0.983 | 0.923 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 41.752 | 0.992 | 0.998 |
| **5** | 35.389 | 0.963 | 0.973 |
| **7** | 31.034 | 0.903 | 0.868 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 37.488 | 0.987 | 0.958 |
| **5** | 31.123 | 0.941 | 0.633 |
| **7** | 27.259 | 0.855 | 0.150 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 37.851 | 0.970 | 0.988 |
| **0.5** | **50** | 38.657 | 0.980 | 0.991 |
| **0.5** | **60** | 39.351 | 0.984 | 0.991 |
| **0.5** | **70** | 40.119 | 0.982 | 0.990 |
| **0.5** | **80** | 41.021 | 0.991 | 0.991 |
| **1** | **40** | 37.781 | 0.969 | 0.987 |
| **1** | **50** | 38.583 | 0.980 | 0.991 |
| **1** | **60** | 39.257 | 0.984 | 0.991 |
| **1** | **70** | 39.982 | 0.982 | 0.989 |
| **1** | **80** | 40.808 | 0.986 | 0.990 |
| **3** | **40** | 37.175 | 0.963 | 0.985 |
| **3** | **50** | 37.796 | 0.965 | 0.986 |
| **3** | **60** | 38.256 | 0.970 | 0.986 |
| **3** | **70** | 38.661 | 0.969 | 0.985 |
| **3** | **80** | 38.984 | 0.969 | 0.987 |
| **5** | **40** | 35.937 | 0.918 | 0.961 |
| **5** | **50** | 36.243 | 0.921 | 0.967 |
| **5** | **60** | 36.370 | 0.931 | 0.973 |
| **5** | **70** | 36.359 | 0.918 | 0.970 |
| **5** | **80** | 35.834 | 0.906 | 0.971 |
| **7** | **40** | 34.278 | 0.856 | 0.932 |
| **7** | **50** | 34.271 | 0.866 | 0.941 |
| **7** | **60** | 34.118 | 0.851 | 0.938 |
| **7** | **70** | 33.677 | 0.839 | 0.941 |
| **7** | **80** | 32.501 | 0.807 | 0.939 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 34.497 | 0.975 | 0.998 |
| **0.001** | **-0.05** | 35.668 | 0.975 | 0.996 |
| **0.001** | **-0.1** | 35.878 | 0.973 | 0.993 |
| **0.001** | **-0.3** | 30.940 | 0.938 | 0.976 |
| **0.001** | **-0.5** | 27.649 | 0.882 | 0.946 |
| **0.002** | **-0.01** | 31.655 | 0.955 | 0.996 |
| **0.002** | **-0.05** | 33.016 | 0.956 | 0.994 |
| **0.002** | **-0.1** | 33.774 | 0.955 | 0.991 |
| **0.002** | **-0.3** | 30.096 | 0.922 | 0.974 |
| **0.002** | **-0.5** | 27.259 | 0.867 | 0.942 |
| **0.003** | **-0.01** | 30.157 | 0.936 | 0.995 |
| **0.003** | **-0.05** | 31.590 | 0.938 | 0.993 |
| **0.003** | **-0.1** | 32.551 | 0.938 | 0.989 |
| **0.003** | **-0.3** | 29.505 | 0.908 | 0.972 |
| **0.003** | **-0.5** | 26.959 | 0.853 | 0.942 |
| **0.004** | **-0.01** | 29.079 | 0.916 | 0.993 |
| **0.004** | **-0.05** | 30.527 | 0.919 | 0.990 |
| **0.004** | **-0.1** | 31.592 | 0.921 | 0.986 |
| **0.004** | **-0.3** | 29.002 | 0.892 | 0.968 |
| **0.004** | **-0.5** | 26.670 | 0.839 | 0.937 |
| **0.005** | **-0.01** | 28.035 | 0.896 | 0.990 |
| **0.005** | **-0.05** | 29.519 | 0.900 | 0.986 |
| **0.005** | **-0.1** | 30.685 | 0.903 | 0.981 |
| **0.005** | **-0.3** | 28.453 | 0.877 | 0.962 |
| **0.005** | **-0.5** | 26.340 | 0.824 | 0.932 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 34.499 | 0.975 | 0.998 |
| **0.001** | **0.05** | 35.661 | 0.975 | 0.996 |
| **0.001** | **0.1** | 35.871 | 0.973 | 0.992 |
| **0.001** | **0.3** | 30.963 | 0.938 | 0.970 |
| **0.001** | **0.5** | 27.673 | 0.882 | 0.929 |
| **0.002** | **0.01** | 31.655 | 0.955 | 0.996 |
| **0.002** | **0.05** | 33.018 | 0.956 | 0.994 |
| **0.002** | **0.1** | 33.780 | 0.955 | 0.989 |
| **0.002** | **0.3** | 30.114 | 0.922 | 0.966 |
| **0.002** | **0.5** | 27.279 | 0.867 | 0.926 |
| **0.003** | **0.01** | 30.156 | 0.936 | 0.995 |
| **0.003** | **0.05** | 31.583 | 0.938 | 0.995 |
| **0.003** | **0.1** | 32.546 | 0.938 | 0.987 |
| **0.003** | **0.3** | 29.514 | 0.907 | 0.964 |
| **0.003** | **0.5** | 26.969 | 0.853 | 0.923 |
| **0.004** | **0.01** | 29.077 | 0.916 | 0.993 |
| **0.004** | **0.05** | 30.522 | 0.919 | 0.995 |
| **0.004** | **0.1** | 31.586 | 0.921 | 0.985 |
| **0.004** | **0.3** | 29.010 | 0.892 | 0.963 |
| **0.004** | **0.5** | 26.677 | 0.838 | 0.924 |
| **0.005** | **0.01** | 28.034 | 0.896 | 0.990 |
| **0.005** | **0.05** | 29.515 | 0.900 | 0.986 |
| **0.005** | **0.1** | 30.678 | 0.903 | 0.981 |
| **0.005** | **0.3** | 28.456 | 0.876 | 0.959 |
| **0.005** | **0.5** | 26.341 | 0.823 | 0.920 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.302 | 0.975 | 0.998 |
| **0.001** | **0.5** | 37.197 | 0.979 | 0.995 |
| **0.001** | **0.7** | 38.140 | 0.980 | 0.982 |
| **0.001** | **1** | 37.545 | 0.978 | 0.970 |
| **0.001** | **1.5** | 37.030 | 0.976 | 0.961 |
| **0.002** | **0.3** | 31.446 | 0.955 | 0.996 |
| **0.002** | **0.5** | 34.668 | 0.962 | 0.991 |
| **0.002** | **0.7** | 36.582 | 0.967 | 0.977 |
| **0.002** | **1** | 36.499 | 0.967 | 0.964 |
| **0.002** | **1.5** | 36.165 | 0.966 | 0.954 |
| **0.003** | **0.3** | 29.941 | 0.936 | 0.995 |
| **0.003** | **0.5** | 33.289 | 0.947 | 0.989 |
| **0.003** | **0.7** | 35.630 | 0.956 | 0.973 |
| **0.003** | **1** | 35.828 | 0.957 | 0.958 |
| **0.003** | **1.5** | 35.605 | 0.956 | 0.949 |
| **0.004** | **0.3** | 28.867 | 0.915 | 0.994 |
| **0.004** | **0.5** | 32.279 | 0.932 | 0.986 |
| **0.004** | **0.7** | 34.869 | 0.945 | 0.970 |
| **0.004** | **1** | 35.257 | 0.947 | 0.954 |
| **0.004** | **1.5** | 35.115 | 0.947 | 0.944 |
| **0.005** | **0.3** | 27.817 | 0.895 | 0.990 |
| **0.005** | **0.5** | 31.277 | 0.915 | 0.981 |
| **0.005** | **0.7** | 34.053 | 0.932 | 0.963 |
| **0.005** | **1** | 34.600 | 0.936 | 0.947 |
| **0.005** | **1.5** | 34.533 | 0.936 | 0.936 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.302 | 0.975 | 0.998 |
| **0.001** | **0.5** | 37.197 | 0.979 | 0.995 |
| **0.001** | **0.7** | 37.932 | 0.979 | 0.978 |
| **0.001** | **0.8** | 37.202 | 0.978 | 0.961 |
| **0.001** | **1** | 35.689 | 0.972 | 0.919 |
| **0.002** | **0.3** | 31.446 | 0.955 | 0.996 |
| **0.002** | **0.5** | 34.668 | 0.962 | 0.991 |
| **0.002** | **0.7** | 36.498 | 0.967 | 0.973 |
| **0.002** | **0.8** | 36.224 | 0.967 | 0.954 |
| **0.002** | **1** | 35.173 | 0.963 | 0.909 |
| **0.003** | **0.3** | 29.941 | 0.936 | 0.995 |
| **0.003** | **0.5** | 33.289 | 0.947 | 0.989 |
| **0.003** | **0.7** | 35.609 | 0.956 | 0.968 |
| **0.003** | **0.8** | 35.591 | 0.957 | 0.948 |
| **0.003** | **1** | 34.838 | 0.955 | 0.902 |
| **0.004** | **0.3** | 28.867 | 0.915 | 0.994 |
| **0.004** | **0.5** | 32.279 | 0.932 | 0.986 |
| **0.004** | **0.7** | 34.889 | 0.945 | 0.964 |
| **0.004** | **0.8** | 35.056 | 0.948 | 0.944 |
| **0.004** | **1** | 34.534 | 0.948 | 0.897 |
| **0.005** | **0.3** | 27.817 | 0.895 | 0.990 |
| **0.005** | **0.5** | 31.277 | 0.915 | 0.981 |
| **0.005** | **0.7** | 34.108 | 0.933 | 0.957 |
| **0.005** | **0.8** | 34.428 | 0.937 | 0.936 |
| **0.005** | **1** | 34.138 | 0.938 | 0.887 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 37.626 | 0.970 | 0.990 |
| **0.005** | **50** | 38.357 | 0.981 | 0.996 |
| **0.005** | **60** | 39.004 | 0.984 | 0.997 |
| **0.005** | **70** | 39.689 | 0.983 | 0.992 |
| **0.005** | **80** | 40.523 | 0.991 | 0.997 |
| **0.007** | **40** | 37.580 | 0.970 | 0.992 |
| **0.007** | **50** | 38.307 | 0.980 | 0.997 |
| **0.007** | **60** | 38..946 | 0.984 | 0.997 |
| **0.007** | **70** | 39.624 | 0.983 | 0.993 |
| **0.007** | **80** | 40.439 | 0.991 | 0.998 |
| **0.01** | **40** | 36.653 | 0.970 | 0.993 |
| **0.01** | **50** | 37.227 | 0.980 | 0.997 |
| **0.01** | **60** | 37.716 | 0.984 | 0.998 |
| **0.01** | **70** | 38.218 | 0.982 | 0.994 |
| **0.01** | **80** | 38.783 | 0.991 | 0.998 |
| **0.02** | **40** | 33.482 | 0.968 | 0.985 |
| **0.02** | **50** | 33.764 | 0.978 | 0.987 |
| **0.02** | **60** | 33.983 | 0.982 | 0.988 |
| **0.02** | **70** | 34.175 | 0.980 | 0.987 |
| **0.02** | **80** | 34.400 | 0.989 | 0.988 |
| **0.03** | **40** | 28.097 | 0.964 | 0.835 |
| **0.03** | **50** | 28.185 | 0.974 | 0.837 |
| **0.03** | **60** | 28.229 | 0.978 | 0.840 |
| **0.03** | **70** | 28.278 | 0.976 | 0.842 |
| **0.03** | **80** | 28.342 | 0.985 | 0.846 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 32.778 | 0.949 | 0.989 |
| **0.001** | **0.002** | 30.551 | 0.929 | 0.986 |
| **0.001** | **0.003** | 29.258 | 0.911 | 0.985 |
| **0.001** | **0.004** | 28.305 | 0.892 | 0.983 |
| **0.001** | **0.005** | 27.349 | 0.872 | 0.977 |
| **0.002** | **0.001** | 31.870 | 0.927 | 0.984 |
| **0.002** | **0.002** | 29.985 | 0.908 | 0.980 |
| **0.002** | **0.003** | 28.832 | 0.890 | 0.978 |
| **0.002** | **0.004** | 27.960 | 0.872 | 0.974 |
| **0.002** | **0.005** | 27.070 | 0.853 | 0.967 |
| **0.003** | **0.001** | 31.129 | 0.907 | 0.978 |
| **0.003** | **0.002** | 29.492 | 0.889 | 0.972 |
| **0.003** | **0.003** | 28.449 | 0.872 | 0.969 |
| **0.003** | **0.004** | 27.645 | 0.854 | 0.964 |
| **0.003** | **0.005** | 26.811 | 0.836 | 0.956 |
| **0.004** | **0.001** | 30.502 | 0.889 | 0.971 |
| **0.004** | **0.002** | 29.052 | 0.871 | 0.963 |
| **0.004** | **0.003** | 28.100 | 0.855 | 0.960 |
| **0.004** | **0.004** | 27.353 | 0.838 | 0.954 |
| **0.004** | **0.005** | 26.569 | 0.821 | 0.944 |
| **0.005** | **0.001** | 29.957 | 0.872 | 0.963 |
| **0.005** | **0.002** | 28.656 | 0.855 | 0.953 |
| **0.005** | **0.003** | 27.779 | 0.840 | 0.950 |
| **0.005** | **0.004** | 27.081 | 0.823 | 0.943 |
| **0.005** | **0.005** | 26.341 | 0.807 | 0.932 |

**image:** images/ct-scan.jpg

**Without attack output:**

Host vs Watermarked: *PSNR* – 40.623, *SSIM* – 0.998  
 Host vs Reconstructed Host: *PSNR* – 46.367, *SSIM* – 0.999

NC: 0.999

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.518 | 0.998 | 0.988 |
| **1** | 42.629 | 0.994 | 0.989 |
| **3** | 37.871 | 0.944 | 0.989 |
| **5** | 34.185 | 0.858 | 0.984 |
| **7** | 31.494 | 0.764 | 0.973 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 38.227 | 0.969 | 0.989 |
| **20** | 40.121 | 0.983 | 0.989 |
| **30** | 41.039 | 0.988 | 0.988 |
| **40** | 41.568 | 0.991 | 0.988 |
| **50** | 41.937 | 0.993 | 0.989 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.011 | 0.975 | 0.998 |
| **0.002** | 31.492 | 0.956 | 0.997 |
| **0.003** | 29.823 | 0.937 | 0.997 |
| **0.004** | 28.711 | 0.916 | 0.996 |
| **0.005** | 27.801 | 0.897 | 0.994 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 37.777 | 0.974 | 0.987 |
| **0.002** | 35.436 | 0.952 | 0.986 |
| **0.003** | 33.946 | 0.933 | 0.984 |
| **0.004** | 32.844 | 0.915 | 0.982 |
| **0.005** | 31.972 | 0.899 | 0.980 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 39.159 | 0.999 | 0.998 |
| **0.007** | 38.809 | 0.998 | 0.998 |
| **0.01** | 38.529 | 0.998 | 0.997 |
| **0.02** | 31.692 | 0.991 | 0.995 |
| **0.03** | 31.362 | 0.990 | 0.996 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 45.949 | 0.999 | 0.999 |
| **-0.05** | 41.522 | 0.996 | 0.999 |
| **-0.1** | 37.011 | 0.987 | 0.997 |
| **-0.3** | 28.419 | 0.909 | 0.984 |
| **-0.5** | 24.731 | 0.814 | 0.959 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 45.934 | 0.999 | 0.999 |
| **0.05** | 41.527 | 0.996 | 0.999 |
| **0.1** | 36.996 | 0.987 | 0.997 |
| **0.3** | 28.410 | 0.909 | 0.982 |
| **0.5** | 24.723 | 0.814 | 0.956 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 34.683 | 0.971 | 0.997 |
| **0.6** | 36.049 | 0.979 | 0.996 |
| **0.7** | 37.845 | 0.986 | 0.998 |
| **0.8** | 39.415 | 0.991 | 0.999 |
| **0.9** | 40.659 | 0.993 | 0.999 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 36.041 | 0.943 | 0.994 |
| **50** | 36.895 | 0.959 | 0.998 |
| **60** | 37.680 | 0.966 | 0.998 |
| **70** | 38.639 | 0.967 | 0.996 |
| **80** | 39.918 | 0.981 | 0.999 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 46.363 | 0.999 | 0.999 |
| **0.5** | 41.102 | 0.995 | 0.998 |
| **0.7** | 36.102 | 0.982 | 0.987 |
| **1** | 32.404 | 0.957 | 0.941 |
| **1.5** | 29.828 | 0.923 | 0.847 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 46.363 | 0.999 | 0.999 |
| **0.5** | 41.102 | 0.995 | 0.998 |
| **0.7** | 36.102 | 0.982 | 0.987 |
| **0.8** | 34.470 | 0.973 | 0.974 |
| **1** | 32.404 | 0.957 | 0.941 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 36.748 | 0.974 | 0.997 |
| **5** | 30.300 | 0.917 | 0.913 |
| **7** | 26.679 | 0.850 | 0.062 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 33.189 | 0.964 | 0.967 |
| **5** | 27.874 | 0.881 | 0.710 |
| **7** | 25.085 | 0.790 | 0.275 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 35.742 | 0.943 | 0.988 |
| **0.5** | **50** | 36.522 | 0.958 | 0.988 |
| **0.5** | **60** | 37.234 | 0.965 | 0.988 |
| **0.5** | **70** | 38.096 | 0.966 | 0.988 |
| **0.5** | **80** | 39.197 | 0.980 | 0.989 |
| **1** | **40** | 35.686 | 0.942 | 0.987 |
| **1** | **50** | 36.461 | 0.958 | 0.988 |
| **1** | **60** | 37.160 | 0.964 | 0.989 |
| **1** | **70** | 37.987 | 0.965 | 0.98 |
| **1** | **80** | 39.030 | 0.974 | 0.990 |
| **3** | **40** | 35.253 | 0.934 | 0.985 |
| **3** | **50** | 35.860 | 0.940 | 0.986 |
| **3** | **60** | 36.397 | 0.946 | 0.987 |
| **3** | **70** | 36.984 | 0.949 | 0.987 |
| **3** | **80** | 37.589 | 0.954 | 0.988 |
| **5** | **40** | 34.329 | 0.889 | 0.977 |
| **5** | **50** | 34.696 | 0.895 | 0.976 |
| **5** | **60** | 34.989 | 0.907 | 0.982 |
| **5** | **70** | 35.206 | 0.899 | 0.981 |
| **5** | **80** | 35.018 | 0.889 | 0.980 |
| **7** | **40** | 33.010 | 0.831 | 0.964 |
| **7** | **50** | 33.204 | 0.843 | 0.969 |
| **7** | **60** | 33.201 | 0.832 | 0.964 |
| **7** | **70** | 32.949 | 0.822 | 0.967 |
| **7** | **80** | 32.054 | 0.790 | 0.966 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 34.304 | 0.975 | 0.998 |
| **0.001** | **-0.05** | 35.076 | 0.973 | 0.998 |
| **0.001** | **-0.1** | 34.338 | 0.965 | 0.997 |
| **0.001** | **-0.3** | 27.914 | 0.890 | 0.985 |
| **0.001** | **-0.5** | 24.504 | 0.798 | 0.962 |
| **0.002** | **-0.01** | 31.801 | 0.956 | 0.998 |
| **0.002** | **-0.05** | 32.903 | 0.955 | 0.998 |
| **0.002** | **-0.1** | 32.920 | 0.949 | 0.996 |
| **0.002** | **-0.3** | 27.537 | 0.875 | 0.984 |
| **0.002** | **-0.5** | 24.341 | 0.784 | 0.962 |
| **0.003** | **-0.01** | 30.144 | 0.937 | 0.997 |
| **0.003** | **-0.05** | 31.389 | 0.937 | 0.996 |
| **0.003** | **-0.1** | 31.799 | 0.932 | 0.995 |
| **0.003** | **-0.3** | 27.169 | 0.860 | 0.982 |
| **0.003** | **-0.5** | 24.163 | 0.770 | 0.961 |
| **0.004** | **-0.01** | 29.031 | 0.917 | 0.996 |
| **0.004** | **-0.05** | 30.334 | 0.918 | 0.995 |
| **0.004** | **-0.1** | 30.959 | 0.915 | 0.993 |
| **0.004** | **-0.3** | 26.863 | 0.845 | 0.981 |
| **0.004** | **-0.5** | 23.999 | 0.756 | 0.960 |
| **0.005** | **-0.01** | 28.123 | 0.898 | 0.994 |
| **0.005** | **-0.05** | 29.468 | 0.901 | 0.993 |
| **0.005** | **-0.1** | 30.244 | 0.899 | 0.991 |
| **0.005** | **-0.3** | 26.581 | 0.830 | 0.979 |
| **0.005** | **-0.5** | 23.846 | 0.744 | 0.959 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 34.309 | 0.975 | 0.998 |
| **0.001** | **0.05** | 35.094 | 0.973 | 0.998 |
| **0.001** | **0.1** | 34.365 | 0.965 | 0.996 |
| **0.001** | **0.3** | 27.927 | 0.890 | 0.980 |
| **0.001** | **0.5** | 24.514 | 0.797 | 0.956 |
| **0.002** | **0.01** | 31.801 | 0.956 | 0.998 |
| **0.002** | **0.05** | 32.898 | 0.955 | 0.997 |
| **0.002** | **0.1** | 32.901 | 0.949 | 0.995 |
| **0.002** | **0.3** | 27.517 | 0.875 | 0.977 |
| **0.002** | **0.5** | 24.329 | 0.783 | 0.952 |
| **0.003** | **0.01** | 30.145 | 0.937 | 0.997 |
| **0.003** | **0.05** | 31.396 | 0.938 | 0.996 |
| **0.003** | **0.1** | 31.812 | 0.933 | 0.993 |
| **0.003** | **0.3** | 27.178 | 0.861 | 0.976 |
| **0.003** | **0.5** | 24.168 | 0.771 | 0.952 |
| **0.004** | **0.01** | 29.029 | 0.917 | 0.996 |
| **0.004** | **0.05** | 30.337 | 0.918 | 0.995 |
| **0.004** | **0.1** | 30.963 | 0.915 | 0.992 |
| **0.004** | **0.3** | 26.864 | 0.845 | 0.975 |
| **0.004** | **0.5** | 24.003 | 0.757 | 0.952 |
| **0.005** | **0.01** | 28.121 | 0.898 | 0.994 |
| **0.005** | **0.05** | 29.466 | 0.901 | 0.992 |
| **0.005** | **0.1** | 30.238 | 0.899 | 0.989 |
| **0.005** | **0.3** | 26.569 | 0.830 | 0.972 |
| **0.005** | **0.5** | 23.837 | 0.744 | 0.950 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.123 | 0.975 | 0.998 |
| **0.001** | **0.5** | 36.302 | 0.975 | 0.997 |
| **0.001** | **0.7** | 35.418 | 0.968 | 0.988 |
| **0.001** | **1** | 34.108 | 0.961 | 0.979 |
| **0.001** | **1.5** | 33.354 | 0.955 | 0.972 |
| **0.002** | **0.3** | 31.602 | 0.956 | 0.997 |
| **0.002** | **0.5** | 34.361 | 0.960 | 0.996 |
| **0.002** | **0.7** | 34.631 | 0.957 | 0.986 |
| **0.002** | **1** | 33.679 | 0.951 | 0.976 |
| **0.002** | **1.5** | 33.025 | 0.945 | 0.969 |
| **0.003** | **0.3** | 29.935 | 0.937 | 0.997 |
| **0.003** | **0.5** | 32.960 | 0.944 | 0.994 |
| **0.003** | **0.7** | 33.921 | 0.945 | 0.983 |
| **0.003** | **1** | 33.253 | 0.940 | 0.973 |
| **0.003** | **1.5** | 32.688 | 0.935 | 0.965 |
| **0.004** | **0.3** | 28.822 | 0.916 | 0.996 |
| **0.004** | **0.5** | 31.987 | 0.928 | 0.992 |
| **0.004** | **0.7** | 33.384 | 0.933 | 0.981 |
| **0.004** | **1** | 32.926 | 0.930 | 0.970 |
| **0.004** | **1.5** | 32.430 | 0.925 | 0.962 |
| **0.005** | **0.3** | 27.913 | 0.897 | 0.994 |
| **0.005** | **0.5** | 31.168 | 0.913 | 0.990 |
| **0.005** | **0.7** | 32.887 | 0.921 | 0.977 |
| **0.005** | **1** | 32.608 | 0.920 | 0.966 |
| **0.005** | **1.5** | 32.174 | 0.916 | 0.958 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.123 | 0.975 | 0.998 |
| **0.001** | **0.5** | 36.302 | 0.975 | 0.997 |
| **0.001** | **0.7** | 35.107 | 0.967 | 0.985 |
| **0.001** | **0.8** | 32.180 | 0.946 | 0.940 |
| **0.001** | **1** | 29.755 | 0.914 | 0.848 |
| **0.002** | **0.3** | 31.602 | 0.956 | 0.997 |
| **0.002** | **0.5** | 34.361 | 0.960 | 0.996 |
| **0.002** | **0.7** | 34.407 | 0.956 | 0.983 |
| **0.002** | **0.8** | 31.990 | 0.938 | 0.936 |
| **0.002** | **1** | 29.685 | 0.908 | 0.842 |
| **0.003** | **0.3** | 29.935 | 0.937 | 0.997 |
| **0.003** | **0.5** | 32.960 | 0.944 | 0.994 |
| **0.003** | **0.7** | 33.761 | 0.944 | 0.980 |
| **0.003** | **0.8** | 31.779 | 0.930 | 0.932 |
| **0.003** | **1** | 29.603 | 0.902 | 0.838 |
| **0.004** | **0.3** | 28.822 | 0.916 | 0.996 |
| **0.004** | **0.5** | 31.987 | 0.928 | 0.992 |
| **0.004** | **0.7** | 33.270 | 0.932 | 0.977 |
| **0.004** | **0.8** | 31.623 | 0.921 | 0.928 |
| **0.004** | **1** | 29.543 | 0.896 | 0.833 |
| **0.005** | **0.3** | 27.913 | 0.897 | 0.994 |
| **0.005** | **0.5** | 31.168 | 0.913 | 0.990 |
| **0.005** | **0.7** | 32.811 | 0.921 | 0.974 |
| **0.005** | **0.8** | 31.470 | 0.913 | 0.923 |
| **0.005** | **1** | 29.489 | 0.889 | 0.828 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 34.647 | 0.942 | 0.996 |
| **0.005** | **50** | 35.238 | 0.958 | 0.998 |
| **0.005** | **60** | 35.725 | 0.965 | 0.998 |
| **0.005** | **70** | 36.320 | 0.966 | 0.997 |
| **0.005** | **80** | 37.002 | 0.980 | 0.998 |
| **0.007** | **40** | 34.524 | 0.942 | 0.996 |
| **0.007** | **50** | 35.096 | 0.958 | 0.998 |
| **0.007** | **60** | 35.562 | 0.965 | 0.998 |
| **0.007** | **70** | 36.134 | 0.966 | 0.997 |
| **0.007** | **80** | 36.787 | 0.980 | 0.998 |
| **0.01** | **40** | 34.390 | 0.942 | 0.995 |
| **0.01** | **50** | 34.964 | 0.957 | 0.997 |
| **0.01** | **60** | 35.427 | 0.965 | 0.998 |
| **0.01** | **70** | 35.967 | 0.966 | 0.997 |
| **0.01** | **80** | 36.593 | 0.979 | 0.998 |
| **0.02** | **40** | 30.472 | 0.935 | 0.992 |
| **0.02** | **50** | 30.689 | 0.951 | 0.994 |
| **0.02** | **60** | 30.864 | 0.958 | 0.994 |
| **0.02** | **70** | 31.036 | 0.959 | 0.992 |
| **0.02** | **80** | 31.224 | 0.973 | 0.994 |
| **0.03** | **40** | 30.242 | 0.934 | 0.993 |
| **0.03** | **50** | 30.436 | 0.950 | 0.995 |
| **0.03** | **60** | 30.594 | 0.956 | 0.995 |
| **0.03** | **70** | 30.752 | 0.957 | 0.994 |
| **0.03** | **80** | 30.929 | 0.971 | 0.996 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 32.671 | 0.951 | 0.986 |
| **0.001** | **0.002** | 30.692 | 0.932 | 0.987 |
| **0.001** | **0.003** | 29.263 | 0.914 | 0.987 |
| **0.001** | **0.004** | 28.272 | 0.894 | 0.987 |
| **0.001** | **0.005** | 27.442 | 0.876 | 0.986 |
| **0.002** | **0.001** | 31.808 | 0.930 | 0.984 |
| **0.002** | **0.002** | 30.126 | 0.912 | 0.985 |
| **0.002** | **0.003** | 28.849 | 0.894 | 0.985 |
| **0.002** | **0.004** | 27.939 | 0.875 | 0.985 |
| **0.002** | **0.005** | 27.165 | 0.858 | 0.983 |
| **0.003** | **0.001** | 31.099 | 0.911 | 0.982 |
| **0.003** | **0.002** | 29.632 | 0.894 | 0.983 |
| **0.003** | **0.003** | 28.476 | 0.877 | 0.983 |
| **0.003** | **0.004** | 27.635 | 0.859 | 0.982 |
| **0.003** | **0.005** | 26.909 | 0.842 | 0.981 |
| **0.004** | **0.001** | 30.492 | 0.894 | 0.980 |
| **0.004** | **0.002** | 29.192 | 0.877 | 0.980 |
| **0.004** | **0.003** | 28.135 | 0.861 | 0.981 |
| **0.004** | **0.004** | 27.352 | 0.843 | 0.980 |
| **0.004** | **0.005** | 26.669 | 0.827 | 0.978 |
| **0.005** | **0.001** | 29.965 | 0.878 | 0.977 |
| **0.005** | **0.002** | 28.795 | 0.862 | 0.978 |
| **0.005** | **0.003** | 27.821 | 0.846 | 0.978 |
| **0.005** | **0.004** | 27.088 | 0.829 | 0.977 |
| **0.005** | **0.005** | 26.443 | 0.813 | 0.975 |

**image:** images/girl.jpg

**Without attack output:**

Host vs Watermarked: *PSNR* – 40.599, *SSIM* – 0.998  
 Host vs Reconstructed Host: *PSNR* – 46.624, *SSIM* – 0.999

NC: 0.994

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.243 | 0.997 | 0.966 |
| **1** | 42.279 | 0.993 | 0.966 |
| **3** | 37.379 | 0.950 | 0.964 |
| **5** | 33.697 | 0.879 | 0.961 |
| **7** | 31.021 | 0.797 | 0.957 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 36.334 | 0.940 | 0.965 |
| **20** | 38.557 | 0.968 | 0.964 |
| **30** | 39.672 | 0.978 | 0.964 |
| **40** | 40.351 | 0.983 | 0.965 |
| **50** | 40.828 | 0.986 | 0.965 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.979 | 0.974 | 0.994 |
| **0.002** | 32.264 | 0.951 | 0.994 |
| **0.003** | 30.496 | 0.928 | 0.994 |
| **0.004** | 29.140 | 0.904 | 0.991 |
| **0.005** | 28.201 | 0.882 | 0.990 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.858 | 0.924 | 0.957 |
| **0.002** | 32.230 | 0.869 | 0.948 |
| **0.003** | 30.629 | 0.824 | 0.938 |
| **0.004** | 29.476 | 0.787 | 0.926 |
| **0.005** | 28.572 | 0.754 | 0.912 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 44.404 | 0.999 | 0.994 |
| **0.007** | 43.518 | 0.998 | 0.994 |
| **0.01** | 41.003 | 0.997 | 0.994 |
| **0.02** | 35.855 | 0.992 | 0.980 |
| **0.03** | 30.025 | 0.981 | 0.895 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 45.980 | 0.999 | 0.994 |
| **-0.05** | 39.697 | 0.988 | 0.994 |
| **-0.1** | 34.631 | 0.959 | 0.992 |
| **-0.3** | 26.250 | 0.767 | 0.964 |
| **-0.5** | 23.425 | 0.655 | 0.901 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 45.984 | 0.999 | 0.994 |
| **0.05** | 39.823 | 0.988 | 0.995 |
| **0.1** | 34.778 | 0.959 | 0.993 |
| **0.3** | 26.450 | 0.767 | 0.967 |
| **0.5** | 23.585 | 0.655 | 0.910 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 31.005 | 0.868 | 0.998 |
| **0.6** | 32.194 | 0.898 | 0.998 |
| **0.7** | 33.544 | 0.925 | 0.997 |
| **0.8** | 34.936 | 0.945 | 0.997 |
| **0.9** | 36.133 | 0.960 | 0.997 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 32.594 | 0.868 | 0.990 |
| **50** | 33.268 | 0.887 | 0.993 |
| **60** | 33.959 | 0.903 | 0.992 |
| **70** | 34.961 | 0.923 | 0.993 |
| **80** | 36.489 | 0.945 | 0.993 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 46.610 | 0.999 | 0.994 |
| **0.5** | 38.734 | 0.981 | 0.998 |
| **0.7** | 33.771 | 0.932 | 0.998 |
| **1** | 31.878 | 0.892 | 0.997 |
| **1.5** | 31.007 | 0.867 | 0.995 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 46.610 | 0.999 | 0.994 |
| **0.5** | 38.734 | 0.981 | 0.998 |
| **0.7** | 33.502 | 0.928 | 0.998 |
| **0.8** | 32.179 | 0.903 | 0.996 |
| **1** | 30.590 | 0.862 | 0.987 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 31.894 | 0.859 | 0.995 |
| **5** | 29.007 | 0.765 | 0.974 |
| **7** | 27.563 | 0.724 | 0.912 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 30.458 | 0.849 | 0.994 |
| **5** | 27.278 | 0.739 | 0.899 |
| **7** | 25.732 | 0.685 | 0.582 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 32.436 | 0.868 | 0.964 |
| **0.5** | **50** | 33.071 | 0.886 | 0.963 |
| **0.5** | **60** | 33.731 | 0.902 | 0.965 |
| **0.5** | **70** | 34.656 | 0.922 | 0.963 |
| **0.5** | **80** | 36.072 | 0.944 | 0.965 |
| **1** | **40** | 32.405 | 0.867 | 0.963 |
| **1** | **50** | 33.035 | 0.885 | 0.962 |
| **1** | **60** | 33.678 | 0.901 | 0.964 |
| **1** | **70** | 34.594 | 0.920 | 0.964 |
| **1** | **80** | 35.968 | 0.942 | 0.965 |
| **3** | **40** | 32.119 | 0.858 | 0.959 |
| **3** | **50** | 32.674 | 0.874 | 0.961 |
| **3** | **60** | 33.208 | 0.888 | 0.962 |
| **3** | **70** | 33.945 | 0.905 | 0.962 |
| **3** | **80** | 34.930 | 0.923 | 0.962 |
| **5** | **40** | 31.552 | 0.838 | 0.959 |
| **5** | **50** | 31.951 | 0.850 | 0.959 |
| **5** | **60** | 32.318 | 0.861 | 0.959 |
| **5** | **70** | 32.745 | 0.871 | 0.958 |
| **5** | **80** | 33.072 | 0.876 | 0.960 |
| **7** | **40** | 30.708 | 0.804 | 0.953 |
| **7** | **50** | 30.949 | 0.812 | 0.953 |
| **7** | **60** | 31.097 | 0.816 | 0.955 |
| **7** | **70** | 31.127 | 0.816 | 0.954 |
| **7** | **80** | 30.746 | 0.797 | 0.953 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 35.196 | 0.974 | 0.994 |
| **0.001** | **-0.05** | 35.140 | 0.966 | 0.994 |
| **0.001** | **-0.1** | 33.131 | 0.941 | 0.993 |
| **0.001** | **-0.3** | 26.008 | 0.753 | 0.965 |
| **0.001** | **-0.5** | 23.303 | 0.642 | 0.904 |
| **0.002** | **-0.01** | 32.506 | 0.951 | 0.994 |
| **0.002** | **-0.05** | 33.062 | 0.946 | 0.994 |
| **0.002** | **-0.1** | 32.051 | 0.923 | 0.992 |
| **0.002** | **-0.3** | 25.779 | 0.739 | 0.964 |
| **0.002** | **-0.5** | 23.177 | 0.631 | 0.903 |
| **0.003** | **-0.01** | 30.752 | 0.929 | 0.994 |
| **0.003** | **-0.05** | 31.598 | 0.926 | 0.994 |
| **0.003** | **-0.1** | 31.174 | 0.906 | 0.992 |
| **0.003** | **-0.3** | 25.567 | 0.726 | 0.963 |
| **0.003** | **-0.5** | 23.059 | 0.620 | 0.900 |
| **0.004** | **-0.01** | 29.389 | 0.905 | 0.991 |
| **0.004** | **-0.05** | 30.360 | 0.904 | 0.991 |
| **0.004** | **-0.1** | 30.306 | 0.886 | 0.989 |
| **0.004** | **-0.3** | 25.334 | 0.710 | 0.958 |
| **0.004** | **-0.5** | 22.928 | 0.606 | 0.892 |
| **0.005** | **-0.01** | 28.453 | 0.883 | 0.990 |
| **0.005** | **-0.05** | 29.485 | 0.885 | 0.989 |
| **0.005** | **-0.1** | 29.654 | 0.869 | 0.987 |
| **0.005** | **-0.3** | 25.136 | 0.697 | 0.956 |
| **0.005** | **-0.5** | 22.813 | 0.594 | 0.889 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 35.189 | 0.974 | 0.995 |
| **0.001** | **0.05** | 35.151 | 0.966 | 0.995 |
| **0.001** | **0.1** | 33.200 | 0.940 | 0.993 |
| **0.001** | **0.3** | 26.183 | 0.752 | 0.967 |
| **0.001** | **0.5** | 23.451 | 0.642 | 0.910 |
| **0.002** | **0.01** | 32.507 | 0.951 | 0.994 |
| **0.002** | **0.05** | 33.101 | 0.946 | 0.995 |
| **0.002** | **0.1** | 32.151 | 0.923 | 0.994 |
| **0.002** | **0.3** | 25.970 | 0.739 | 0.968 |
| **0.002** | **0.5** | 23.335 | 0.631 | 0.911 |
| **0.003** | **0.01** | 30.750 | 0.929 | 0.994 |
| **0.003** | **0.05** | 31.608 | 0.926 | 0.995 |
| **0.003** | **0.1** | 31.225 | 0.906 | 0.994 |
| **0.003** | **0.3** | 25.737 | 0.725 | 0.969 |
| **0.003** | **0.5** | 23.206 | 0.619 | 0.913 |
| **0.004** | **0.01** | 29.391 | 0.905 | 0.992 |
| **0.004** | **0.05** | 30.378 | 0.904 | 0.993 |
| **0.004** | **0.1** | 30.361 | 0.886 | 0.992 |
| **0.004** | **0.3** | 25.508 | 0.710 | 0.968 |
| **0.004** | **0.5** | 23.082 | 0.607 | 0.911 |
| **0.005** | **0.01** | 28.454 | 0.883 | 0.991 |
| **0.005** | **0.05** | 29.495 | 0.885 | 0.992 |
| **0.005** | **0.1** | 29.696 | 0.869 | 0.992 |
| **0.005** | **0.3** | 25.299 | 0.697 | 0.969 |
| **0.005** | **0.5** | 22.963 | 0.596 | 0.912 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.052 | 0.974 | 0.994 |
| **0.001** | **0.5** | 35.851 | 0.963 | 0.998 |
| **0.001** | **0.7** | 33.238 | 0.920 | 0.998 |
| **0.001** | **1** | 31.628 | 0.883 | 0.996 |
| **0.001** | **1.5** | 30.823 | 0.859 | 0.994 |
| **0.002** | **0.3** | 32.339 | 0.951 | 0.994 |
| **0.002** | **0.5** | 34.236 | 0.945 | 0.998 |
| **0.002** | **0.7** | 32.795 | 0.909 | 0.998 |
| **0.002** | **1** | 31.403 | 0.874 | 0.996 |
| **0.002** | **1.5** | 30.651 | 0.850 | 0.994 |
| **0.003** | **0.3** | 30.572 | 0.929 | 0.994 |
| **0.003** | **0.5** | 32.980 | 0.928 | 0.998 |
| **0.003** | **0.7** | 32.366 | 0.898 | 0.998 |
| **0.003** | **1** | 31.177 | 0.865 | 0.996 |
| **0.003** | **1.5** | 30.478 | 0.843 | 0.994 |
| **0.004** | **0.3** | 29.212 | 0.904 | 0.992 |
| **0.004** | **0.5** | 31.916 | 0.909 | 0.996 |
| **0.004** | **0.7** | 31.933 | 0.885 | 0.997 |
| **0.004** | **1** | 30.939 | 0.855 | 0.996 |
| **0.004** | **1.5** | 30.293 | 0.834 | 0.994 |
| **0.005** | **0.3** | 28.273 | 0.882 | 0.990 |
| **0.005** | **0.5** | 31.131 | 0.892 | 0.995 |
| **0.005** | **0.7** | 31.560 | 0.874 | 0.995 |
| **0.005** | **1** | 30.722 | 0.846 | 0.994 |
| **0.005** | **1.5** | 30.125 | 0.825 | 0.992 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.052 | 0.974 | 0.994 |
| **0.001** | **0.5** | 35.851 | 0.963 | 0.998 |
| **0.001** | **0.7** | 33.025 | 0.917 | 0.997 |
| **0.001** | **0.8** | 31.910 | 0.894 | 0.995 |
| **0.001** | **1** | 30.462 | 0.856 | 0.986 |
| **0.002** | **0.3** | 32.339 | 0.951 | 0.994 |
| **0.002** | **0.5** | 34.236 | 0.945 | 0.998 |
| **0.002** | **0.7** | 28.648 | 0.794 | 0.953 |
| **0.002** | **0.8** | 32.624 | 0.906 | 0.997 |
| **0.002** | **1** | 31.673 | 0.885 | 0.995 |
| **0.003** | **0.3** | 30.344 | 0.849 | 0.985 |
| **0.003** | **0.5** | 32.980 | 0.928 | 0.998 |
| **0.003** | **0.7** | 32.232 | 0.895 | 0.997 |
| **0.003** | **0.8** | 31.434 | 0.876 | 0.994 |
| **0.003** | **1** | 30.222 | 0.843 | 0.984 |
| **0.004** | **0.3** | 29.212 | 0.904 | 0.992 |
| **0.004** | **0.5** | 31.916 | 0.909 | 0.996 |
| **0.004** | **0.7** | 31.835 | 0.883 | 0.997 |
| **0.004** | **0.8** | 31.183 | 0.866 | 0.994 |
| **0.004** | **1** | 30.093 | 0.836 | 0.985 |
| **0.005** | **0.3** | 28.273 | 0.882 | 0.990 |
| **0.005** | **0.5** | 31.131 | 0.892 | 0.995 |
| **0.005** | **0.7** | 31.489 | 0.872 | 0.995 |
| **0.005** | **0.8** | 30.953 | 0.857 | 0.992 |
| **0.005** | **1** | 29.969 | 0.830 | 0.982 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 32.493 | 0.868 | 0.990 |
| **0.005** | **50** | 33.146 | 0.886 | 0.993 |
| **0.005** | **60** | 33.814 | 0.903 | 0.992 |
| **0.005** | **70** | 34.778 | 0.922 | 0.993 |
| **0.005** | **80** | 36.228 | 0.944 | 0.993 |
| **0.007** | **40** | 32.451 | 0.868 | 0.991 |
| **0.007** | **50** | 33.087 | 0.886 | 0.993 |
| **0.007** | **60** | 33.736 | 0.902 | 0.993 |
| **0.007** | **70** | 34.679 | 0.922 | 0.994 |
| **0.007** | **80** | 36.087 | 0.944 | 0.994 |
| **0.01** | **40** | 32.210 | 0.867 | 0.991 |
| **0.01** | **50** | 32.801 | 0.885 | 0.993 |
| **0.01** | **60** | 33.417 | 0.901 | 0.992 |
| **0.01** | **70** | 34.275 | 0.921 | 0.993 |
| **0.01** | **80** | 35.519 | 0.943 | 0.993 |
| **0.02** | **40** | 31.119 | 0.864 | 0.976 |
| **0.02** | **50** | 31.552 | 0.882 | 0.978 |
| **0.02** | **60** | 31.995 | 0.898 | 0.979 |
| **0.02** | **70** | 32.579 | 0.917 | 0.978 |
| **0.02** | **80** | 33.388 | 0.939 | 0.979 |
| **0.03** | **40** | 28.229 | 0.855 | 0.888 |
| **0.03** | **50** | 28.466 | 0.872 | 0.890 |
| **0.03** | **60** | 28.673 | 0.888 | 0.890 |
| **0.03** | **70** | 28.907 | 0.907 | 0.892 |
| **0.03** | **80** | 29.245 | 0.928 | 0.893 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 32.061 | 0.902 | 0.959 |
| **0.001** | **0.002** | 30.467 | 0.881 | 0.957 |
| **0.001** | **0.003** | 29.223 | 0.861 | 0.959 |
| **0.001** | **0.004** | 28.174 | 0.839 | 0.952 |
| **0.001** | **0.005** | 27.408 | 0.819 | 0.950 |
| **0.002** | **0.001** | 30.488 | 0.849 | 0.950 |
| **0.002** | **0.002** | 29.321 | 0.830 | 0.947 |
| **0.002** | **0.003** | 28.336 | 0.811 | 0.949 |
| **0.002** | **0.004** | 27.463 | 0.791 | 0.940 |
| **0.002** | **0.005** | 26.805 | 0.773 | 0.937 |
| **0.003** | **0.001** | 29.355 | 0.806 | 0.939 |
| **0.003** | **0.002** | 28.431 | 0.788 | 0.936 |
| **0.003** | **0.003** | 27.612 | 0.771 | 0.938 |
| **0.003** | **0.004** | 26.864 | 0.752 | 0.926 |
| **0.003** | **0.005** | 26.285 | 0.736 | 0.922 |
| **0.004** | **0.001** | 28.468 | 0.769 | 0.927 |
| **0.004** | **0.002** | 27.701 | 0.753 | 0.923 |
| **0.004** | **0.003** | 27.000 | 0.737 | 0.924 |
| **0.004** | **0.004** | 26.343 | 0.720 | 0.910 |
| **0.004** | **0.005** | 25.826 | 0.704 | 0.905 |
| **0.005** | **0.001** | 27.738 | 0.738 | 0.913 |
| **0.005** | **0.002** | 27.081 | 0.723 | 0.908 |
| **0.005** | **0.003** | 26.467 | 0.708 | 0.908 |
| **0.005** | **0.004** | 25.882 | 0.692 | 0.892 |
| **0.005** | **0.005** | 25.415 | 0.677 | 0.886 |

**image:** images/grass.tiff

**Without attack output:**

Host vs Watermarked: *PSNR* – 40.297, *SSIM* – 0.999  
 Host vs Reconstructed Host: *PSNR* – 48.131, *SSIM* – 1.000

NC: 0.994

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.996 | 1.000 | 0.965 |
| **1** | 42.905 | 0.999 | 0.965 |
| **3** | 37.592 | 0.992 | 0.965 |
| **5** | 33.771 | 0.979 | 0.965 |
| **7** | 31.040 | 0.961 | 0.964 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 35.139 | 0.985 | 0.968 |
| **20** | 37.672 | 0.992 | 0.96 |
| **30** | 38.991 | 0.995 | 0.966 |
| **40** | 39.841 | 0.996 | 0.965 |
| **50** | 40.455 | 0.997 | 0.965 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 35.326 | 0.991 | 0.993 |
| **0.002** | 32.165 | 0.981 | 0.991 |
| **0.003** | 30.653 | 0.973 | 0.989 |
| **0.004** | 29.077 | 0.961 | 0.986 |
| **0.005** | 28.021 | 0.950 | 0.985 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 32.653 | 0.972 | 0.964 |
| **0.002** | 29.823 | 0.947 | 0.962 |
| **0.003** | 28.146 | 0.924 | 0.960 |
| **0.004** | 26.956 | 0.903 | 0.957 |
| **0.005** | 26.036 | 0.884 | 0.954 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 39.501 | 0.999 | 0.991 |
| **0.007** | 38.226 | 0.999 | 0.989 |
| **0.01** | 35.507 | 0.997 | 0.984 |
| **0.02** | 31.138 | 0.988 | 0.974 |
| **0.03** | 28.527 | 0.976 | 0.938​ |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 45.823 | 1.000 | 0.994 |
| **-0.05** | 35.674 | 0.990 | 0.996 |
| **-0.1** | 30.057 | 0.961 | 0.995 |
| **-0.3** | 21.429 | 0.740 | 0.979 |
| **-0.5** | 18.329 | 0.501 | 0.941 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 45.835 | 1.000 | 0.994 |
| **0.05** | 35.707 | 0.990 | 0.995 |
| **0.1** | 30.097 | 0.961 | 0.991 |
| **0.3** | 21.485 | 0.740 | 0.943 |
| **0.5** | 18.378 | 0.501 | 0.848 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 28.091 | 0.910 | 0.999 |
| **0.6** | 29.629 | 0.938 | 0.998 |
| **0.7** | 31.515 | 0.961 | 0.998 |
| **0.8** | 33.146 | 0.974 | 0.998 |
| **0.9** | 34.480 | 0.981 | 0.998 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 31.017 | 0.959 | 0.993 |
| **50** | 31.852 | 0.966 | 0.993 |
| **60** | 32.706 | 0.972 | 0.993 |
| **70** | 33.857 | 0.979 | 0.994 |
| **80** | 35.526 | 0.986 | 0.994 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.129 | 1.000 | 0.994 |
| **0.5** | 36.237 | 0.989 | 0.999 |
| **0.7** | 30.806 | 0.954 | 0.994 |
| **1** | 28.790 | 0.924 | 0.985 |
| **1.5** | 27.865 | 0.904 | 0.977 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.129 | 1.000 | 0.994 |
| **0.5** | 36.237 | 0.989 | 0.999 |
| **0.7** | 30.360 | 0.949 | 0.991 |
| **0.8** | 28.703 | 0.923 | 0.978 |
| **1** | 26.655 | 0.871 | 0.942 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 29.824 | 0.936 | 0.993 |
| **5** | 23.533 | 0.705 | 0.943 |
| **7** | 20.607 | 0.443 | 0.835 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 27.278 | 0.888 | 0.971 |
| **5** | 22.241 | 0.614 | 0.668 |
| **7** | 20.084 | 0.373 | 0.212 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 30.909 | 0.959 | 0.966 |
| **0.5** | **50** | 31.711 | 0.966 |  |
| **0.5** | **60** | 32.536 | 0.972 | 0.964 |
| **0.5** | **70** | 33.635 | 0.979 | 0.965 |
| **0.5** | **80** | 35.191 | 0.985 | 0.965 |
| **1** | **40** | 30.889 | 0.959 | 0.966 |
| **1** | **50** | 31.681 | 0.966 | 0.963 |
| **1** | **60** | 32.497 | 0.972 | 0.964 |
| **1** | **70** | 33.580 | 0.978 | 0.965 |
| **1** | **80** | 35.105 | 0.985 | 0.965 |
| **3** | **40** | 30.657 | 0.956 | 0.966 |
| **3** | **50** | 31.385 | 0.963 | 0.965 |
| **3** | **60** | 32.100 | 0.969 | 0.965 |
| **3** | **70** | 33.020 | 0.975 | 0.965 |
| **3** | **80** | 34.172 | 0.981 | 0.965 |
| **5** | **40** | 30.201 | 0.952 | 0.965 |
| **5** | **50** | 30.792 | 0.958 | 0.963 |
| **5** | **60** | 31.333 | 0.963 | 0.965 |
| **5** | **70** | 31.940 | 0.968 | 0.966 |
| **5** | **80** | 32.524 | 0.972 | 0.966 |
| **7** | **40** | 29.539 | 0.944 | 0.962 |
| **7** | **50** | 29.943 | 0.950 | 0.962 |
| **7** | **60** | 30.259 | 0.953 | 0.965 |
| **7** | **70** | 30.501 | 0.956 | 0.964 |
| **7** | **80** | 30.448 | 0.955 | 0.964 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 35.406 | 0.991 | 0.993 |
| **0.001** | **-0.05** | 33.385 | 0.983 | 0.995 |
| **0.001** | **-0.1** | 29.497 | 0.956 | 0.994 |
| **0.001** | **-0.3** | 21.348 | 0.736 | 0.978 |
| **0.001** | **-0.5** | 18.289 | 0.498 | 0.937 |
| **0.002** | **-0.01** | 32.336 | 0.981 | 0.992 |
| **0.002** | **-0.05** | 31.730 | 0.975 | 0.993 |
| **0.002** | **-0.1** | 28.942 | 0.949 | 0.993 |
| **0.002** | **-0.3** | 21.264 | 0.731 | 0.975 |
| **0.002** | **-0.5** | 18.254 | 0.496 | 0.934 |
| **0.003** | **-0.01** | 30.840 | 0.974 | 0.990 |
| **0.003** | **-0.05** | 30.703 | 0.969 | 0.992 |
| **0.003** | **-0.1** | 28.511 | 0.945 | 0.992 |
| **0.003** | **-0.3** | 21.193 | 0.727 | 0.972 |
| **0.003** | **-0.5** | 18.217 | 0.493 | 0.928 |
| **0.004** | **-0.01** | 29.270 | 0.962 | 0.987 |
| **0.004** | **-0.05** | 29.534 | 0.959 | 0.989 |
| **0.004** | **-0.1** | 27.950 | 0.937 | 0.989 |
| **0.004** | **-0.3** | 21.094 | 0.722 | 0.967 |
| **0.004** | **-0.5** | 18.167 | 0.489 | 0.918 |
| **0.005** | **-0.01** | 28.230 | 0.951 | 0.986 |
| **0.005** | **-0.05** | 28.721 | 0.950 | 0.989 |
| **0.005** | **-0.1** | 27.526 | 0.930 | 0.989 |
| **0.005** | **-0.3** | 21.007 | 0.717 | 0.964 |
| **0.005** | **-0.5** | 18.126 | 0.486 | 0.913 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 35.414 | 0.991 | 0.993 |
| **0.001** | **0.05** | 33.425 | 0.983 | 0.994 |
| **0.001** | **0.1** | 29.548 | 0.956 | 0.990 |
| **0.001** | **0.3** | 21.409 | 0.736 | 0.938 |
| **0.001** | **0.5** | 18.342 | 0.498 | 0.839 |
| **0.002** | **0.01** | 32.333 | 0.981 | 0.992 |
| **0.002** | **0.05** | 31.744 | 0.975 | 0.993 |
| **0.002** | **0.1** | 28.977 | 0.949 | 0.991 |
| **0.002** | **0.3** | 21.319 | 0.731 | 0.941 |
| **0.002** | **0.5** | 18.302 | 0.495 | 0.841 |
| **0.003** | **0.01** | 30.840 | 0.974 | 0.990 |
| **0.003** | **0.05** | 30.721 | 0.969 | 0.991 |
| **0.003** | **0.1** | 28.550 | 0.945 | 0.987 |
| **0.003** | **0.3** | 21.254 | 0.728 | 0.934 |
| **0.003** | **0.5** | 18.267 | 0.493 | 0.827 |
| **0.004** | **0.01** | 29.276 | 0.962 | 0.987 |
| **0.004** | **0.05** | 29.565 | 0.959 | 0.989 |
| **0.004** | **0.1** | 28.006 | 0.937 | 0.987 |
| **0.004** | **0.3** | 21.164 | 0.723 | 0.929 |
| **0.004** | **0.5** | 18.223 | 0.490 | 0.812 |
| **0.005** | **0.01** | 28.235 | 0.951 | 0.986 |
| **0.005** | **0.05** | 28.752 | 0.951 | 0.988 |
| **0.005** | **0.1** | 27.586 | 0.931 | 0.986 |
| **0.005** | **0.3** | 21.080 | 0.719 | 0.926 |
| **0.005** | **0.5** | 18.184 | 0.488 | 0.808 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.369 | 0.991 | 0.993 |
| **0.001** | **0.5** | 34.462 | 0.983 | 0.998 |
| **0.001** | **0.7** | 30.536 | 0.952 | 0.994 |
| **0.001** | **1** | 28.666 | 0.922 | 0.985 |
| **0.001** | **1.5** | 27.773 | 0.902 | 0.902 |
| **0.002** | **0.3** | 32.208 | 0.981 | 0.991 |
| **0.002** | **0.5** | 33.041 | 0.977 | 0.998 |
| **0.002** | **0.7** | 30.227 | 0.948 | 0.995 |
| **0.002** | **1** | 28.512 | 0.919 | 0.986 |
| **0.002** | **1.5** | 27.656 | 0.899 | 0.979 |
| **0.003** | **0.3** | 30.698 | 0.973 | 0.989 |
| **0.003** | **0.5** | 32.177 | 0.973 | 0.997 |
| **0.003** | **0.7** | 30.004 | 0.946 | 0.995 |
| **0.003** | **1** | 28.399 | 0.917 | 0.987 |
| **0.003** | **1.5** | 27.570 | 0.898 | 0.980 |
| **0.004** | **0.3** | 29.118 | 0.961 | 0.986 |
| **0.004** | **0.5** | 31.134 | 0.965 | 0.997 |
| **0.004** | **0.7** | 29.695 | 0.942 | 0.995 |
| **0.004** | **1** | 28.242 | 0.915 | 0.988 |
| **0.004** | **1.5** | 27.451 | 0.895 | 0.981 |
| **0.005** | **0.3** | 28.061 | 0.950 | 0.985 |
| **0.005** | **0.5** | 30.359 | 0.959 | 0.996 |
| **0.005** | **0.7** | 29.421 | 0.938 | 0.996 |
| **0.005** | **1** | 28.093 | 0.912 | 0.988 |
| **0.005** | **1.5** | 27.336 | 0.893 | 0.981 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.369 | 0.991 | 0.993 |
| **0.001** | **0.5** | 34.462 | 0.983 | 0.998 |
| **0.001** | **0.7** | 30.128 | 0.946 | 0.991 |
| **0.001** | **0.8** | 28.581 | 0.921 | 0.979 |
| **0.001** | **1** | 26.602 | 0.870 | 0.942 |
| **0.002** | **0.3** | 32.208 | 0.981 | 0.991 |
| **0.002** | **0.5** | 33.041 | 0.977 | 0.998 |
| **0.002** | **0.7** | 29.857 | 0.943 | 0.992 |
| **0.002** | **0.8** | 28.429 | 0.918 | 0.980 |
| **0.002** | **1** | 26.529 | 0.868 | 0.944 |
| **0.003** | **0.3** | 30.698 | 0.973 | 0.989 |
| **0.003** | **0.5** | 32.177 | 0.973 | 0.997 |
| **0.003** | **0.7** | 29.662 | 0.941 | 0.993 |
| **0.003** | **0.8** | 28.319 | 0.916 | 0.981 |
| **0.003** | **1** | 26.477 | 0.866 | 0.945 |
| **0.004** | **0.3** | 29.118 | 0.961 | 0.986 |
| **0.004** | **0.5** | 31.134 | 0.965 | 0.997 |
| **0.004** | **0.7** | 29.389 | 0.937 | 0.993 |
| **0.004** | **0.8** | 28.164 | 0.914 | 0.982 |
| **0.004** | **1** | 26.405 | 0.864 | 0.944 |
| **0.005** | **0.3** | 28.061 | 0.950 | 0.985 |
| **0.005** | **0.5** | 30.359 | 0.959 | 0.996 |
| **0.005** | **0.7** | 29.145 | 0.934 | 0.994 |
| **0.005** | **0.8** | 28.019 | 0.911 | 0.982 |
| **0.005** | **1** | 26.333 | 0.862 | 0.941 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 30.562 | 0.958 | 0.990 |
| **0.005** | **50** | 31.291 | 0.965 | 0.991 |
| **0.005** | **60** | 32.017 | 0.972 | 0.991 |
| **0.005** | **70** | 32.960 | 0.978 | 0.991 |
| **0.005** | **80** | 34.260 | 0.985 | 0.991 |
| **0.007** | **40** | 30.370 | 0.958 | 0.988 |
| **0.007** | **50** | 31.074 | 0.965 | 0.989 |
| **0.007** | **60** | 31.760 | 0.971 | 0.989 |
| **0.007** | **70** | 32.658 | 0.977 | 0.989 |
| **0.007** | **80** | 33.847 | 0.984 | 0.989 |
| **0.01** | **40** | 29.824 | 0.956 | 0.984 |
| **0.01** | **50** | 30.427 | 0.963 | 0.984 |
| **0.01** | **60** | 31.004 | 0.970 | 0.984 |
| **0.01** | **70** | 31.735 | 0.976 | 0.984 |
| **0.01** | **80** | 32.654 | 0.983 | 0.984 |
| **0.02** | **40** | 28.197 | 0.948 | 0.972 |
| **0.02** | **50** | 28.608 | 0.955 | 0.974 |
| **0.02** | **60** | 28.974 | 0.961 | 0.973 |
| **0.02** | **70** | 29.398 | 0.968 | 0.974 |
| **0.02** | **80** | 29.897 | 0.974 | 0.974 |
| **0.03** | **40** | 26.710 | 0.936 | 0.937 |
| **0.03** | **50** | 26.977 | 0.943 | 0.939 |
| **0.03** | **60** | 27.225 | 0.949 | 0.937 |
| **0.03** | **70** | 27.502 | 0.955 | 0.939 |
| **0.03** | **80** | 27.811 | 0.962 | 0.937 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 30.860 | 0.963 | 0.961 |
| **0.001** | **0.002** | 29.455 | 0.953 | 0.956 |
| **0.001** | **0.003** | 28.582 | 0.946 | 0.950 |
| **0.001** | **0.004** | 27.540 | 0.935 | 0.942 |
| **0.001** | **0.005** | 26.774 | 0.924 | 0.938 |
| **0.002** | **0.001** | 28.799 | 0.938 | 0.959 |
| **0.002** | **0.002** | 27.874 | 0.929 | 0.954 |
| **0.002** | **0.003** | 27.250 | 0.922 | 0.948 |
| **0.002** | **0.004** | 26.461 | 0.911 | 0.940 |
| **0.002** | **0.005** | 25.853 | 0.902 | 0.935 |
| **0.003** | **0.001** | 27.426 | 0.916 | 0.956 |
| **0.003** | **0.002** | 26.734 | 0.907 | 0.952 |
| **0.003** | **0.003** | 26.247 | 0.901 | 0.946 |
| **0.003** | **0.004** | 25.610 | 0.890 | 0.936 |
| **0.003** | **0.005** | 25.105 | 0.881 | 0.931 |
| **0.004** | **0.001** | 26.399 | 0.896 | 0.953 |
| **0.004** | **0.002** | 25.844 | 0.887 | 0.948 |
| **0.004** | **0.003** | 25.444 | 0.881 | 0.942 |
| **0.004** | **0.004** | 24.909 | 0.871 | 0.932 |
| **0.004** | **0.005** | 24.476 | 0.862 | 0.927 |
| **0.005** | **0.001** | 25.580 | 0.877 | 0.950 |
| **0.005** | **0.002** | 25.117 | 0.869 | 0.944 |
| **0.005** | **0.003** | 24.777 | 0.863 | 0.938 |
| **0.005** | **0.004** | 24.315 | 0.853 | 0.927 |
| **0.005** | **0.005** | 23.935 | 0.845 | 0.921 |

**image:** images/house.tiff

**Without attack output:**

Host vs Watermarked: *PSNR* – 41.206, *SSIM* – 0.997  
 Host vs Reconstructed Host: *PSNR* – 48.131, *SSIM* – 1.000

NC: 0.992

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.996 | 0.996 | 0.955 |
| **1** | 42.901 | 0.988 | 0.955 |
| **3** | 37.588 | 0.909 | 0.954 |
| **5** | 33.768 | 0.790 | 0.952 |
| **7** | 31.034 | 0.670 | 0.950 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 36.043 | 0.866 | 0.959 |
| **20** | 38.463 | 0.926 | 0.958 |
| **30** | 39.707 | 0.948 | 0.956 |
| **40** | 40.495 | 0.960 | 0.955 |
| **50** | 41.050 | 0.968 | 0.956 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 35.346 | 0.967 | 0.991 |
| **0.002** | 32.567 | 0.938 | 0.990 |
| **0.003** | 30.884 | 0.910 | 0.990 |
| **0.004** | 29.570 | 0.879 | 0.987 |
| **0.005** | 28.632 | 0.852 | 0.985 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.321 | 0.818 | 0.953 |
| **0.002** | 31.535 | 0.715 | 0.951 |
| **0.003** | 29.859 | 0.645 | 0.949 |
| **0.004** | 28.657 | 0.592 | 0.948 |
| **0.005** | 27.720 | 0.551 | 0.946 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 34.669 | 0.998 | 0.999 |
| **0.007** | 34.724 | 0.998 | 0.999 |
| **0.01** | 31.800 | 0.995 | 1.000 |
| **0.02** | 31.517 | 0.993 | 0.997 |
| **0.03** | 31.291 | 0.990 | 0.996 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 47.713 | 1.000 | 0.992 |
| **-0.05** | 42.982 | 0.998 | 0.992 |
| **-0.1** | 38.260 | 0.993 | 0.991 |
| **-0.3** | 29.852 | 0.955 | 0.973 |
| **-0.5** | 26.620 | 0.905 | 0.925 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 47.731 | 1.000 | 0.992 |
| **0.05** | 43.132 | 0.998 | 0.991 |
| **0.1** | 38.474 | 0.993 | 0.990 |
| **0.3** | 30.018 | 0.955 | 0.967 |
| **0.5** | 26.764 | 0.905 | 0.911 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 45.191 | 0.995 | 0.998 |
| **0.6** | 43.882 | 0.992 | 0.996 |
| **0.7** | 45.030 | 0.995 | 0.996 |
| **0.8** | 45.886 | 0.996 | 0.996 |
| **0.9** | 46.309 | 0.997 | 0.995 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 40.962 | 0.967 | 0.993 |
| **50** | 41.743 | 0.974 | 0.991 |
| **60** | 42.499 | 0.979 | 0.991 |
| **70** | 43.460 | 0.984 | 0.992 |
| **80** | 44.562 | 0.989 | 0.992 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.131 | 1.000 | 0.992 |
| **0.5** | 46.592 | 0.998 | 0.996 |
| **0.7** | 43.963 | 0.994 | 0.998 |
| **1** | 42.475 | 0.991 | 0.997 |
| **1.5** | 41.696 | 0.989 | 0.997 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.131 | 1.000 | 0.992 |
| **0.5** | 46.592 | 0.998 | 0.996 |
| **0.7** | 43.503 | 0.994 | 0.998 |
| **0.8** | 42.069 | 0.990 | 0.997 |
| **1** | 40.016 | 0.984 | 0.992 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 44.997 | 0.992 | 0.995 |
| **5** | 39.722 | 0.963 | 0.990 |
| **7** | 36.268 | 0.929 | 0.954 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 41.200 | 0.987 | 0.996 |
| **5** | 34.949 | 0.948 | 0.933 |
| **7** | 31.492 | 0.902 | 0.705 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 40.038 | 0.966 | 0.961 |
| **0.5** | **50** | 40.554 | 0.973 | 0.950 |
| **0.5** | **60** | 41.176 | 0.978 | 0.953 |
| **0.5** | **70** | 41.841 | 0.983 | 0.954 |
| **0.5** | **80** | 42.541 | 0.988 | 0.954 |
| **1** | **40** | 39.988 | 0.966 | 0.962 |
| **1** | **50** | 40.476 | 0.973 | 0.950 |
| **1** | **60** | 41.084 | 0.977 | 0.955 |
| **1** | **70** | 41.696 | 0.982 | 0.954 |
| **1** | **80** | 42.333 | 0.986 | 0.954 |
| **3** | **40** | 39.197 | 0.955 | 0.959 |
| **3** | **50** | 39.460 | 0.958 | 0.953 |
| **3** | **60** | 39.670 | 0.959 | 0.952 |
| **3** | **70** | 39.696 | 0.956 | 0.952 |
| **3** | **80** | 39.633 | 0.952 | 0.953 |
| **5** | **40** | 37.225 | 0.915 | 0.955 |
| **5** | **50** | 37.014 | 0.907 | 0.949 |
| **5** | **60** | 36.807 | 0.899 | 0.951 |
| **5** | **70** | 36.484 | 0.887 | 0.950 |
| **5** | **80** | 35.677 | 0.862 | 0.951 |
| **7** | **40** | 34.720 | 0.840 | 0.951 |
| **7** | **50** | 34.322 | 0.822 | 0.946 |
| **7** | **60** | 34.015 | 0.809 | 0.949 |
| **7** | **70** | 33.371 | 0.782 | 0.947 |
| **7** | **80** | 31.909 | 0.716 | 0.950 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 35.593 | 0.968 | 0.991 |
| **0.001** | **-0.05** | 36.322 | 0.968 | 0.991 |
| **0.001** | **-0.1** | 35.554 | 0.966 | 0.990 |
| **0.001** | **-0.3** | 29.328 | 0.929 | 0.973 |
| **0.001** | **-0.5** | 26.372 | 0.881 | 0.926 |
| **0.002** | **-0.01** | 32.823 | 0.938 | 0.990 |
| **0.002** | **-0.05** | 33.856 | 0.941 | 0.990 |
| **0.002** | **-0.1** | 33.897 | 0.941 | 0.990 |
| **0.002** | **-0.3** | 28.868 | 0.905 | 0.972 |
| **0.002** | **-0.5** | 26.135 | 0.858 | 0.924 |
| **0.003** | **-0.01** | 31.146 | 0.911 | 0.990 |
| **0.003** | **-0.05** | 32.314 | 0.916 | 0.990 |
| **0.003** | **-0.1** | 32.739 | 0.918 | 0.989 |
| **0.003** | **-0.3** | 28.489 | 0.883 | 0.971 |
| **0.003** | **-0.5** | 25.933 | 0.837 | 0.923 |
| **0.004** | **-0.01** | 29.829 | 0.881 | 0.987 |
| **0.004** | **-0.05** | 31.076 | 0.888 | 0.987 |
| **0.004** | **-0.1** | 31.727 | 0.892 | 0.986 |
| **0.004** | **-0.3** | 28.096 | 0.860 | 0.966 |
| **0.004** | **-0.5** | 25.714 | 0.814 | 0.914 |
| **0.005** | **-0.01** | 28.898 | 0.854 | 0.985 |
| **0.005** | **-0.05** | 30.186 | 0.862 | 0.986 |
| **0.005** | **-0.1** | 30.978 | 0.869 | 0.985 |
| **0.005** | **-0.3** | 27.749 | 0.838 | 0.965 |
| **0.005** | **-0.5** | 25.505 | 0.793 | 0.913 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 35.593 | 0.968 | 0.991 |
| **0.001** | **0.05** | 36.360 | 0.968 | 0.991 |
| **0.001** | **0.1** | 35.657 | 0.966 | 0.990 |
| **0.001** | **0.3** | 29.472 | 0.929 | 0.967 |
| **0.001** | **0.5** | 26.508 | 0.881 | 0.911 |
| **0.002** | **0.01** | 32.827 | 0.938 | 0.990 |
| **0.002** | **0.05** | 33.89 | 0.941 | 0.990 |
| **0.002** | **0.1** | 34.006 | 0.941 | 0.990 |
| **0.002** | **0.3** | 29.026 | 0.906 | 0.968 |
| **0.002** | **0.5** | 26.282 | 0.858 | 0.914 |
| **0.003** | **0.01** | 31.146 | 0.911 | 0.990 |
| **0.003** | **0.05** | 32.318 | 0.916 | 0.990 |
| **0.003** | **0.1** | 32.782 | 0.918 | 0.990 |
| **0.003** | **0.3** | 28.609 | 0.884 | 0.970 |
| **0.003** | **0.5** | 26.056 | 0.837 | 0.915 |
| **0.004** | **0.01** | 29.831 | 0.881 | 0.987 |
| **0.004** | **0.05** | 31.080 | 0.888 | 0.988 |
| **0.004** | **0.1** | 31.758 | 0.893 | 0.988 |
| **0.004** | **0.3** | 28.206 | 0.860 | 0.968 |
| **0.004** | **0.5** | 25.828 | 0.814 | 0.909 |
| **0.005** | **0.01** | 28.901 | 0.854 | 0.985 |
| **0.005** | **0.05** | 30.198 | 0.863 | 0.986 |
| **0.005** | **0.1** | 31.021 | 0.869 | 0.986 |
| **0.005** | **0.3** | 27.866 | 0.838 | 0.965 |
| **0.005** | **0.5** | 25.630 | 0.794 | 0.905 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.408 | 0.967 | 0.991 |
| **0.001** | **0.5** | 38.566 | 0.973 | 0.996 |
| **0.001** | **0.7** | 40.429 | 0.976 | 0.998 |
| **0.001** | **1** | 40.364 | 0.976 | 0.998 |
| **0.001** | **1.5** | 40.017 | 0.975 | 0.997 |
| **0.002** | **0.3** | 32.627 | 0.938 | 0.990 |
| **0.002** | **0.5** | 36.007 | 0.949 | 0.99 |
| **0.002** | **0.7** | 38.575 | 0.959 | 0.998 |
| **0.002** | **1** | 38.994 | 0.962 | 0.998 |
| **0.002** | **1.5** | 38.847 | 0.961 | 0.998 |
| **0.003** | **0.3** | 30.946 | 0.910 | 0.990 |
| **0.003** | **0.5** | 34.426 | 0.927 | 0.995 |
| **0.003** | **0.7** | 37.315 | 0.944 | 0.998 |
| **0.003** | **1** | 37.991 | 0.949 | 0.998 |
| **0.003** | **1.5** | 37.956 | 0.949 | 0.998 |
| **0.004** | **0.3** | 29.629 | 0.880 | 0.987 |
| **0.004** | **0.5** | 33.147 | 0.903 | 0.994 |
| **0.004** | **0.7** | 36.204 | 0.926 | 0.997 |
| **0.004** | **1** | 37.047 | 0.935 | 0.998 |
| **0.004** | **1.5** | 37.103 | 0.936 | 0.998 |
| **0.005** | **0.3** | 28.692 | 0.852 | 0.985 |
| **0.005** | **0.5** | 32.227 | 0.880 | 0.992 |
| **0.005** | **0.7** | 35.366 | 0.910 | 0.997 |
| **0.005** | **1** | 36.310 | 0.922 | 0.997 |
| **0.005** | **1.5** | 36.417 | 0.923 | 0.997 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.408 | 0.967 | 0.991 |
| **0.001** | **0.5** | 38.566 | 0.973 | 0.996 |
| **0.001** | **0.7** | 40.351 | 0.976 | 0.998 |
| **0.001** | **0.8** | 40.114 | 0.976 | 0.997 |
| **0.001** | **1** | 39.092 | 0.973 | 0.993 |
| **0.002** | **0.3** | 32.627 | 0.938 | 0.990 |
| **0.002** | **0.5** | 36.007 | 0.949 | 0.996 |
| **0.002** | **0.7** | 38.606 | 0.959 | 0.998 |
| **0.002** | **0.8** | 38.820 | 0.962 | 0.998 |
| **0.002** | **1** | 38.363 | 0.962 | 0.993 |
| **0.003** | **0.3** | 30.946 | 0.910 | 0.990 |
| **0.003** | **0.5** | 34.426 | 0.927 | 0.995 |
| **0.003** | **0.7** | 37.402 | 0.944 | 0.998 |
| **0.003** | **0.8** | 37.851 | 0.949 | 0.998 |
| **0.003** | **1** | 37.754 | 0.953 | 0.994 |
| **0.004** | **0.3** | 29.629 | 0.880 | 0.987 |
| **0.004** | **0.5** | 33.147 | 0.903 | 0.994 |
| **0.004** | **0.7** | 36.327 | 0.928 | 0.998 |
| **0.004** | **0.8** | 36.941 | 0.935 | 0.998 |
| **0.004** | **1** | 37.131 | 0.943 | 0.994 |
| **0.005** | **0.3** | 28.692 | 0.852 | 0.985 |
| **0.005** | **0.5** | 32.227 | 0.880 | 0.992 |
| **0.005** | **0.7** | 35.512 | 0.912 | 0.997 |
| **0.005** | **0.8** | 36.224 | 0.922 | 0.997 |
| **0.005** | **1** | 36.606 | 0.933 | 0.994 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 33.924 | 0.965 | 0.999 |
| **0.005** | **50** | 34.118 | 0.972 | 0.998 |
| **0.005** | **60** | 34.279 | 0.977 | 0.998 |
| **0.005** | **70** | 34.298 | 0.981 | 0.999 |
| **0.005** | **80** | 34.406 | 0.987 | 0.999 |
| **0.007** | **40** | 33.973 | 0.965 | 0.999 |
| **0.007** | **50** | 34.164 | 0.972 | 0.999 |
| **0.007** | **60** | 34.325 | 0.977 | 0.999 |
| **0.007** | **70** | 34.345 | 0.981 | 0.999 |
| **0.007** | **80** | 34.458 | 0.987 | 0.999 |
| **0.01** | **40** | 31.392 | 0.962 | 0.999 |
| **0.01** | **50** | 31.483 | 0.969 | 1.000 |
| **0.01** | **60** | 31.554 | 0.974 | 0.999 |
| **0.01** | **70** | 31.605 | 0.979 | 1.000 |
| **0.01** | **80** | 31.657 | 0.984 | 1.000 |
| **0.02** | **40** | 31.111 | 0.961 | 0.997 |
| **0.02** | **50** | 31.213 | 0.967 | 0.997 |
| **0.02** | **60** | 31.298 | 0.972 | 0.996 |
| **0.02** | **70** | 31.340 | 0.977 | 0.997 |
| **0.02** | **80** | 31.394 | 0.982 | 0.997 |
| **0.03** | **40** | 30.917 | 0.958 | 0.995 |
| **0.03** | **50** | 31.004 | 0.964 | 0.995 |
| **0.03** | **60** | 31.086 | 0.969 | 0.996 |
| **0.03** | **70** | 31.127 | 0.974 | 0.996 |
| **0.03** | **80** | 31.175 | 0.979 | 0.996 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 31.898 | 0.793 | 0.951 |
| **0.001** | **0.002** | 30.423 | 0.771 | 0.949 |
| **0.001** | **0.003** | 29.322 | 0.750 | 0.949 |
| **0.001** | **0.004** | 28.366 | 0.726 | 0.942 |
| **0.001** | **0.005** | 27.639 | 0.705 | 0.938 |
| **0.002** | **0.001** | 30.097 | 0.695 | 0.949 |
| **0.002** | **0.002** | 29.069 | 0.677 | 0.948 |
| **0.002** | **0.003** | 28.239 | 0.659 | 0.947 |
| **0.002** | **0.004** | 27.476 | 0.640 | 0.940 |
| **0.002** | **0.005** | 26.876 | 0.622 | 0.936 |
| **0.003** | **0.001** | 28.833 | 0.628 | 0.948 |
| **0.003** | **0.002** | 28.044 | 0.612 | 0.946 |
| **0.003** | **0.003** | 27.376 | 0.597 | 0.945 |
| **0.003** | **0.004** | 26.742 | 0.580 | 0.938 |
| **0.003** | **0.005** | 26.231 | 0.565 | 0.934 |
| **0.004** | **0.001** | 27.858 | 0.577 | 0.946 |
| **0.004** | **0.002** | 27.218 | 0.563 | 0.944 |
| **0.004** | **0.003** | 26.659 | 0.550 | 0.943 |
| **0.004** | **0.004** | 26.117 | 0.535 | 0.936 |
| **0.004** | **0.005** | 25.670 | 0.522 | 0.932 |
| **0.005** | **0.001** | 27.066 | 0.537 | 0.944 |
| **0.005** | **0.002** | 26.527 | 0.525 | 0.942 |
| **0.005** | **0.003** | 26.046 | 0.513 | 0.941 |
| **0.005** | **0.004** | 25.572 | 0.500 | 0.934 |
| **0.005** | **0.005** | 25.177 | 0.488 | 0.930 |

**image:** images/pepper.tiff

**Without attack output:**

Host vs Watermarked: *PSNR* – 41.230, *SSIM* – 0.998  
 Host vs Reconstructed Host: *PSNR* – 48.131, *SSIM* – 1.000

NC: 0.992

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.997 | 0.997 | 0.955 |
| **1** | 42.905 | 0.992 | 0.955 |
| **3** | 37.595 | 0.940 | 0.955 |
| **5** | 33.781 | 0.856 | 0.956 |
| **7** | 31.061 | 0.763 | 0..957 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 36.547 | 0.921 | 0.960 |
| **20** | 38.904 | 0.957 | 0.958 |
| **30** | 40.092 | 0.970 | 0.957 |
| **40** | 40.842 | 0.977 | 0.957 |
| **50** | 41.355 | 0.982 | 0.956 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 35.032 | 0.972 | 0.993 |
| **0.002** | 32.167 | 0.946 | 0.994 |
| **0.003** | 30.765 | 0.925 | 0.994 |
| **0.004** | 29.303 | 0.897 | 0.992 |
| **0.005** | 28.336 | 0.874 | 0.991 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 35.080 | 0.894 | 0.954 |
| **0.002** | 32.331 | 0.824 | 0.953 |
| **0.003** | 30.661 | 0.772 | 0.952 |
| **0.004** | 29.459 | 0.730 | 0.951 |
| **0.005** | 28.520 | 0.695 | 0.950 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 34.991 | 0.998 | 0.995 |
| **0.007** | 31.794 | 0.997 | 0.995 |
| **0.01** | 31.674 | 0.996 | 0.995 |
| **0.02** | 30.664 | 0.991 | 0.985 |
| **0.03** | 28.200 | 0.980 | 0.944 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 47.282 | 0.999 | 0.992 |
| **-0.05** | 40.247 | 0.989 | 0.992 |
| **-0.1** | 35.145 | 0.964 | 0.988 |
| **-0.3** | 26.977 | 0.838 | 0.943 |
| **-0.5** | 24.013 | 0.765 | 0.854 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 47.279 | 0.999 | 0.993 |
| **0.05** | 40.214 | 0.989 | 0.993 |
| **0.1** | 35.112 | 0.964 | 0.990 |
| **0.3** | 26.942 | 0.838 | 0.955 |
| **0.5** | 24.017 | 0.765 | 0.874 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 31.855 | 0.899 | 0.998 |
| **0.6** | 32.974 | 0.912 | 0.996 |
| **0.7** | 35.795 | 0.926 | 0.996 |
| **0.8** | 35.795 | 0.939 | 0.996 |
| **0.9** | 37.466 | 0.952 | 0.996 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 34.059 | 0.879 | 0.992 |
| **50** | 34.582 | 0.889 | 0.992 |
| **60** | 35.076 | 0.898 | 0.992 |
| **70** | 35.684 | 0.908 | 0.992 |
| **80** | 36.482 | 0.921 | 0.992 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.122 | 1.000 | 0.992 |
| **0.5** | 38.875 | 0.977 | 0.977 |
| **0.7** | 33.944 | 0.934 | 0.996 |
| **1** | 32.132 | 0.910 | 0.993 |
| **1.5** | 31.304 | 0.898 | 0.991 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.122 | 1.000 | 0.992 |
| **0.5** | 38.875 | 0.977 | 0.977 |
| **0.7** | 33.769 | 0.932 | 0.996 |
| **0.8** | 32.608 | 0.917 | 0.992 |
| **1** | 31.217 | 0.896 | 0.979 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 34.969 | 0.900 | 0.991 |
| **5** | 32.354 | 0.864 | 0.970 |
| **7** | 30.468 | 0.837 | 0.893 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 30.781 | 0.891 | 0.989 |
| **5** | 28.278 | 0.835 | 0.864 |
| **7** | 26.690 | 0.789 | 0.524 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 33.837 | 0.879 | 0.954 |
| **0.5** | **50** | 34.330 | 0.889 | 0.954 |
| **0.5** | **60** | 34.787 | 0.898 | 0.953 |
| **0.5** | **70** | 35.351 | 0.908 | 0.953 |
| **0.5** | **80** | 36.088 | 0.920 | 0.955 |
| **1** | **40** | 33.813 | 0.878 | 0.955 |
| **1** | **50** | 34.304 | 0.888 | 0.956 |
| **1** | **60** | 34.749 | 0.897 | 0.954 |
| **1** | **70** | 35.298 | 0.906 | 0.953 |
| **1** | **80** | 36.009 | 0.918 | 0.955 |
| **3** | **40** | 33.535 | 0.870 | 0.956 |
| **3** | **50** | 33.910 | 0.877 | 0.953 |
| **3** | **60** | 34.263 | 0.883 | 0.954 |
| **3** | **70** | 34.669 | 0.890 | 0.954 |
| **3** | **80** | 35.036 | 0.895 | 0.956 |
| **5** | **40** | 32.850 | 0.845 | 0.956 |
| **5** | **50** | 33.039 | 0.846 | 0.954 |
| **5** | **60** | 33.226 | 0.848 | 0.956 |
| **5** | **70** | 33.347 | 0.848 | 0.955 |
| **5** | **80** | 33.060 | 0.836 | 0.956 |
| **7** | **40** | 31.756 | 0.800 | 0.958 |
| **7** | **50** | 31.806 | 0.796 | 0.957 |
| **7** | **60** | 31.784 | 0.792 | 0.956 |
| **7** | **70** | 31.476 | 0.778 | 0.956 |
| **7** | **80** | 30.627 | 0.742 | 0.959 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 35.265 | 0.972 | 0.994 |
| **0.001** | **-0.05** | 35.367 | 0.964 | 0.993 |
| **0.001** | **-0.1** | 33.518 | 0.943 | 0.989 |
| **0.001** | **-0.3** | 26.667 | 0.819 | 0.945 |
| **0.001** | **-0.5** | 23.868 | 0.748 | 0.854 |
| **0.002** | **-0.01** | 32.409 | 0.947 | 0.994 |
| **0.002** | **-0.05** | 33.094 | 0.941 | 0.994 |
| **0.002** | **-0.1** | 32.302 | 0.922 | 0.991 |
| **0.002** | **-0.3** | 26.410 | 0.802 | 0.947 |
| **0.002** | **-0.5** | 23.725 | 0.731 | 0.859 |
| **0.003** | **-0.01** | 31.019 | 0.926 | 0.994 |
| **0.003** | **-0.05** | 31.898 | 0.922 | 0.994 |
| **0.003** | **-0.1** | 31.552 | 0.905 | 0.990 |
| **0.003** | **-0.3** | 26.225 | 0.788 | 0.947 |
| **0.003** | **-0.5** | 23.622 | 0.718 | 0.860 |
| **0.004** | **-0.01** | 29.560 | 0.898 | 0.993 |
| **0.004** | **-0.05** | 30.609 | 0.897 | 0.993 |
| **0.004** | **-0.1** | 30.660 | 0.883 | 0.990 |
| **0.004** | **-0.3** | 25.946 | 0.769 | 0.945 |
| **0.004** | **-0.5** | 23.477 | 0.701 | 0.855 |
| **0.005** | **-0.01** | 28.599 | 0.876 | 0.991 |
| **0.005** | **-0.05** | 29.731 | 0.877 | 0.992 |
| **0.005** | **-0.1** | 30.012 | 0.865 | 0.988 |
| **0.005** | **-0.3** | 25..727 | 0.754 | 0.943 |
| **0.005** | **-0.5** | 23.355 | 0.687 | 0.854 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 35.262 | 0.972 | 0.994 |
| **0.001** | **0.05** | 35.341 | 0.964 | 0.994 |
| **0.001** | **0.1** | 33.478 | 0.943 | 0.991 |
| **0.001** | **0.3** | 26.628 | 0.819 | 0.956 |
| **0.001** | **0.5** | 23.869 | 0.747 | 0.876 |
| **0.002** | **0.01** | 32.414 | 0.947 | 0.995 |
| **0.002** | **0.05** | 33.099 | 0.941 | 0.995 |
| **0.002** | **0.1** | 32.297 | 0.922 | 0.992 |
| **0.002** | **0.3** | 26.390 | 0.802 | 0.956 |
| **0.002** | **0.5** | 23.736 | 0.731 | 0.873 |
| **0.003** | **0.01** | 31.019 | 0.926 | 0.994 |
| **0.003** | **0.05** | 31.879 | 0.922 | 0.994 |
| **0.003** | **0.1** | 31.510 | 0.905 | 0.992 |
| **0.003** | **0.3** | 26.188 | 0.787 | 0.958 |
| **0.003** | **0.5** | 23.624 | 0.718 | 0.874 |
| **0.004** | **0.01** | 29.562 | 0.898 | 0.993 |
| **0.004** | **0.05** | 30.594 | 0.897 | 0.993 |
| **0.004** | **0.1** | 30.627 | 0.883 | 0.990 |
| **0.004** | **0.3** | 25.914 | 0.769 | 0.956 |
| **0.004** | **0.5** | 23.483 | 0.701 | 0.868 |
| **0.005** | **0.01** | 28.601 | 0.876 | 0.991 |
| **0.005** | **0.05** | 29.721 | 0.877 | 0.992 |
| **0.005** | **0.1** | 29.986 | 0.865 | 0.990 |
| **0.005** | **0.3** | 25.691 | 0.753 | 0.955 |
| **0.005** | **0.5** | 23.354 | 0.687 | 0.868 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.112 | 0.972 | 0.993 |
| **0.001** | **0.5** | 35.925 | 0.956 | 0.998 |
| **0.001** | **0.7** | 33.397 | 0.920 | 0.997 |
| **0.001** | **1** | 31.870 | 0.899 | 0.994 |
| **0.001** | **1.5** | 31.108 | 0.888 | 0.991 |
| **0.002** | **0.3** | 32.240 | 0.947 | 0.994 |
| **0.002** | **0.5** | 34.184 | 0.936 | 0.998 |
| **0.002** | **0.7** | 32.901 | 0.907 | 0.997 |
| **0.002** | **1** | 31.614 | 0.888 | 0.993 |
| **0.002** | **1.5** | 30.911 | 0.878 | 0.990 |
| **0.003** | **0.3** | 30.840 | 0.925 | 0.994 |
| **0.003** | **0.5** | 33.198 | 0.921 | 0.998 |
| **0.003** | **0.7** | 32.558 | 0.897 | 0.997 |
| **0.003** | **1** | 31.432 | 0.880 | 0.993 |
| **0.003** | **1.5** | 30.770 | 0.871 | 0.991 |
| **0.004** | **0.3** | 29.374 | 0.898 | 0.992 |
| **0.004** | **0.5** | 32.057 | 0.899 | 0.998 |
| **0.004** | **0.7** | 32.089 | 0.882 | 0.997 |
| **0.004** | **1** | 31.166 | 0.869 | 0.994 |
| **0.004** | **1.5** | 30.562 | 0.860 | 0.991 |
| **0.005** | **0.3** | 28.407 | 0.875 | 0.991 |
| **0.005** | **0.5** | 31.257 | 0.882 | 0.997 |
| **0.005** | **0.7** | 31.712 | 0.871 | 0.996 |
| **0.005** | **1** | 30.944 | 0.859 | 0.993 |
| **0.005** | **1.5** | 30.386 | 0.851 | 0.990 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 35.112 | 0.972 | 0.993 |
| **0.001** | **0.5** | 35.925 | 0.956 | 0.998 |
| **0.001** | **0.7** | 33.271 | 0.919 | 0.996 |
| **0.001** | **0.8** | 32.318 | 0.906 | 0.992 |
| **0.001** | **1** | 31.073 | 0.888 | 0.978 |
| **0.002** | **0.3** | 32.240 | 0.947 | 0.994 |
| **0.002** | **0.5** | 34.184 | 0.936 | 0.998 |
| **0.002** | **0.7** | 32.813 | 0.906 | 0.996 |
| **0.002** | **0.8** | 32.037 | 0.896 | 0.991 |
| **0.002** | **1** | 30.929 | 0.881 | 0.976 |
| **0.003** | **0.3** | 30.840 | 0.925 | 0.994 |
| **0.003** | **0.5** | 33.198 | 0.921 | 0.998 |
| **0.003** | **0.7** | 32.495 | 0.896 | 0.996 |
| **0.003** | **0.8** | 31.837 | 0.888 | 0.991 |
| **0.003** | **1** | 30.824 | 0.875 | 0.977 |
| **0.004** | **0.3** | 29.374 | 0.898 | 0.992 |
| **0.004** | **0.5** | 32.057 | 0.899 | 0.998 |
| **0.004** | **0.7** | 32.056 | 0.883 | 0.996 |
| **0.004** | **0.8** | 31.546 | 0.877 | 0.992 |
| **0.004** | **1** | 30.664 | 0.867 | 0.977 |
| **0.005** | **0.3** | 28.407 | 0.875 | 0.991 |
| **0.005** | **0.5** | 31.257 | 0.882 | 0.997 |
| **0.005** | **0.7** | 31.701 | 0.871 | 0.996 |
| **0.005** | **0.8** | 31.304 | 0.867 | 0.991 |
| **0.005** | **1** | 30.527 | 0.860 | 0.976 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 31.655 | 0.879 | 0.994 |
| **0.005** | **50** | 31.915 | 0.888 | 0.994 |
| **0.005** | **60** | 32.170 | 0.897 | 0.995 |
| **0.005** | **70** | 32.458 | 0.907 | 0.995 |
| **0.005** | **80** | 32.806 | 0.919 | 0.995 |
| **0.007** | **40** | 29.909 | 0.878 | 0.995 |
| **0.007** | **50** | 30.071 | 0.888 | 0.995 |
| **0.007** | **60** | 30.228 | 0.896 | 0.995 |
| **0.007** | **70** | 30.406 | 0.906 | 0.995 |
| **0.007** | **80** | 30.614 | 0.918 | 0.995 |
| **0.01** | **40** | 29.836 | 0.878 | 0.994 |
| **0.01** | **50** | 30.002 | 0.887 | 0.994 |
| **0.01** | **60** | 30.153 | 0.895 | 0.995 |
| **0.01** | **70** | 30.324 | 0.905 | 0.994 |
| **0.01** | **80** | 30.527 | 0.917 | 0.995 |
| **0.02** | **40** | 29.170 | 0.874 | 0.986 |
| **0.02** | **50** | 29.314 | 0.884 | 0.985 |
| **0.02** | **60** | 29.444 | 0.892 | 0.985 |
| **0.02** | **70** | 29.587 | 0.901 | 0.985 |
| **0.02** | **80** | 29.748 | 0.913 | 0.985 |
| **0.03** | **40** | 27.308 | 0.866 | 0.945 |
| **0.03** | **50** | 27.400 | 0.875 | 0.944 |
| **0.03** | **60** | 27.478 | 0.883 | 0.945 |
| **0.03** | **70** | 27.558 | 0.893 | 0.944 |
| **0.03** | **80** | 27.658 | 0.904 | 0.944 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 32.157 | 0.871 | 0.958 |
| **0.001** | **0.002** | 30.451 | 0.849 | 0.962 |
| **0.001** | **0.003** | 29.460 | 0.831 | 0.961 |
| **0.001** | **0.004** | 28.334 | 0.808 | 0.958 |
| **0.001** | **0.005** | 27.545 | 0.789 | 0.957 |
| **0.002** | **0.001** | 30.543 | 0.804 | 0.957 |
| **0.002** | **0.002** | 29.300 | 0.785 | 0.961 |
| **0.002** | **0.003** | 28.521 | 0.769 | 0.960 |
| **0.002** | **0.004** | 27.593 | 0.749 | 0.957 |
| **0.002** | **0.005** | 26.919 | 0.732 | 0.956 |
| **0.003** | **0.001** | 29.370 | 0.753 | 0.956 |
| **0.003** | **0.002** | 28.390 | 0.736 | 0.960 |
| **0.003** | **0.003** | 27.749 | 0.722 | 0.959 |
| **0.003** | **0.004** | 26.960 | 0.704 | 0.956 |
| **0.003** | **0.005** | 26.372 | 0.689 | 0.955 |
| **0.004** | **0.001** | 28.448 | 0.713 | 0.954 |
| **0.004** | **0.002** | 27.640 | 0.698 | 0.959 |
| **0.004** | **0.003** | 27.095 | 0.685 | 0.958 |
| **0.004** | **0.004** | 26.408 | 0.669 | 0.955 |
| **0.004** | **0.005** | 25.887 | 0.655 | 0.954 |
| **0.005** | **0.001** | 27.689 | 0.680 | 0.953 |
| **0.005** | **0.002** | 27.002 | 0.666 | 0.958 |
| **0.005** | **0.003** | 26.528 | 0.654 | 0.956 |
| **0.005** | **0.004** | 25.920 | 0.639 | 0.954 |
| **0.005** | **0.005** | 25.452 | 0.626 | 0.953 |

**image:** images/texture.tiff

**Without attack output:**

Host vs Watermarked: *PSNR* – 40.442, *SSIM* – 0.999  
 Host vs Reconstructed Host: *PSNR* – 47.532, *SSIM* – 1.000

NC: 0.995

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 43.733 | 0.999 | 0.968 |
| **1** | 42.698 | 0.999 | 0.968 |
| **3** | 37.583 | 0.996 | 0.970 |
| **5** | 33.851 | 0.990 | 0.973 |
| **7** | 31.174 | 0.981 | 0.977 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 36.314 | 0.995 | 0.971 |
| **20** | 38.626 | 0.997 | 0.970 |
| **30** | 39.809 | 0.998 | 0.969 |
| **40** | 40.530 | 0.998 | 0.969 |
| **50** | 41.048 | 0.999 | 0.969 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.485 | 0.994 | 0.996 |
| **0.002** | 31.735 | 0.989 | 0.996 |
| **0.003** | 29.920 | 0.983 | 0.997 |
| **0.004** | 28.567 | 0.977 | 0.996 |
| **0.005** | 27.650 | 0.971 | 0.996 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.331 | 0.992 | 0.966 |
| **0.002** | 31.639 | 0.986 | 0.964 |
| **0.003** | 30.019 | 0.979 | 0.961 |
| **0.004** | 28.861 | 0.973 | 0.957 |
| **0.005** | 27.959 | 0.968 | 0.953 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 35.613 | 0.999 | 0.991 |
| **0.007** | 31.677 | 0.998 | 0.976 |
| **0.01** | 27.096 | 0.995 | 0.977 |
| **0.02** | 24.404 | 0.986 | 0.939 |
| **0.03** | 22.293 | 0.969 | 0.873 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 43.010 | 0.999 | 0.996 |
| **-0.05** | 30.952 | 0.988 | 0.994 |
| **-0.1** | 25.317 | 0.955 | 0.983 |
| **-0.3** | 16.977 | 0.717 | 0.912 |
| **-0.5** | 14.217 | 0.502 | 0.861 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 43.025 | 0.999 | 0.996 |
| **0.05** | 30.968 | 0.988 | 0.995 |
| **0.1** | 25.334 | 0.955 | 0.985 |
| **0.3** | 16.991 | 0.717 | 0.899 |
| **0.5** | 14.228 | 0.502 | 0.819 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 22.127 | 0.885 | 0.997 |
| **0.6** | 23.288 | 0.913 | 0.992 |
| **0.7** | 24.707 | 0.939 | 0.996 |
| **0.8** | 26.099 | 0.956 | 0.997 |
| **0.9** | 27.509 | 0.968 | 0.998 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 26.250 | 0.952 | 0.998 |
| **50** | 27.136 | 0.961 | 0.998 |
| **60** | 28.084 | 0.968 | 0.998 |
| **70** | 29.470 | 0.976 | 0.997 |
| **80** | 31.721 | 0.985 | 0.997 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 47.050 | 1.000 | 0.995 |
| **0.5** | 29.958 | 0.983 | 0.996 |
| **0.7** | 24.613 | 0.936 | 0.967 |
| **1** | 22.728 | 0.899 | 0.932 |
| **1.5** | 21.879 | 0.875 | 0.906 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 47.050 | 1.000 | 0.995 |
| **0.5** | 29.958 | 0.983 | 0.996 |
| **0.7** | 24.302 | 0.931 | 0.956 |
| **0.8** | 22.910 | 0.902 | 0.906 |
| **1** | 21.238 | 0.850 | 0.779 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 23.391 | 0.907 | 0.868 |
| **5** | 18.976 | 0.728 | 0.667 |
| **7** | 16.909 | 0.557 | 0.442 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 21.349 | 0.858 | 0.886 |
| **5** | 17.782 | 0.644 | 0.243 |
| **7** | 16.073 | 0.463 | -0.143 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 26.209 | 0.952 | 0.980 |
| **0.5** | **50** | 27.084 | 0.960 | 0.979 |
| **0.5** | **60** | 28.019 | 0.967 | 0.978 |
| **0.5** | **70** | 29.383 | 0.976 | 0.976 |
| **0.5** | **80** | 31.573 | 0.985 | 0.974 |
| **1** | **40** | 26.199 | 0.952 | 0.981 |
| **1** | **50** | 27.070 | 0.960 | 0.979 |
| **1** | **60** | 28.003 | 0.967 | 0.979 |
| **1** | **70** | 29.352 | 0.975 | 0.976 |
| **1** | **80** | 31.518 | 0.984 | 0.975 |
| **3** | **40** | 26.087 | 0.950 | 0.981 |
| **3** | **50** | 26.920 | 0.959 | 0.980 |
| **3** | **60** | 27.794 | 0.966 | 0.979 |
| **3** | **70** | 29.037 | 0.973 | 0.977 |
| **3** | **80** | 30.934 | 0.982 | 0.977 |
| **5** | **40** | 25.872 | 0.948 | 0.983 |
| **5** | **50** | 26.630 | 0.955 | 0.983 |
| **5** | **60** | 27.405 | 0.962 | 0.982 |
| **5** | **70** | 28.459 | 0.969 | 0.980 |
| **5** | **80** | 29.927 | 0.977 | 0.979 |
| **7** | **40** | 25.563 | 0.943 | 0.986 |
| **7** | **50** | 26.212 | 0.950 | 0.985 |
| **7** | **60** | 26.862 | 0.956 | 0.986 |
| **7** | **70** | 27.667 | 0.963 | 0.984 |
| **7** | **80** | 28.689 | 0.969 | 0.983 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 34.348 | 0.994 | 0.996 |
| **0.001** | **-0.05** | 29.869 | 0.984 | 0.994 |
| **0.001** | **-0.1** | 25.084 | 0.951 | 0.982 |
| **0.001** | **-0.3** | 16.945 | 0.714 | 0.909 |
| **0.001** | **-0.5** | 14.203 | 0.501 | 0.857 |
| **0.002** | **-0.01** | 31.794 | 0.989 | 0.997 |
| **0.002** | **-0.05** | 29.063 | 0.979 | 0.995 |
| **0.002** | **-0.1** | 24.877 | 0.948 | 0.983 |
| **0.002** | **-0.3** | 16.913 | 0.712 | 0.912 |
| **0.002** | **-0.5** | 14.188 | 0.499 | 0.862 |
| **0.003** | **-0.01** | 30.041 | 0.983 | 0.997 |
| **0.003** | **-0.05** | 28.294 | 0.975 | 0.993 |
| **0.003** | **-0.1** | 24.650 | 0.945 | 0.979 |
| **0.003** | **-0.3** | 16.885 | 0.710 | 0.907 |
| **0.003** | **-0.5** | 14.174 | 0.497 | 0.854 |
| **0.004** | **-0.01** | 28.712 | 0.977 | 0.996 |
| **0.004** | **-0.05** | 27.602 | 0.970 | 0.991 |
| **0.004** | **-0.1** | 24.419 | 0.941 | 0.977 |
| **0.004** | **-0.3** | 16.852 | 0.707 | 0.901 |
| **0.004** | **-0.5** | 14.161 | 0.496 | 0.842 |
| **0.005** | **-0.01** | 27.824 | 0.972 | 0.996 |
| **0.005** | **-0.05** | 27.089 | 0.966 | 0.990 |
| **0.005** | **-0.1** | 24.236 | 0.938 | 0.975 |
| **0.005** | **-0.3** | 16.822 | 0.705 | 0.896 |
| **0.005** | **-0.5** | 14.147 | 0.494 | 0.837 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 34.346 | 0.994 | 0.996 |
| **0.001** | **0.05** | 29.870 | 0.984 | 0.995 |
| **0.001** | **0.1** | 25.093 | 0.952 | 0.985 |
| **0.001** | **0.3** | 16.958 | 0.715 | 0.899 |
| **0.001** | **0.5** | 14.215 | 0.501 | 0.818 |
| **0.002** | **0.01** | 31.793 | 0.989 | 0.997 |
| **0.002** | **0.05** | 29.076 | 0.980 | 0.995 |
| **0.002** | **0.1** | 24.892 | 0.948 | 0.982 |
| **0.002** | **0.3** | 16.926 | 0.712 | 0.895 |
| **0.002** | **0.5** | 14.198 | 0.499 | 0.809 |
| **0.003** | **0.01** | 30.040 | 0.983 | 0.997 |
| **0.003** | **0.05** | 28.285 | 0.975 | 0.995 |
| **0.003** | **0.1** | 24.651 | 0.945 | 0.982 |
| **0.003** | **0.3** | 16.892 | 0.710 | 0.891 |
| **0.003** | **0.5** | 14.182 | 0.497 | 0.803 |
| **0.004** | **0.01** | 28.716 | 0.977 | 0.997 |
| **0.004** | **0.05** | 27.602 | 0.970 | 0.996 |
| **0.004** | **0.1** | 24.430 | 0.941 | 0.982 |
| **0.004** | **0.3** | 16.861 | 0.707 | 0.885 |
| **0.004** | **0.5** | 14.165 | 0.496 | 0.789 |
| **0.005** | **0.01** | 27.822 | 0.972 | 0.997 |
| **0.005** | **0.05** | 27.092 | 0.966 | 0.994 |
| **0.005** | **0.1** | 24.249 | 0.938 | 0.980 |
| **0.005** | **0.3** | 16.833 | 0.705 | 0.879 |
| **0.005** | **0.5** | 14.152 | 0.494 | 0.784 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.531 | 0.994 | 0.995 |
| **0.001** | **0.5** | 29.355 | 0.980 | 0.995 |
| **0.001** | **0.7** | 24.523 | 0.935 | 0.963 |
| **0.001** | **1** | 22.683 | 0.897 | 0.926 |
| **0.001** | **1.5** | 21.845 | 0.874 | 0.899 |
| **0.002** | **0.3** | 31.791 | 0.989 | 0.996 |
| **0.002** | **0.5** | 28.862 | 0.976 | 0.993 |
| **0.002** | **0.7** | 24.442 | 0.933 | 0.959 |
| **0.002** | **1** | 22.642 | 0.896 | 0.919 |
| **0.002** | **1.5** | 21.813 | 0.873 | 0.891 |
| **0.003** | **0.3** | 29.980 | 0.983 | 0.997 |
| **0.003** | **0.5** | 28.373 | 0.973 | 0.991 |
| **0.003** | **0.7** | 24.353 | 0.931 | 0.950 |
| **0.003** | **1** | 22.598 | 0.895 | 0.907 |
| **0.003** | **1.5** | 21.780 | 0.871 | 0.877 |
| **0.004** | **0.3** | 28.624 | 0.977 | 0.996 |
| **0.004** | **0.5** | 27.906 | 0.970 | 0.990 |
| **0.004** | **0.7** | 24.261 | 0.929 | 0.948 |
| **0.004** | **1** | 22.551 | 0.893 | 0.902 |
| **0.004** | **1.5** | 21.743 | 0.870 | 0.870 |
| **0.005** | **0.3** | 27.711 | 0.972 | 0.996 |
| **0.005** | **0.5** | 27.531 | 0.966 | 0.988 |
| **0.005** | **0.7** | 24.181 | 0.927 | 0.942 |
| **0.005** | **1** | 22.511 | 0.892 | 0.895 |
| **0.005** | **1.5** | 21.713 | 0.869 | 0.861 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.531 | 0.994 | 0.995 |
| **0.001** | **0.5** | 29.355 | 0.980 | 0.995 |
| **0.001** | **0.7** | 24.221 | 0.929 | 0.951 |
| **0.001** | **0.8** | 22.862 | 0.901 | 0.898 |
| **0.001** | **1** | 21.213 | 0.849 | 0.769 |
| **0.002** | **0.3** | 31.791 | 0.989 | 0.996 |
| **0.002** | **0.5** | 28.862 | 0.976 | 0.993 |
| **0.002** | **0.7** | 24.148 | 0.928 | 0.945 |
| **0.002** | **0.8** | 22.820 | 0.900 | 0.890 |
| **0.002** | **1** | 21.191 | 0.849 | 0.756 |
| **0.003** | **0.3** | 29.980 | 0.983 | 0.997 |
| **0.003** | **0.5** | 28.373 | 0.973 | 0.991 |
| **0.003** | **0.7** | 24.068 | 0.926 | 0.936 |
| **0.003** | **0.8** | 22.772 | 0.898 | 0.876 |
| **0.003** | **1** | 21.165 | 0.847 | 0.737 |
| **0.004** | **0.3** | 28.624 | 0.977 | 0.996 |
| **0.004** | **0.5** | 27.906 | 0.970 | 0.990 |
| **0.004** | **0.7** | 23.985 | 0.924 | 0.932 |
| **0.004** | **0.8** | 22.722 | 0.897 | 0.869 |
| **0.004** | **1** | 21.138 | 0.846 | 0.722 |
| **0.005** | **0.3** | 27.711 | 0.972 | 0.996 |
| **0.005** | **0.5** | 27.531 | 0.966 | 0.988 |
| **0.005** | **0.7** | 23.913 | 0.922 | 0.926 |
| **0.005** | **0.8** | 22.680 | 0.895 | 0.860 |
| **0.005** | **1** | 21.116 | 0.845 | 0.709 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 25.830 | 0.951 | 0.996 |
| **0.005** | **50** | 26.617 | 0.960 | 0.995 |
| **0.005** | **60** | 27.448 | 0.967 | 0.995 |
| **0.005** | **70** | 28.595 | 0.975 | 0.994 |
| **0.005** | **80** | 30.322 | 0.984 | 0.994 |
| **0.007** | **40** | 25.222 | 0.951 | 0.982 |
| **0.007** | **50** | 25.897 | 0.959 | 0.982 |
| **0.007** | **60** | 26.581 | 0.966 | 0.981 |
| **0.007** | **70** | 27.493 | 0.974 | 0.979 |
| **0.007** | **80** | 28.753 | 0.983 | 0.979 |
| **0.01** | **40** | 23.710 | 0.948 | 0.982 |
| **0.01** | **50** | 24.163 | 0.956 | 0.981 |
| **0.01** | **60** | 24.606 | 0.963 | 0.981 |
| **0.01** | **70** | 25.156 | 0.971 | 0.980 |
| **0.01** | **80** | 25.853 | 0.980 | 0.979 |
| **0.02** | **40** | 22.306 | 0.939 | 0.942 |
| **0.02** | **50** | 22.626 | 0.947 | 0.941 |
| **0.02** | **60** | 22.918 | 0.954 | 0.941 |
| **0.02** | **70** | 23.277 | 0.962 | 0.940 |
| **0.02** | **80** | 23.705 | 0.971 | 0.940 |
| **0.03** | **40** | 20.907 | 0.923 | 0.867 |
| **0.03** | **50** | 21.130 | 0.931 | 0.871 |
| **0.03** | **60** | 21.339 | 0.938 | 0.871 |
| **0.03** | **70** | 21.579 | 0.946 | 0.871 |
| **0.03** | **80** | 21.856 | 0.955 | 0.871 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 31.506 | 0.987 | 0.970 |
| **0.001** | **0.002** | 29.909 | 0.981 | 0.973 |
| **0.001** | **0.003** | 28.637 | 0.976 | 0.976 |
| **0.001** | **0.004** | 27.592 | 0.970 | 0.973 |
| **0.001** | **0.005** | 26.846 | 0.964 | 0.976 |
| **0.002** | **0.001** | 29.900 | 0.980 | 0.968 |
| **0.002** | **0.002** | 28.738 | 0.975 | 0.970 |
| **0.002** | **0.003** | 27.735 | 0.969 | 0.974 |
| **0.002** | **0.004** | 26.869 | 0.964 | 0.970 |
| **0.002** | **0.005** | 26.230 | 0.958 | 0.973 |
| **0.003** | **0.001** | 28.752 | 0.974 | 0.965 |
| **0.003** | **0.002** | 27.834 | 0.969 | 0.967 |
| **0.003** | **0.003** | 27.004 | 0.963 | 0.971 |
| **0.003** | **0.004** | 26.262 | 0.958 | 0.966 |
| **0.003** | **0.005** | 25.701 | 0.952 | 0.970 |
| **0.004** | **0.001** | 27.860 | 0.968 | 0.961 |
| **0.004** | **0.002** | 27.099 | 0.963 | 0.964 |
| **0.004** | **0.003** | 26.388 | 0.958 | 0.968 |
| **0.004** | **0.004** | 25.738 | 0.952 | 0.962 |
| **0.004** | **0.005** | 25.238 | 0.947 | 0.967 |
| **0.005** | **0.001** | 27.129 | 0.962 | 0.958 |
| **0.005** | **0.002** | 26.478 | 0.957 | 0.961 |
| **0.005** | **0.003** | 25.856 | 0.952 | 0.964 |
| **0.005** | **0.004** | 25.277 | 0.947 | 0.957 |
| **0.005** | **0.005** | 24.825 | 0.941 | 0.962 |

**image:** images/tribe\_woman.jpg

**Without attack output:**

Host vs Watermarked: *PSNR* – 41.106, *SSIM* – 0.997  
 Host vs Reconstructed Host: *PSNR* – 48.193, *SSIM* – 0.997

NC: 0.994

**Gaussian Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sigma** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 44.142 | 0.993 | 0.969 |
| **1** | 43.077 | 0.989 | 0.969 |
| **3** | 37.813 | 0.944 | 0.974 |
| **5** | 34.013 | 0.872 | 0.978 |
| **7** | 31.298 | 0.795 | 0.981 |

**Poisson Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **10** | 36.391 | 0.906 | 0.972 |
| **20** | 38.801 | 0.945 | 0.970 |
| **30** | 40.002 | 0.960 | 0.969 |
| **40** | 40.770 | 0.968 | 0.969 |
| **50** | 41.315 | 0.973 | 0.969 |

**Salt & Pepper Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.350 | 0.976 | 0.994 |
| **0.002** | 31.779 | 0.960 | 0.994 |
| **0.003** | 30.087 | 0.943 | 0.993 |
| **0.004** | 28.892 | 0.926 | 0.992 |
| **0.005** | 28.004 | 0.910 | 0.991 |

**Speckle Noise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variance** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | 34.154 | 0.854 | 0.966 |
| **0.002** | 31.349 | 0.790 | 0.964 |
| **0.003** | 29.660 | 0.751 | 0.962 |
| **0.004** | 28.454 | 0.724 | 0.960 |
| **0.005** | 27.517 | 0.704 | 0.958 |

**Cropping**

|  |  |  |  |
| --- | --- | --- | --- |
| **Crop Percentage** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | 43.645 | 0.996 | 0.994 |
| **0.007** | 42.603 | 0.996 | 0.993 |
| **0.01** | 38.650 | 0.996 | 0.989 |
| **0.02** | 32.742 | 0.991 | 0.966 |
| **0.03** | 20.204 | 0.970 | 0.966 |

**Rotation Attack**

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **-0.01** | 46.661 | 0.996 | 0.995 |
| **-0.05** | 38.037 | 0.992 | 0.995 |
| **-0.1** | 32.542 | 0.981 | 0.992 |
| **-0.3** | 23.859 | 0.903 | 0.941 |
| **-0.5** | 20.639 | 0.819 | 0.848 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.01** | 46.653 | 0.996 | 0.995 |
| **0.05** | 37.997 | 0.992 | 0.995 |
| **0.1** | 32.478 | 0.981 | 0.993 |
| **0.3** | 23.792 | 0.903 | 0.946 |
| **0.5** | 20.585 | 0.819 | 0.867 |

**Scaling**

|  |  |  |  |
| --- | --- | --- | --- |
| **Scale Factor** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | 30.780 | 0.958 | 0.999 |
| **0.6** | 32.037 | 0.967 | 0.998 |
| **0.7** | 33.766 | 0.976 | 0.999 |
| **0.8** | 35.245 | 0.982 | 0.999 |
| **0.9** | 36.575 | 0.986 | 0.999 |

**JPEG Compression**

|  |  |  |  |
| --- | --- | --- | --- |
| **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **40** | 33.413 | 0.961 | 0.997 |
| **50** | 34.141 | 0.967 | 0.995 |
| **60** | 34.888 | 0.971 | 0.996 |
| **70** | 35.904 | 0.978 | 0.996 |
| **80** | 37.526 | 0.984 | 0.995 |

**Gaussian Blur**

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.171 | 0.997 | 0.994 |
| **0.5** | 38.267 | 0.991 | 0.999 |
| **0.7** | 33.048 | 0.975 | 0.990 |
| **1** | 31.102 | 0.963 | 0.977 |
| **1.5** | 30.208 | 0.955 | 0.966 |

|  |  |  |  |
| --- | --- | --- | --- |
| **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.3** | 48.171 | 0.997 | 0.994 |
| **0.5** | 38.267 | 0.991 | 0.999 |
| **0.7** | 32.616 | 0.973 | 0.986 |
| **0.8** | 31.012 | 0.963 | 0.967 |
| **1** | 29.013 | 0.944 | 0.911 |

**Median Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 31.400 | 0.960 | 0.983 |
| **5** | 26.623 | 0.897 | 0.904 |
| **7** | 23.988 | 0.829 | 0.739 |

**Average Filter**

|  |  |  |  |
| --- | --- | --- | --- |
| **Kernel Size** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **3** | 29.642 | 0.949 | 0.957 |
| **5** | 24.672 | 0.862 | 0.510 |
| **7** | 22.119 | 0.771 | -0.004 |

**Hybrid Attack (gaussian noise + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Noise Std.** | **JPEG**  **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.5** | **40** | 33.256 | 0.959 | 0.980 |
| **0.5** | **50** | 33.932 | 0.965 | 0.972 |
| **0.5** | **60** | 34.647 | 0.970 | 0.974 |
| **0.5** | **70** | 35.596 | 0.976 | 0.974 |
| **0.5** | **80** | 37.076 | 0.982 | 0.972 |
| **1** | **40** | 33.233 | 0.959 | 0.980 |
| **1** | **50** | 33.908 | 0.965 | 0.972 |
| **1** | **60** | 34.612 | 0.970 | 0.975 |
| **1** | **70** | 35.550 | 0.976 | 0.974 |
| **1** | **80** | 36.998 | 0.981 | 0.974 |
| **3** | **40** | 32.984 | 0.954 | 0.982 |
| **3** | **50** | 33.574 | 0.958 | 0.976 |
| **3** | **60** | 34.137 | 0.960 | 0.977 |
| **3** | **70** | 34.813 | 0.961 | 0.977 |
| **3** | **80** | 35.752 | 0.961 | 0.976 |
| **5** | **40** | 32.369 | 0.928 | 0.982 |
| **5** | **50** | 32.767 | 0.925 | 0.979 |
| **5** | **60** | 33.081 | 0.921 | 0.980 |
| **5** | **70** | 33.437 | 0.917 | 0.982 |
| **5** | **80** | 33.626 | 0.905 | 0.981 |
| **7** | **40** | 31.387 | 0.878 | 0.981 |
| **7** | **50** | 31.601 | 0.872 | 0.983 |
| **7** | **60** | 31.735 | 0.865 | 0.985 |
| **7** | **70** | 31.658 | 0.852 | 0.984 |
| **7** | **80** | 31.177 | 0.818 | 0.984 |

**Hybrid Attack (SPN + Rotation)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **-0.01** | 34.539 | 0.976 | 0.995 |
| **0.001** | **-0.05** | 34.055 | 0.974 | 0.995 |
| **0.001** | **-0.1** | 31.385 | 0.965 | 0.992 |
| **0.001** | **-0.3** | 23.682 | 0.887 | 0.944 |
| **0.001** | **-0.5** | 20.556 | 0.804 | 0.851 |
| **0.002** | **-0.01** | 32.012 | 0.960 | 0.994 |
| **0.002** | **-0.05** | 32.283 | 0.959 | 0.994 |
| **0.002** | **-0.1** | 30.610 | 0.951 | 0.992 |
| **0.002** | **-0.3** | 23.540 | 0.874 | 0.941 |
| **0.002** | **-0.5** | 20.491 | 0.792 | 0.846 |
| **0.003** | **-0.01** | 30.322 | 0.943 | 0.994 |
| **0.003** | **-0.05** | 30.901 | 0.944 | 0.995 |
| **0.003** | **-0.1** | 29.866 | 0.938 | 0.992 |
| **0.003** | **-0.3** | 23.401 | 0.861 | 0.946 |
| **0.003** | **-0.5** | 20.420 | 0.780 | 0.847 |
| **0.004** | **-0.01** | 29.137 | 0.927 | 0.992 |
| **0.004** | **-0.05** | 29.916 | 0.929 | 0.993 |
| **0.004** | **-0.1** | 29.285 | 0.924 | 0.990 |
| **0.004** | **-0.3** | 23.271 | 0.848 | 0.942 |
| **0.004** | **-0.5** | 20.358 | 0.768 | 0.768 |
| **0.005** | **-0.01** | 28.263 | 0.912 | 0.991 |
| **0.005** | **-0.05** | 29.174 | 0.915 | 0.992 |
| **0.005** | **-0.1** | 28.823 | 0.912 | 0.989 |
| **0.005** | **-0.3** | 23.150 | 0.837 | 0.937 |
| **0.005** | **-0.5** | 20.298 | 0.758 | 0.832 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **Angle**  **(anti-clockwise)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.01** | 34.548 | 0.976 | 0.995 |
| **0.001** | **0.05** | 34.068 | 0.974 | 0.995 |
| **0.001** | **0.1** | 31.362 | 0.965 | 0.993 |
| **0.001** | **0.3** | 23.629 | 0.887 | 0.945 |
| **0.001** | **0.5** | 20.508 | 0.805 | 0.865 |
| **0.002** | **0.01** | 32.016 | 0.960 | 0.994 |
| **0.002** | **0.05** | 32.307 | 0.959 | 0.995 |
| **0.002** | **0.1** | 30.611 | 0.952 | 0.992 |
| **0.002** | **0.3** | 23.495 | 0.875 | 0.943 |
| **0.002** | **0.5** | 20.444 | 0.793 | 0.858 |
| **0.003** | **0.01** | 30.323 | 0.943 | 0.994 |
| **0.003** | **0.05** | 30.910 | 0.944 | 0.994 |
| **0.003** | **0.1** | 29.857 | 0.938 | 0.991 |
| **0.003** | **0.3** | 23.360 | 0.861 | 0.939 |
| **0.003** | **0.5** | 20.379 | 0.781 | 0.850 |
| **0.004** | **0.01** | 29.134 | 0.927 | 0.992 |
| **0.004** | **0.05** | 29.914 | 0.929 | 0.992 |
| **0.004** | **0.1** | 29.264 | 0.924 | 0.989 |
| **0.004** | **0.3** | 23.221 | 0.848 | 0.933 |
| **0.004** | **0.5** | 20.311 | 0.768 | 0.838 |
| **0.005** | **0.01** | 28.260 | 0.912 | 0.991 |
| **0.005** | **0.05** | 29.168 | 0.915 | 0.991 |
| **0.005** | **0.1** | 28.795 | 0.912 | 0.988 |
| **0.005** | **0.3** | 23.093 | 0.837 | 0.930 |
| **0.005** | **0.5** | 20.244 | 0.757 | 0.832 |

**Hybrid Attack (SPN + Gaussian Blur)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (3x3)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.417 | 0.976 | 0.994 |
| **0.001** | **0.5** | 35.234 | 0.975 | 0.998 |
| **0.001** | **0.7** | 32.499 | 0.963 | 0.989 |
| **0.001** | **1** | 30.841 | 0.952 | 0.974 |
| **0.001** | **1.5** | 30.013 | 0.945 | 0.963 |
| **0.002** | **0.3** | 31.847 | 0.960 | 0.994 |
| **0.002** | **0.5** | 33.686 | 0.962 | 0.998 |
| **0.002** | **0.7** | 32.075 | 0.954 | 0.989 |
| **0.002** | **1** | 30.624 | 0.944 | 0.974 |
| **0.002** | **1.5** | 29.848 | 0.937 | 0.962 |
| **0.003** | **0.3** | 30.155 | 0.943 | 0.993 |
| **0.003** | **0.5** | 32.496 | 0.949 | 0.997 |
| **0.003** | **0.7** | 31.675 | 0.944 | 0.986 |
| **0.003** | **1** | 30.411 | 0.936 | 0.970 |
| **0.003** | **1.5** | 29.684 | 0.929 | 0.957 |
| **0.004** | **0.3** | 28.959 | 0.927 | 0.992 |
| **0.004** | **0.5** | 31.580 | 0.936 | 0.996 |
| **0.004** | **0.7** | 31.320 | 0.934 | 0.986 |
| **0.004** | **1** | 30.216 | 0.927 | 0.969 |
| **0.004** | **1.5** | 29.533 | 0.921 | 0.956 |
| **0.005** | **0.3** | 28.074 | 0.911 | 0.991 |
| **0.005** | **0.5** | 30.858 | 0.924 | 0.995 |
| **0.005** | **0.7** | 31.003 | 0.925 | 0.984 |
| **0.005** | **1** | 30.036 | 0.920 | 0.968 |
| **0.005** | **1.5** | 29.393 | 0.914 | 0.954 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Probability** | **kernel (5x5)** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.3** | 34.417 | 0.976 | 0.994 |
| **0.001** | **0.5** | 35.234 | 0.975 | 0.998 |
| **0.001** | **0.7** | 32.141 | 0.962 | 0.984 |
| **0.001** | **0.8** | 30.756 | 0.953 | 0.964 |
| **0.001** | **1** | 28.898 | 0.936 | 0.904 |
| **0.002** | **0.3** | 31.847 | 0.960 | 0.994 |
| **0.002** | **0.5** | 33.686 | 0.962 | 0.998 |
| **0.002** | **0.7** | 31.767 | 0.952 | 0.984 |
| **0.002** | **0.8** | 30.543 | 0.945 | 0.963 |
| **0.002** | **1** | 28.798 | 0.930 | 0.902 |
| **0.003** | **0.3** | 30.155 | 0.943 | 0.993 |
| **0.003** | **0.5** | 32.496 | 0.949 | 0.997 |
| **0.003** | **0.7** | 31.410 | 0.943 | 0.981 |
| **0.003** | **0.8** | 30.334 | 0.937 | 0.959 |
| **0.003** | **1** | 28.698 | 0.923 | 0.894 |
| **0.004** | **0.3** | 28.959 | 0.927 | 0.992 |
| **0.004** | **0.5** | 31.580 | 0.936 | 0.996 |
| **0.004** | **0.7** | 31.092 | 0.933 | 0.981 |
| **0.004** | **0.8** | 30.142 | 0.929 | 0.957 |
| **0.004** | **1** | 28.605 | 0.917 | 0.891 |
| **0.005** | **0.3** | 28.074 | 0.911 | 0.991 |
| **0.005** | **0.5** | 30.858 | 0.924 | 0.995 |
| **0.005** | **0.7** | 30.806 | 0.925 | 0.979 |
| **0.005** | **0.8** | 29.966 | 0.921 | 0.955 |
| **0.005** | **1** | 28.517 | 0.911 | 0.887 |

**Hybrid Attack (Cropping + JPEG)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Crop Percentage** | **Quality** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.005** | **40** | 33.179 | 0.960 | 0.996 |
| **0.005** | **50** | 33.858 | 0.966 | 0.995 |
| **0.005** | **60** | 34.558 | 0.971 | 0.995 |
| **0.005** | **70** | 35.476 | 0.977 | 0.995 |
| **0.005** | **80** | 36.902 | 0.983 | 0.995 |
| **0.007** | **40** | 33.075 | 0.960 | 0.996 |
| **0.007** | **50** | 33.740 | 0.966 | 0.994 |
| **0.007** | **60** | 34.418 | 0.971 | 0.994 |
| **0.007** | **70** | 35.298 | 0.977 | 0.995 |
| **0.007** | **80** | 36.653 | 0.983 | 0.994 |
| **0.01** | **40** | 32.431 | 0.960 | 0.992 |
| **0.01** | **50** | 33.007 | 0.966 | 0.991 |
| **0.01** | **60** | 33.563 | 0.971 | 0.990 |
| **0.01** | **70** | 34.264 | 0.977 | 0.991 |
| **0.01** | **80** | 35.281 | 0.983 | 0.990 |
| **0.02** | **40** | 30.194 | 0.956 | 0.972 |
| **0.02** | **50** | 30.525 | 0.962 | 0.970 |
| **0.02** | **60** | 30.821 | 0.967 | 0.968 |
| **0.02** | **70** | 31.167 | 0.973 | 0.969 |
| **0.02** | **80** | 31.634 | 0.978 | 0.968 |
| **0.03** | **40** | 20.008 | 0.936 | 0.964 |
| **0.03** | **50** | 20.047 | 0.942 | 0.966 |
| **0.03** | **60** | 20.076 | 0.946 | 0.965 |
| **0.03** | **70** | 20.097 | 0.952 | 0.965 |
| **0.03** | **80** | 20.132 | 0.958 | 0.966 |

**Hybrid Attack (Speckle + SPN)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variance** | **Probability** | **Host vs Reconstructed host** | | **NC**  **(Watermark vs Extracted Watermark)** |
| **PSNR** | **SSIM** |
| **0.001** | **0.001** | 31.333 | 0.839 | 0.966 |
| **0.001** | **0.002** | 29.863 | 0.827 | 0.964 |
| **0.001** | **0.003** | 28.703 | 0.814 | 0.964 |
| **0.001** | **0.004** | 27.804 | 0.802 | 0.960 |
| **0.001** | **0.005** | 27.099 | 0.791 | 0.958 |
| **0.002** | **0.001** | 29.649 | 0.777 | 0.964 |
| **0.002** | **0.002** | 28.601 | 0.767 | 0.962 |
| **0.002** | **0.003** | 27.707 | 0.756 | 0.962 |
| **0.002** | **0.004** | 26.978 | 0.746 | 0.958 |
| **0.002** | **0.005** | 26.388 | 0.736 | 0.956 |
| **0.003** | **0.001** | 28.439 | 0.740 | 0.962 |
| **0.003** | **0.002** | 27.625 | 0.731 | 0.959 |
| **0.003** | **0.003** | 26.897 | 0.721 | 0.960 |
| **0.003** | **0.004** | 26.284 | 0.712 | 0.955 |
| **0.003** | **0.005** | 25.777 | 0.703 | 0.953 |
| **0.004** | **0.001** | 27.500 | 0.714 | 0.960 |
| **0.004** | **0.002** | 26.834 | 0.705 | 0.957 |
| **0.004** | **0.003** | 26.219 | 0.696 | 0.958 |
| **0.004** | **0.004** | 25.691 | 0.688 | 0.953 |
| **0.004** | **0.005** | 25.245 | 0.680 | 0.951 |
| **0.005** | **0.001** | 26.734 | 0.694 | 0.958 |
| **0.005** | **0.002** | 26.169 | 0.686 | 0.955 |
| **0.005** | **0.003** | 25.637 | 0.677 | 0.955 |
| **0.005** | **0.004** | 25.172 | 0.669 | 0.951 |
| **0.005** | **0.005** | 24.775 | 0.662 | 0.948 |