**Results for Otsu Entropy**

**PSNR**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Image | No. of Thresholds | WOA | MSWOA | Proposed |
| Lena | 2 | 11.90 | 11.90 | 20.70 |
| 3 | 14.10 | 14.10 | 23.31 |
| 5 | 19.16 | 19.21 | 23.89 |
| 8 | 20.58 | 22.58 | 27.40 |
| Baboon | 2 | 11.58 | 11.58 | 19.91 |
| 3 | 13.54 | 13.63 | 21.40 |
| 5 | 17.27 | 17.18 | 22.37 |
| 8 | 20.02 | 20.39 | 23.37 |
| Starfish | 2 | 12.62 | 12.70 | 20.90 |
| 3 | 15.26 | 15.26 | 23.56 |
| 5 | 19.05 | 19.59 | 25.45 |
| 8 | 23.17 | 25.23 | 28.80 |
| Couple | 2 | 12.11 | 12.11 | 20.20 |
| 3 | 14.27 | 14.27 | 21.95 |
| 5 | 16.89 | 18.12 | 23.96 |
| 8 | 20.74 | 25.32 | 24.60 |
| Cameraman | 2 | 12.23 | 12.23 | 18.86 |
| 3 | 14.55 | 15.72 | 21.77 |
| 5 | 18.62 | 18.62 | 27.50 |
| 8 | 20.89 | 20.99 | 29.05 |
| Peppers | 2 | 12.30 | 12.30 | 19.21 |
| 3 | 14.41 | 14.48 | 22.32 |
| 5 | 18.02 | 19.57 | 25.65 |
| 8 | 22.35 | 22.73 | 26.60 |
| Tree | 2 | 13.99 | 13.99 | 21.04 |
| 3 | 16.51 | 16.74 | 22.91 |
| 5 | 20.04 | 21.38 | 24.25 |
| 8 | 25.02 | 25.46 | 28.87 |
| Building | 2 | 12.06 | 12.06 | 17.33 |
| 3 | 13.93 | 14.08 | 20.90 |
| 5 | 17.75 | 18.41 | 24.80 |
| 8 | 20.81 | 20.97 | 24.89 |

**SSIM**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Image | No. of Thresholds | WOA | MSWOA | Proposed |
| Lena | 2 | 0.3847 | 0.3847 | 0.6918 |
| 3 | 0.4686 | 0.4686 | 0.7647 |
| 5 | 0.6989 | 0.7030 | 0.7783 |
| 8 | 0.7231 | 0.8016 | 0.8392 |
| Baboon | 2 | 0.4442 | 0.4442 | 0.6754 |
| 3 | 0.5212 | 0.5214 | 0.7407 |
| 5 | 0.7103 | 0.7050 | 0.7910 |
| 8 | 0.8007 | 0.8035 | 0.8343 |
| Starfish | 2 | 0.3200 | 0.3240 | 0.6016 |
| 3 | 0.4414 | 0.4414 | 0.6915 |
| 5 | 0.6167 | 0.6384 | 0.7543 |
| 8 | 0.7589 | 0.8545 | 0.8429 |
| Couple | 2 | 0.4242 | 0.4242 | 0.6614 |
| 3 | 0.5046 | 0.5046 | 0.7492 |
| 5 | 0.6270 | 0.6583 | 0.8295 |
| 8 | 0.7414 | 0.8336 | 0.8678 |
| Cameraman | 2 | 0.4337 | 0.4337 | 0.7459 |
| 3 | 0.4822 | 0.5240 | 0.7465 |
| 5 | 0.6137 | 0.6141 | 0.8439 |
| 8 | 0.6727 | 0.6758 | 0.8774 |
| Peppers | 2 | 0.3726 | 0.3726 | 0.6846 |
| 3 | 0.4709 | 0.4741 | 0.7470 |
| 5 | 0.6170 | 0.6654 | 0.8151 |
| 8 | 0.7639 | 0.7606 | 0.8520 |
| Tree | 2 | 0.4957 | 0.4957 | 0.6804 |
| 3 | 0.5199 | 0.5461 | 0.7338 |
| 5 | 0.6437 | 0.6706 | 0.7741 |
| 8 | 0.7954 | 0.8140 | 0.8304 |
| Building | 2 | 0.3527 | 0.3527 | 0.7168 |
| 3 | 0.4602 | 0.4778 | 0.7708 |
| 5 | 0.6884 | 0.6980 | 0.8579 |
| 8 | 0.7581 | 0.7601 | 0.8458 |

**FSIM**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Image | No. of Thresholds | WOA | MSWOA | Proposed |
| Lena | 2 | 0.6671 | 0.6671 | 0.6848 |
| 3 | 0.7146 | 0.7146 | 0.7661 |
| 5 | 0.8016 | 0.8046 | 0.7803 |
| 8 | 0.8757 | 0.9075 | 0.8699 |
| Baboon | 2 | 0.6880 | 0.6880 | 0.7328 |
| 3 | 0.7501 | 0.7509 | 0.7963 |
| 5 | 0.8179 | 0.8148 | 0.8241 |
| 8 | 0.8640 | 0.8666 | 0.8497 |
| Starfish | 2 | 0.5530 | 0.5544 | 0.6182 |
| 3 | 0.6409 | 0.6409 | 0.7041 |
| 5 | 0.7679 | 0.7747 | 0.7583 |
| 8 | 0.8562 | 0.8652 | 0.8585 |
| Couple | 2 | 0.6262 | 0.6262 | 0.7140 |
| 3 | 0.6909 | 0.6909 | 0.7822 |
| 5 | 0.7681 | 0.7896 | 0.8719 |
| 8 | 0.8464 | 0.8412 | 0.8877 |
| Cameraman | 2 | 0.6281 | 0.6281 | 0.7527 |
| 3 | 0.6756 | 0.7103 | 0.7679 |
| 5 | 0.7913 | 0.7924 | 0.8495 |
| 8 | 0.8361 | 0.8375 | 0.9081 |
| Peppers | 2 | 0.6110 | 0.6110 | 0.6913 |
| 3 | 0.6662 | 0.6663 | 0.7702 |
| 5 | 0.7504 | 0.7713 | 0.8357 |
| 8 | 0.8077 | 0.8125 | 0.8651 |
| Tree | 2 | 0.6901 | 0.6901 | 0.6897 |
| 3 | 0.7026 | 0.7144 | 0.7624 |
| 5 | 0.7764 | 0.7935 | 0.7968 |
| 8 | 0.8321 | 0.8469 | 0.8607 |
| Building | 2 | 0.6202 | 0.6202 | 0.7491 |
| 3 | 0.6784 | 0.6793 | 0.8049 |
| 5 | 0.7384 | 0.7470 | 0.8657 |
| 8 | 0.7974 | 0.8181 | 0.8694 |

**Results for Kapur Entropy**

**PSNR**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Image | No. of Thresholds | WOA | MSWOA | Proposed |
| Lena | 2 | 14.39 | 14.48 | 20.55 |
| 3 | 16.83 | 16.96 | 21.39 |
| 5 | 19.79 | 19.87 | 24.75 |
| 8 | 21.83 | 24.97 | 26.38 |
| Baboon | 2 | 12.34 | 12.34 | 18.36 |
| 3 | 14.34 | 14.34 | 21.15 |
| 5 | 22.86 | 22.93 | 25.18 |
| 8 | 30.36 | 30.38 | 29.22 |
| Starfish | 2 | 15.16 | 15.16 | 20.18 |
| 3 | 18.16 | 18.16 | 23.68 |
| 5 | 22.09 | 22.22 | 25.29 |
| 8 | 25.28 | 28.31 | 29.24 |
| Couple | 2 | 14.29 | 14.29 | 17.11 |
| 3 | 16.93 | 16.98 | 22.92 |
| 5 | 20.53 | 20.73 | 22.51 |
| 8 | 22.08 | 28.11 | 27.28 |
| Cameraman | 2 | 14.73 | 14.90 | 18.20 |
| 3 | 21.28 | 21.76 | 19.61 |
| 5 | 25.68 | 26.07 | 26.53 |
| 8 | 29.05 | 29.13 | 28.41 |
| Peppers | 2 | 13.21 | 13.21 | 18.95 |
| 3 | 15.42 | 15.42 | 21.35 |
| 5 | 23.37 | 23.56 | 24.62 |
| 8 | 29.36 | 29.51 | 26.50 |
| Tree | 2 | 16.41 | 16.57 | 21.22 |
| 3 | 19.78 | 19.90 | 19.71 |
| 5 | 22.18 | 22.50 | 23.92 |
| 8 | 26.02 | 28.38 | 28.30 |
| Building | 2 | 12.15 | 12.15 | 18.98 |
| 3 | 13.43 | 13.43 | 19.77 |
| 5 | 19.23 | 19.23 | 20.80 |
| 8 | 29.83 | 30.37 | 28.03 |

**SSIM**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Image | No. of Thresholds | WOA | MSWOA | Proposed |
| Lena | 2 | 0.4786 | 0.4835 | 0.6903 |
| 3 | 0.5661 | 0.5726 | 0.7061 |
| 5 | 0.6508 | 0.6486 | 0.7873 |
| 8 | 0.7265 | 0.7891 | 0.8206 |
| Baboon | 2 | 0.5174 | 0.5174 | 0.5278 |
| 3 | 0.6230 | 0.6230 | 0.6732 |
| 5 | 0.7901 | 0.7913 | 0.8160 |
| 8 | 0.9060 | 0.9072 | 0.8787 |
| Starfish | 2 | 0.3768 | 0.3768 | 0.5902 |
| 3 | 0.5041 | 0.5041 | 0.6853 |
| 5 | 0.6502 | 0.6518 | 0.7572 |
| 8 | 0.7605 | 0.8450 | 0.8448 |
| Couple | 2 | 0.4815 | 0.4815 | 0.4131 |
| 3 | 0.5752 | 0.5751 | 0.7048 |
| 5 | 0.6962 | 0.6997 | 0.6879 |
| 8 | 0.7709 | 0.8581 | 0.8734 |
| Cameraman | 2 | 0.5422 | 0.5457 | 0.7850 |
| 3 | 0.6709 | 0.6544 | 0.7973 |
| 5 | 0.7218 | 0.7273 | 0.8331 |
| 8 | 0.7545 | 0.7540 | 0.8636 |
| Peppers | 2 | 0.5251 | 0.5251 | 0.7005 |
| 3 | 0.6037 | 0.6037 | 0.7727 |
| 5 | 0.7289 | 0.7348 | 0.8464 |
| 8 | 0.8215 | 0.8279 | 0.8712 |
| Tree | 2 | 0.5102 | 0.5167 | 0.6945 |
| 3 | 0.6263 | 0.6335 | 0.6972 |
| 5 | 0.6577 | 0.6677 | 0.7722 |
| 8 | 0.7548 | 0.8441 | 0.8006 |
| Building | 2 | 0.5730 | 0.5730 | 0.6880 |
| 3 | 0.6141 | 0.6141 | 0.7186 |
| 5 | 0.7225 | 0.7237 | 0.8061 |
| 8 | 0.8970 | 0.9104 | 0.8831 |

**FSIM**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Image | No. of Thresholds | WOA | MSWOA | Proposed |
| Lena | 2 | 0.6836 | 0.6850 | 0.6920 |
| 3 | 0.7542 | 0.7558 | 0.6978 |
| 5 | 0.8433 | 0.8436 | 0.8116 |
| 8 | 0.8846 | 0.9066 | 0.8377 |
| Baboon | 2 | 0.7335 | 0.7335 | 0.5855 |
| 3 | 0.7961 | 0.7961 | 0.7251 |
| 5 | 0.8968 | 0.8981 | 0.8474 |
| 8 | 0.9787 | 0.9790 | 0.9158 |
| Starfish | 2 | 0.5705 | 0.5705 | 0.6180 |
| 3 | 0.6634 | 0.6634 | 0.6949 |
| 5 | 0.7758 | 0.7749 | 0.7762 |
| 8 | 0.8591 | 0.8668 | 0.8665 |
| Couple | 2 | 0.6458 | 0.6458 | 0.5025 |
| 3 | 0.7234 | 0.7232 | 0.7368 |
| 5 | 0.8123 | 0.8124 | 0.6939 |
| 8 | 0.8650 | 0.8901 | 0.8899 |
| Cameraman | 2 | 0.6547 | 0.6563 | 0.7524 |
| 3 | 0.7956 | 0.7848 | 0.7853 |
| 5 | 0.8549 | 0.8690 | 0.8521 |
| 8 | 0.9103 | 0.9097 | 0.8928 |
| Peppers | 2 | 0.6453 | 0.6453 | 0.6767 |
| 3 | 0.7008 | 0.7008 | 0.7717 |
| 5 | 0.7880 | 0.7899 | 0.8508 |
| 8 | 0.8575 | 0.8578 | 0.8864 |
| Tree | 2 | 0.6925 | 0.6949 | 0.6811 |
| 3 | 0.7647 | 0.7664 | 0.7081 |
| 5 | 0.7938 | 0.7984 | 0.8084 |
| 8 | 0.8526 | 0.8643 | 0.8364 |
| Building | 2 | 0.6069 | 0.6069 | 0.6792 |
| 3 | 0.6593 | 0.6593 | 0.7248 |
| 5 | 0.7682 | 0.7692 | 0.8061 |
| 8 | 0.9037 | 0.9046 | 0.9016 |