* 1. 修正結果と修正前との比較

1. DCT単体の情報量
2. Step1後のDCT領域の情報量
3. Step1後のICA領域の情報量
4. 各ICA基底の情報量（1基底の平均値）＝0.053577 bit/pel（Barbara）
5. ICA領域のDC成分（各領域の平均画像値）の情報量

（単位はすべてbit/pel）

表1　各符号化レートの画質と領域数

|  |  |  |  |
| --- | --- | --- | --- |
| Qレート | 画質(PSNR) | DCT領域 | ICA領域 |
| 100 | 49.51 | 1006 | 18 |
| 90 | 37.03 | 919 | 105 |
| 80 | 33.71 | 831 | 193 |
| 70 | 31.83 | 755 | 269 |
| 60 | 30.48 | 709 | 315 |
| 50 | 29.48 | 668 | 356 |
| 40 | 28.49 | 631 | 393 |
| 30 | 27.21 | 587 | 437 |
| 20 | 25.60 | 494 | 530 |
| 10 | 23.14 | 330 | 694 |

表2　修正結果

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Qレート | A : DCT単独 | B : DCT領域 | C : ICA領域 | E : DC成分 |
| 100 | 4.44 | 4.36 | 0.11 | 0.002 |
| 90 | 2.12 | 1.82 | 0.31 | 0.011 |
| 80 | 1.62 | 1.21 | 0.37 | 0.021 |
| 70 | 1.38 | 0.92 | 0.36 | 0.029 |
| 60 | 1.21 | 0.73 | 0.35 | 0.034 |
| 50 | 1.09 | 0.61 | 0.32 | 0.039 |
| 40 | 0.96 | 0.52 | 0.27 | 0.043 |
| 30 | 0.82 | 0.42 | 0.21 | 0.048 |
| 20 | 0.63 | 0.30 | 0.15 | 0.058 |
| 10 | 0.41 | 0.15 | 0.06 | 0.076 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Qレート | DCT単独 | | DCT領域 | | 基底数 | |
| 100 | 4.81 | 4.44 | 4.82 | 4.36 | -0.20 | 1.27 |
| 90 | 1.96 | 2.12 | 1.79 | 1.82 | 2.84 | 5.11 |
| 80 | 1.38 | 1.62 | 1.12 | 1.21 | 4.11 | 7.06 |
| 70 | 1.11 | 1.38 | 0.81 | 0.92 | 4.57 | 7.91 |
| 60 | 0.93 | 1.21 | 0.62 | 0.73 | 4.55 | 8.11 |
| 50 | 0.81 | 1.09 | 0.51 | 0.61 | 4.28 | 7.96 |
| 40 | 0.69 | 0.96 | 0.43 | 0.52 | 3.69 | 7.34 |
| 30 | 0.55 | 0.82 | 0.33 | 0.42 | 2.98 | 6.45 |
| 20 | 0.38 | 0.63 | 0.22 | 0.30 | 1.88 | 5.22 |
| 10 | 0.18 | 0.41 | 0.10 | 0.15 | 0.13 | 3.42 |

表3　修正前との比較（右：修正前，左：修正後）

表4　その他のICA基底の情報

|  |  |  |
| --- | --- | --- |
| Qレート | 全体で使われるICA基底数（全64個） | 1つのICA領域で使われる基底数の平均 |
| 100 | 64 | 47.5 |
| 90 | 64 | 24.3 |
| 80 | 64 | 15.5 |
| 70 | 64 | 11.1 |
| 60 | 64 | 9.1 |
| 50 | 64 | 7.4 |
| 40 | 64 | 5.7 |
| 30 | 64 | 4.0 |
| 20 | 63 | 2.3 |
| 10 | 54 | 0.7 |

* 2.　各基底の使用頻度の調査結果

図1.1　Q100　　　　　　　　　　　　　　　　　　　図1.2　Q80

図1.3　Q60 図1.4　Q40

図1　DCT基底の使用頻度の等高線

図2.1　Q100　　　　　　　　　　　　　　　　　　　図2.2　Q80

図2.3　Q60 図2.4　Q40

図2　ICA基底の使用頻度の等高線

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1024 | 1024 | 1024 | 952 | 844 | 726 | 505 | 353 |
| 224 | 75 | 915 | 827 | 696 | 577 | 466 | 251 |
| 131 | 84 | 735 | 760 | 597 | 441 | 301 | 211 |
| 89 | 58 | 578 | 462 | 332 | 267 | 165 | 68 |
| 41 | 14 | 336 | 246 | 116 | 64 | 49 | 8 |
| 0 | 1 | 80 | 29 | 15 | 6 | 2 | 0 |
| 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1024 | 1008 | 969 | 964 | 926 | 919 | 914 | 875 |
| 1014 | 973 | 963 | 929 | 941 | 932 | 916 | 847 |
| 977 | 961 | 920 | 915 | 891 | 896 | 888 | 838 |
| 921 | 903 | 875 | 856 | 872 | 856 | 830 | 778 |
| 877 | 845 | 824 | 825 | 800 | 800 | 780 | 771 |
| 756 | 744 | 692 | 709 | 698 | 759 | 730 | 696 |
| 653 | 634 | 637 | 632 | 634 | 665 | 707 | 649 |
| 579 | 539 | 558 | 584 | 605 | 648 | 704 | 630 |

表5　DCT基底の使用頻度（詳細値）

表5.1　Q100 表5.2　Q80

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1024 | 1024 | 1024 | 1024 | 1024 | 886 | 719 | 519 |
| 375 | 199 | 95 | 23 | 802 | 670 | 560 | 440 |
| 313 | 145 | 50 | 25 | 564 | 539 | 376 | 279 |
| 171 | 112 | 24 | 12 | 414 | 281 | 175 | 152 |
| 77 | 24 | 9 | 1 | 141 | 89 | 41 | 27 |
| 8 | 0 | 0 | 0 | 11 | 3 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1024 | 1024 | 1024 | 1024 | 1024 | 1024 | 1024 | 808 |
| 591 | 414 | 255 | 116 | 52 | 7 | 707 | 571 |
| 411 | 320 | 210 | 91 | 22 | 12 | 414 | 385 |
| 268 | 191 | 121 | 61 | 16 | 3 | 265 | 180 |
| 98 | 88 | 42 | 5 | 0 | 1 | 59 | 32 |
| 21 | 6 | 0 | 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

表5.3　Q60　　　　　　　　　　　　　　　　　　表5.4　Q40

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 13 | 9 | 13 | 15 | 11 | 10 | 9 | 14 |
| 11 | 14 | 12 | 14 | 14 | 11 | 12 | 13 |
| 9 | 16 | 15 | 16 | 13 | 12 | 14 | 17 |
| 15 | 15 | 13 | 17 | 14 | 15 | 16 | 15 |
| 14 | 16 | 15 | 11 | 11 | 12 | 12 | 16 |
| 14 | 15 | 14 | 13 | 14 | 16 | 10 | 13 |
| 13 | 7 | 16 | 14 | 12 | 14 | 10 | 12 |
| 16 | 14 | 14 | 14 | 13 | 12 | 16 | 15 |

表6　ICA基底の使用頻度（詳細値）

表6.1　Q100 表6.2　Q80

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 25 | 17 | 67 | 62 | 51 | 29 | 41 | 68 |
| 37 | 29 | 48 | 41 | 79 | 52 | 52 | 35 |
| 38 | 63 | 103 | 44 | 38 | 22 | 85 | 62 |
| 52 | 59 | 12 | 45 | 61 | 42 | 61 | 59 |
| 30 | 47 | 83 | 23 | 42 | 34 | 25 | 76 |
| 106 | 80 | 46 | 57 | 39 | 44 | 54 | 26 |
| 16 | 31 | 86 | 46 | 38 | 37 | 28 | 79 |
| 37 | 39 | 15 | 10 | 29 | 18 | 38 | 50 |

表6.3　Q60 表6.4　Q40

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 15 | 17 | 55 | 72 | 44 | 18 | 43 | 57 |
| 21 | 23 | 67 | 35 | 90 | 45 | 51 | 23 |
| 27 | 73 | 118 | 48 | 35 | 19 | 96 | 64 |
| 52 | 61 | 13 | 38 | 50 | 30 | 64 | 58 |
| 24 | 39 | 90 | 16 | 37 | 38 | 23 | 97 |
| 129 | 82 | 41 | 59 | 30 | 44 | 38 | 17 |
| 9 | 20 | 92 | 53 | 40 | 40 | 14 | 65 |
| 38 | 31 | 18 | 8 | 21 | 9 | 37 | 55 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 5 | 17 | 34 | 52 | 33 | 15 | 32 | 39 |
| 19 | 18 | 54 | 28 | 75 | 31 | 38 | 13 |
| 25 | 65 | 99 | 34 | 27 | 12 | 80 | 52 |
| 39 | 40 | 7 | 26 | 34 | 21 | 52 | 43 |
| 15 | 24 | 81 | 10 | 26 | 22 | 19 | 90 |
| 107 | 57 | 24 | 48 | 28 | 27 | 32 | 15 |
| 8 | 16 | 83 | 46 | 33 | 30 | 11 | 44 |
| 33 | 22 | 11 | 5 | 14 | 3 | 28 | 52 |

* 3.　比率変更の結果と1.との比較

表7　比率変更の結果

|  |  |  |  |
| --- | --- | --- | --- |
| Qレート | A : DCT単独 | B : DCT領域 | C : ICA領域 |
| 100 | 4.24 | 4.17 | 0.10 |
| 90 | 1.51 | 1.28 | 0.30 |
| 80 | 1.07 | 0.78 | 0.35 |
| 70 | 0.92 | 0.60 | 0.34 |
| 60 | 0.81 | 0.48 | 0.33 |
| 50 | 0.73 | 0.41 | 0.30 |
| 40 | 0.64 | 0.34 | 0.25 |
| 30 | 0.52 | 0.26 | 0.20 |
| 20 | 0.38 | 0.17 | 0.13 |
| 10 | 0.22 | 0.08 | 0.05 |

表8　1.との比較（左：1，右：3）

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Qレート | A : DCT単独 | | B : DCT領域 | | C : ICA領域 | | 基底数 | |
| 100 | 4.44 | 4.24 | 4.36 | 4.17 | 0.11 | 0.10 | 1.27 | 1.22 |
| 90 | 2.12 | 1.51 | 1.82 | 1.28 | 0.31 | 0.30 | 5.11 | 3.84 |
| 80 | 1.62 | 1.07 | 1.21 | 0.78 | 0.37 | 0.35 | 7.06 | 4.85 |
| 70 | 1.38 | 0.92 | 0.92 | 0.60 | 0.36 | 0.34 | 7.91 | 5.31 |
| 60 | 1.21 | 0.81 | 0.73 | 0.48 | 0.35 | 0.33 | 8.11 | 5.41 |
| 50 | 1.09 | 0.73 | 0.61 | 0.41 | 0.32 | 0.30 | 7.96 | 5.28 |
| 40 | 0.96 | 0.64 | 0.52 | 0.34 | 0.27 | 0.25 | 7.34 | 4.75 |
| 30 | 0.82 | 0.52 | 0.42 | 0.26 | 0.21 | 0.20 | 6.45 | 3.96 |
| 20 | 0.63 | 0.38 | 0.30 | 0.17 | 0.15 | 0.13 | 5.22 | 2.78 |
| 10 | 0.41 | 0.22 | 0.15 | 0.08 | 0.06 | 0.05 | 3.42 | 1.18 |

* Step１後の再構成画像（Barbara）



Q100 (49.51dB) Q60 (30.48dB)



Q30 (27.21dB) Q20 (25.60dB)