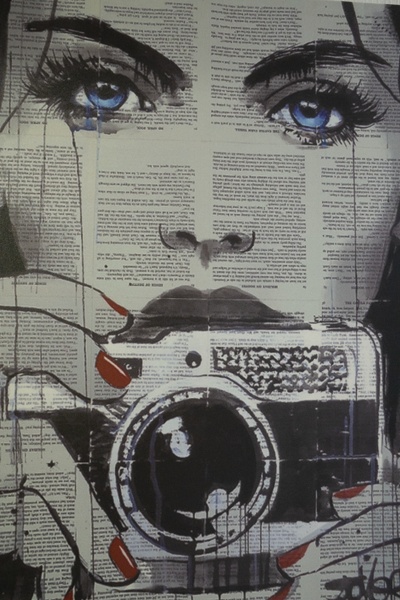
**Normalization results for pairs 8\_0.png\_8\_1.png from subset png\picture\_inside**

**8\_0.png: 8\_1.png: **

**Table 1 - Found homography parameters and normalization accuracy assessment**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Original:  img1: 0 img2: 0 | h11 | h12 | h13 | h21 | h22 | h23 | h31 | h32 | h33 | avg ErrPar (param) | avg ErrIM (pixel) | max ErrIM | avg ErrCPM (corner) | max ErrCPM | Expert rate |
| SIFT | 0,507 | -0,015 | 63,143 | -0,218 | 0,679 | 88,645 | -0,001 | -0 | 1 | 0 | 0,588 | 2,629 | ~ | ~ |  |
| SURF128 | 0,499 | -0,023 | 65,263 | -0,216 | 0,656 | 92,334 | -0,001 | -0 | 1 | 0 | 1,063 | 4,079 | ~ | ~ |  |
| SURF64 | 0,497 | -0,022 | 64,974 | -0,216 | 0,653 | 92,748 | -0,001 | -0 | 1 | 0 | 1,111 | 3,824 | ~ | ~ |  |
| ORB | 0,491 | -0,028 | 66,561 | -0,217 | 0,64 | 94,259 | -0,001 | -0 | 1 | 0 | 0,939 | 3,883 | ~ | ~ |  |
| ORB1000 | 0,494 | -0,013 | 63,126 | -0,231 | 0,679 | 88,582 | -0,001 | -0 | 1 | 0 | 0,905 | 3,339 | ~ | ~ |  |
| BRISK | 0,493 | -0,027 | 66,052 | -0,215 | 0,64 | 94,009 | -0,001 | -0 | 1 | 0 | 0,813 | 3,671 | ~ | ~ |  |
| KAZE | 0,504 | -0,022 | 64,426 | -0,213 | 0,659 | 91,714 | -0,001 | -0 | 1 | 0 | 0,891 | 3,274 | ~ | ~ |  |
| AKAZE | 0,498 | -0,023 | 65,125 | -0,217 | 0,655 | 92,49 | -0,001 | -0 | 1 | 0 | 0,681 | 2,641 | ~ | ~ |  |
| Original matrix |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

where h11, h12, h13, h21, h22, h23, h31, h32, h33 - parameters of found homography matrix H\* or of original one H;   
avgErrPar - average error of found parameters, the accuracy of found homography matrix parameters with a preliminary minimax normalization of found and original matrices;  
avgErrIM - average error of inlier coordinate matching;  
inliers - correct matches; outliers - false matches;  
maxErrIM – maximum error of inlier coordinate matching;  
avgErrCPM - average error of corner point matching;  
maxErrCPM - maximum error of corner point matching;  
expert rate - experts assessment of normalization accuracy with a 5-point scale: 0 - normalization failed, 1 - insufficient, 2 - satisfactory, 3 - good, 4 – excellent.

**Table 2 - Quantitative evaluation of descriptors, precision and recall estimation (with found overlap)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | NP1 | NP2 | NM | NI | DP1 | DP2 | OP1 | OP2 | NPO1 | NPO2 | NMO | DPO1 | DPO2 | Precision | RecallO1 | Comments |
| SIFT | 2459 | 1580 | 876 | 702 | 0,0102 | 0,0066 | 100 | 62,4475 | 2459 | 1453 | 876 | 0,0102 | 0,0097 | 0,8014 | 0,2855 |  |
| SURF128 | 3631 | 2815 | 693 | 594 | 0,0151 | 0,0117 | 100 | 61,7825 | 3631 | 2428 | 693 | 0,0151 | 0,0164 | 0,8571 | 0,1636 |  |
| SURF64 | 3631 | 2815 | 891 | 748 | 0,0151 | 0,0117 | 100 | 61,6537 | 3631 | 2424 | 891 | 0,0151 | 0,0164 | 0,8395 | 0,206 |  |
| ORB | 10155 | 8142 | 2357 | 2045 | 0,0423 | 0,0339 | 100 | 61,9558 | 10155 | 7810 | 2357 | 0,0423 | 0,0525 | 0,8676 | 0,2014 |  |
| ORB1000 | 1000 | 1000 | 398 | 333 | 0,0042 | 0,0042 | 99,9854 | 63,4625 | 1000 | 968 | 398 | 0,0042 | 0,0064 | 0,8367 | 0,333 |  |
| BRISK | 4531 | 2896 | 900 | 799 | 0,0189 | 0,0121 | 100 | 61,8387 | 4531 | 2754 | 900 | 0,0189 | 0,0186 | 0,8878 | 0,1763 |  |
| KAZE | 870 | 743 | 328 | 289 | 0,0036 | 0,0031 | 100 | 61,7771 | 870 | 669 | 328 | 0,0036 | 0,0045 | 0,8811 | 0,3322 |  |
| AKAZE | 745 | 708 | 221 | 200 | 0,0031 | 0,0029 | 100 | 61,9213 | 745 | 676 | 221 | 0,0031 | 0,0045 | 0,905 | 0,2685 |  |

where NP - number of found key points; NP1, NP2 - number of found key points for image1 and image2 respectively;  
NM - number of matches found with NNDR method, NM=NI+NO;  
NI - number of inliers found with RANSAC method;  
NO - number of outliers discarded with RANSAC method;   
DP - density of key points (per cent), DP= NP/(height x width) , height, width - vertical and horizontal image sizes respectively (pixels)  
DP1, DP2 - density of key points points for image1 and image2 respectively;  
OP1, OP2 - overlap percentage for image1 and image2 respectively;  
NPO1, NPO2 - number of found key points on overlap for image1 and image2 respectivelyy;  
NMO - number of matches on overlap found with NNDR method;  
DPO1, DPO2 - density of key points points on overlap for image1 and image2 respectively;   
OA - overlap area (pixels), OA1, OA2 - overlap area for image1 and image2 respectively;  
DPO1= NPO1/OA1; DPO2= NPO2/OA2;  
Precision = NI/ NM - the rate to evaluate the part of inliers to all found matches with NNDR method;  
RecallO1 = NI/ NPO1 - completeness of inlier retrieval relative to the number of all key points on overlap for image1. The rate illustrates usefulness of the found key points for normalization.

**Table 3 - Estimation of time costs**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Name | NP1 | NP2 | DesT1, sec | DesT2, sec | MatchT, sec | InlierT, sec | AvgDesT, ms | AvgMatchT, ms | AvgInlierT, ms | TotalNormT, sec |
| SIFT | 2459 | 1580 | 0,058664 | 0,052519 | 0,032812 | 0,000931 | 0,028547 | 0,037456 | 0,001325 | 0,144926 |
| SURF128 | 3631 | 2815 | 0,087257 | 0,087077 | 0,09022 | 0,000824 | 0,027482 | 0,130187 | 0,001387 | 0,265377 |
| SURF64 | 3631 | 2815 | 0,078708 | 0,071271 | 0,066237 | 0,000793 | 0,023497 | 0,074339 | 0,00106 | 0,217009 |
| ORB | 10155 | 8142 | 0,023241 | 0,019938 | 0,239808 | 0,001535 | 0,002368 | 0,101742 | 0,00075 | 0,284522 |
| ORB1000 | 1000 | 1000 | 0,010752 | 0,009324 | 0,003585 | 0,000541 | 0,010037 | 0,009007 | 0,001623 | 0,024202 |
| BRISK | 4531 | 2896 | 0,063438 | 0,038569 | 0,042955 | 0,000785 | 0,013658 | 0,047727 | 0,000982 | 0,145747 |
| KAZE | 870 | 743 | 0,113964 | 0,116479 | 0,006995 | 0,000672 | 0,14388 | 0,021325 | 0,002325 | 0,23811 |
| AKAZE | 745 | 708 | 0,018647 | 0,019247 | 0,002654 | 0,000389 | 0,026107 | 0,012006 | 0,001947 | 0,040937 |

where DesT – descriptor creation time (time for key point detection and descriptor computation), DesT1, DesT2 – creation time of descriptors for image1 and image2 respectively;  
MatchT - retrieval time of matching found with NNDR method for the pair;  
InlierT – inlier retrieval time found with RANSAC method for the pair;  
AvgDesT – average time for one descriptor creation;  
AvgMatchT - average time for one match retrieval with NNDR method;  
AvgInlierT – average time for one inlier retrieval with RANSAC method;  
TotalNormT – total normalization time for the pair.