**Normalization results for pairs 7\_0.png\_7\_1.png from subset png\texture\_artificial**

**7\_0.png: 7\_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 ErrIM (pixel) | max ErrIM | Expert rate |
| SIFT | 1,149 | 0,256 | -106,181 | -0,209 | 0,983 | 71,024 | 0 | -0 | 1 | 0,437 | 2,577 |  |
| SURF128 | 1,147 | 0,259 | -106,231 | -0,21 | 0,986 | 70,897 | 0 | -0 | 1 | 0,836 | 2,988 |  |
| SURF64 | 1,144 | 0,258 | -105,483 | -0,21 | 0,982 | 71,151 | 0 | -0 | 1 | 0,902 | 3,363 |  |
| ORB | 1,148 | 0,261 | -106,703 | -0,211 | 0,984 | 71,262 | 0 | -0 | 1 | 0,852 | 3,512 |  |
| ORB1000 | 1,148 | 0,26 | -106,141 | -0,209 | 0,988 | 70,143 | 0 | -0 | 1 | 1,002 | 3,914 |  |
| BRISK | 1,154 | 0,258 | -107,101 | -0,208 | 0,986 | 70,71 | 0 | -0 | 1 | 0,629 | 2,477 |  |
| KAZE | 1,143 | 0,256 | -104,932 | -0,209 | 0,98 | 71,182 | 0 | -0 | 1 | 0,404 | 1,304 |  |
| AKAZE | 1,144 | 0,255 | -105,002 | -0,208 | 0,978 | 71,341 | 0 | -0 | 1 | 0,407 | 1,328 |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

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 | 1403 | 1491 | 788 | 744 | 0,0058 | 0,0062 | 83,7812 | 89,5454 | 1287 | 1418 | 781 | 0,0064 | 0,0066 | 0,9442 | 0,5781 |  |
| SURF128 | 2368 | 2403 | 412 | 365 | 0,0099 | 0,01 | 83,7996 | 89,5975 | 2205 | 2309 | 410 | 0,011 | 0,0107 | 0,8859 | 0,1655 |  |
| SURF64 | 2368 | 2403 | 607 | 544 | 0,0099 | 0,01 | 83,9029 | 89,5558 | 2208 | 2307 | 599 | 0,011 | 0,0107 | 0,8962 | 0,2464 |  |
| ORB | 2782 | 3236 | 952 | 793 | 0,0116 | 0,0135 | 83,8804 | 89,4971 | 2712 | 3223 | 951 | 0,0135 | 0,015 | 0,833 | 0,2924 |  |
| ORB1000 | 1000 | 1000 | 351 | 310 | 0,0042 | 0,0042 | 83,885 | 89,5679 | 985 | 1000 | 351 | 0,0049 | 0,0047 | 0,8832 | 0,3147 |  |
| BRISK | 717 | 856 | 262 | 239 | 0,003 | 0,0036 | 83,8167 | 89,4958 | 689 | 847 | 261 | 0,0034 | 0,0039 | 0,9122 | 0,3469 |  |
| KAZE | 301 | 344 | 174 | 154 | 0,0013 | 0,0014 | 83,98 | 89,4679 | 291 | 340 | 173 | 0,0014 | 0,0016 | 0,8851 | 0,5292 |  |
| AKAZE | 228 | 266 | 119 | 113 | 0,0009 | 0,0011 | 84,0058 | 89,4262 | 225 | 266 | 119 | 0,0011 | 0,0012 | 0,9496 | 0,5022 |  |

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 | 1403 | 1491 | 0,050389 | 0,052941 | 0,016974 | 0,000643 | 0,03571 | 0,02154 | 0,000863 | 0,120947 |
| SURF128 | 2368 | 2403 | 0,054632 | 0,062388 | 0,044073 | 0,000637 | 0,024516 | 0,106973 | 0,001745 | 0,16173 |
| SURF64 | 2368 | 2403 | 0,05894 | 0,058663 | 0,024401 | 0,000799 | 0,024651 | 0,040199 | 0,001469 | 0,142803 |
| ORB | 2782 | 3236 | 0,010633 | 0,011308 | 0,023239 | 0,00081 | 0,003658 | 0,02441 | 0,00102 | 0,04599 |
| ORB1000 | 1000 | 1000 | 0,008347 | 0,008369 | 0,003396 | 0,000472 | 0,008357 | 0,009674 | 0,001523 | 0,020583 |
| BRISK | 717 | 856 | 0,011509 | 0,013181 | 0,002341 | 0,000453 | 0,015724 | 0,008933 | 0,001895 | 0,027483 |
| KAZE | 301 | 344 | 0,098525 | 0,068463 | 0,001238 | 0,000367 | 0,263172 | 0,007116 | 0,002384 | 0,168593 |
| AKAZE | 228 | 266 | 0,012041 | 0,011219 | 0,000512 | 0,000274 | 0,047493 | 0,004299 | 0,002428 | 0,024046 |

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.