

Example of Generating Ground Truth Matches

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Abstract

This document provides additional information on how Ground Truth Matches (GTM) are generated using a simple example on the basis of a single match.

1. Example of generating a single Ground Truth Match

The algorithm for generating GTM is best described using an example for resolving the ambiguity of a single match shown in Figure 1.

For simplicity in Figure 1, the first index of right features k^R and descriptor distances d used in the algorithm description of the paper was skipped and we will use the symbols of Figure 1 for further explanations in this paragraph. For the first backward search using the right feature position with the smallest disparity (k_1^R and d_1 in Figure 1(b)), the left feature within t_d with the smallest disparity must be the same as for the initial search (indicated by the blue arrow in Figure 1(b)). Otherwise, k_1^R is rejected. Here, we are only rejecting the right keypoint to prevent multiple matches to the same right keypoint and to possibly get a TN in the left image. Moreover, k_1^L and k_1^R are only kept if $d_4 \geq 1.5d_1 \leq d_5$. In this case, deleting both corresponding keypoints prevents false local matches to similar neighbors. Rejecting feature k_1^L aborts further verifications for the current correspondence $k_1^L \leftrightarrow k_1^R$ (as rejected) and the next correspondence is analyzed. If $d_4 < 1.5d_7$, feature k_3^L and k_4^R are rejected with d_7 the smallest descriptor distance to its corresponding right feature k_4^R from the forward search over all left features in the beginning. This is indicated by the green arrows in Figure 1. Similarly, if $d_5 < 1.5d_6$, features k_2^L and k_2^R are rejected. Assuming similar descriptor distances for a small spatial neighborhood t_d and true correspondences, we further filter features using the smallest descriptor distance $d_{min} = \min(d_1, d_6, d_7)$ and reject every

Corr. Fig.	Row	Condition	Rej. features
1(a)	1	$d_1 > t_s \vee d_2 < 1.5d_1 > d_3$	k_1^L
	2	$k_1^L \rightarrow k_1^R \wedge k_i^R \rightarrow k_1^L, i \neq 1$	k_1^R
1(b)	3	$d_4 < 1.5d_1 > d_5$	k_1^L, k_1^R
	4	$d_4 < 1.5d_7$	k_3^L, k_4^R
	5	$d_5 < 1.5d_6$	k_2^L, k_2^R
	6	$d_1 < 1.25 \min(d_1, d_6, d_7)$	k_1^L
	7	$d_6 < 1.25 \min(d_1, d_6, d_7)$	k_2^L
	8	$d_7 < 1.25 \min(d_1, d_6, d_7)$	k_3^L
	9	$d_2 < 1.5d_6 > d_8 \vee 1.5d_6 > d_9$	k_2^L, k_2^R
1(c)	10	$d_2 < 1.5d_1$	k_1^L, k_1^R
	11	$d_9 < 1.5d_7$	k_3^L, k_4^R
	12	$d_1 < 1.25 \min(d_1, d_6, d_7)$	k_1^L
	13	$d_6 < 1.25 \min(d_1, d_6, d_7)$	k_2^L
	14	$d_7 < 1.25 \min(d_1, d_6, d_7)$	k_3^L
	15	$d_3 < 1.5d_1$	k_1^L, k_1^R
1(d)	16	$d_{10} < 1.5d_6$	k_2^L, k_2^R
	17	$d_1 < 1.25 \min(d_1, d_6)$	k_1^L
	18	$d_6 < 1.25 \min(d_1, d_6)$	k_2^L

Table 1. Conditions to reject features for a single potential correspondence illustrated in Figure 1.

left feature (k_1^L , k_2^L , or k_3^L) for which $d_f < 1.25d_{min}$, $f \in [1, 6, 7]$ does not hold. These above conditions are summarized in Table 1. The same procedure is performed for the remaining 2 right features k_2^R and k_3^R . Moreover, Table 1 states the conditions and possible rejected features for these remaining features and steps shown in Figures 1(c) and 1(d). In this example, the rows 6-8 of Table 1 are identical to rows 12-14, but for high feature densities and/or a large local variance in spatial transformation between the images this is rarely the case. As can be seen in Figure 1(c), k_4^L has no corresponding feature in the right image as there was not found any during the initial forward search within t_d . Similarly, no left feature corresponds to k_3^R , as the descriptor distance from any left feature within t_d to this feature is larger than to other right features within t_d , shown in Figure 1(d). Something like this is also possible if no feature exists within t_d around the position, the ground truth points to.

After filtering all available correspondences like de-

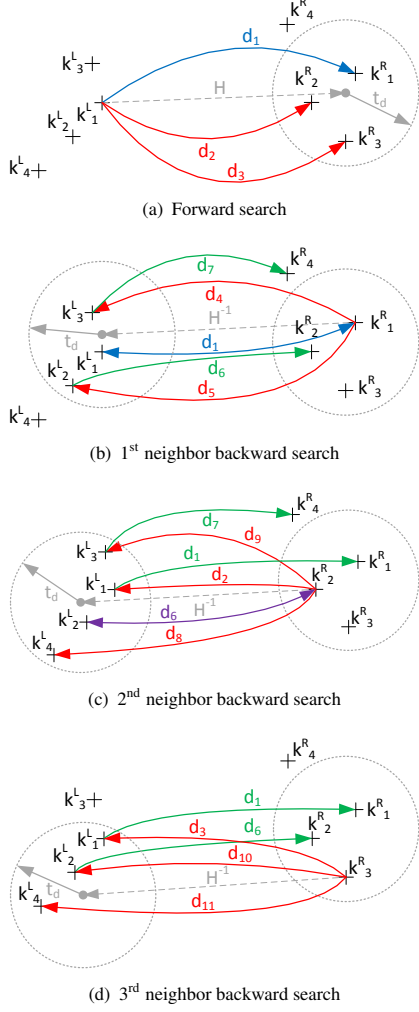


Figure 1. Example of removing the match ambiguity for a single potential correspondence with steps (a) to (d). k^L denotes left and k^R right features with descriptor distances d . t_d corresponds to the spatial search radius at the position calculated by the ground truth H or f . The blue arrows indicate the match under test with the smallest descriptor distance from the forward search. The red arrows point to spatial nearest neighbors for which their descriptor distance to the query is not the smallest and the violet and green arrows indicate matches that feature smallest descriptor distance of other correspondences under test (like $k_1^L \rightarrow k_1^R$ in this example).

scribed in the last paragraph, the whole procedure is repeated until the number of features converges.