H-RANSAC: A HYBRID POINT CLOUD SEGMENTATION COMBINING 2D AND 3D

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1. METHODOLOGY

The proposed approach, H-RANSAC, consists of the following steps (Figure 1).

First, planes are identified by applying RANSAC 3D segmentation on the point cloud that has been generated from the overlapping images. In finding the plane with maximum inliers, (i.e. points assigned to the plane based on the distance between the points and the plane), [**?**] forms multiple random subsets of three points which define the candidate planes. For each subset, the distance of the remaining points from the plane is computed and the points with a distance lower than a predefined threshold are considered as inliers. The candidate plane with the greatest number of inliers is selected as 3D object. Finally, this plane is extracted from the point cloud and the process repeats until there are no points left.

In order to incorporate the information from the 2D space, H-RANSAC modifies the candidate planes based on the 2D segmentation results. More specifically, for each candidate plane, H-RANSAC selects the most appropriate view of the plane from the overlapping images, assuring that it depicts the whole object, while radial distortions and occlusions are minimized. In this way, we overcome the problem of unfavorable perspectives and select the view that has the best chances of detecting the desired object.

2D segmentation based on k-means is afterwards applied on the texture and spatial features of the selected image and the plane is updated based on a consistency check, i.e. ensuring that all points belonging to the same plane, also belong to the same segmented object in the 2D space. This is achieved by removing from the candidate plane the inliers where their corresponding pixes in the image space do not belong to the same 2D object as the corresponding pixel of the plane's barycenter. Then, the plane with the maximum inliers from the modified candidate planes is selected and removed from the point cloud. This process continues until there are no points left in the point cloud. Finally, H-RANSAC refines the segmentation output by dismissing the small planes with points less than a predefined threshold and assign them to neighboring objects. The different steps of H-RANSAC are presented in Algorithm 1.

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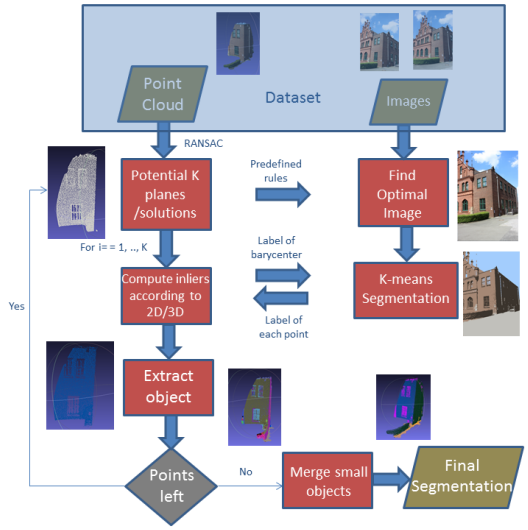

Fig. 1: The flowchart of H-RANSAC

Algorithm 1 H-RANSAC

while Point cloud has remaining points **do**
  Extract Candidate planes based on RANSAC (k candidate planes)
  for $i = 1 : k$ **do**
    Compute the barycenter b_i and the bounding box $\mathbf{B}_i$ and project them to the set of images
    Identify the optimal image
    Remove the 3D points from the plane that are not in the 2D segment containing the barycenter
    $Inliers_i = \#$points in the plane
  end for
  Select the plane with the most inliers and remove it from the point cloud
end while
Merge small objects