

Detection of Vanishing Points Using Hough Transform for Single View 3D Reconstruction

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Abstract: Single View Reconstruction (SVR) is a technique to reconstruct three-dimensional scenes or objects of interest from a single image. Unlike traditional (multi-view) close-range photogrammetry, SVR does not require camera parameters for obtaining 3D coordinates of the targets. A common approach for SVR is to establish the 3D metrology based on vanishing points from a single image with perspective projection. Therefore it is important to identify vanishing points correctly and effectively in order to obtain accurate 3D reconstruction results in SVR approaches. This study developed a double Hough transformation algorithm to estimate vanishing points on images with perspective projection. The algorithm starts by extracting feature lines of the raw image. The extracted feature edges are then transformed into Hough space, in which line segments are identified and short or discontinuous segments are discarded. The threshold for the line segment extraction and filtering can be automatically fine-tuned based on the statistical analysis of the data. For the best results, this study uses an inverted pyramid pattern iterative calculation procedure to improve the line detection and filtering. Based on the peak values of the first Hough transformation, second transformation for those peaks is performed to identify line segments passing through the same point (or small area) on the image space. Finally, vanishing points are calculated according to the grouped line segments and optimized with iterative calculation. Experimental results using computer-simulated data and real images indicate that the developed algorithm can identify vanishing points effectively and the detected vanishing points can be used to reconstruct accurate 3D models of the objects of interest from a single image.

Keyword: Vanishing point, Single view reconstruction, Close range photogrammetry, 3D reconstruction.