Implementing High Dynamic Range (HDR) Photography to Improve 3D Laser Scanning Point Cloud Visualization and Segmentation

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Abstract:
This research introduces novel point cloud segmentation approaches with the aid of the colorimetric data using computer vision algorithms. To improve the imagery data, High Dynamic Range (HDR) photography, which combines multiple images with varying exposure levels, is applied. Implementing HDR brought additional challenges such as detecting moving objects in images and properly preserving details when displaying the HDR image to minimize false segmentation. First, a new method is developed to detect these moving objects in digital images acquired with different exposures. Next, a general-purpose tone mapping operator using geostatistical methods is invented with the intent of preserving detail in extreme lighting regions. Furthermore, this research contains two novel approaches for point cloud segmentation using computer vision algorithms. In the first, a superpixel algorithm is applied for clustering the colorimetric data. Each superpixel is then classified as either “ground”, “wall”, or “vegetation” based on its corresponding normal vector. The second approach uses colorimetric, laser intensity, and geometric data to segment lidar point clouds. In this approach, an image segmentation algorithm is applied on panoramic image maps of various subsets of the scan data. Finally, the union of the segmented panoramic images is mapped back to the 3D point cloud. The proposed approach shows significant enhancements to point cloud visualization and segmentation using HDR technique. It has proven to be a more efficient and robust approach than current geometric-based techniques.