Accurate 3D Railway Track Extraction from Aerial Images

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ABSTRACT

Three-dimensional (3D) lines require further enhancement in both clustering and triangulation. Line clustering assigns multiple image lines to a single 3D line to eliminate redundant 3D lines. Currently, it depends on the fixed and empirical parameter. However, a loose parameter could lead to over-clustering, while a strict one may cause redundant 3D lines. Due to the absence of the ground truth, the assessment of line clustering remains unexplored. Additionally, 3D line triangulation, which determines the 3D line segment in object space, is prone to failure due to its sensitivity to positional and camera errors.

This paper aims to improve the clustering and triangulation of 3D lines and to offer a reliable evaluation method. (1) To achieve accurate clustering, we introduce a probability model, which uses the prior error of the structure from the motion, to determine adaptive thresholds;

1. Introduction

Currently, the length of the railway has exceeded 1.3 million kilometers on the earth. Thus, extracting the center line of the rail track (CRT) accurately and efficiently, to support engineering design, monitor construction quality, and ensure operational safety, has become one of the basic components in the maintenance of existing railways.

CRT extraction can be achieved by real-time kinematics, LiDAR, and multiple images. The real-time kinematic is generally mounted on a railway measurement vehicle and obtains the CRT by moving along the rail track. In general, it has a satisfactory accuracy while requiring operations on the track, thus demanding the cooperation of railway departments, and there are issues related to both safety and efficiency. LiDAR sensors can be mounted on a drone, which is more convenient and secure than real-time kinematic. Because a further process, like point segmentation or classification, is required for CRT extraction, the drone must maintain a low flight altitude to satisfy the standards of the point-cloud density, which would impact the efficiency. A drone with cameras can capture multiple images efficiently with a safe distance from the railway area. But CRT extraction is challenging in multiple images: (1) The dense points reconstructed with images are inaccurate around the railway track because of the occlusion and matching problems caused by the parallax variation. (2) Joining image semantics to obtain CRT might be workable; However, how to detect the semantics of CRT accurately and completely in multiple images remains to be studied. I have changed in overleaf

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References

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