High Resolution Ortho Photos via Image Stitiching for Pavment Cameras

Martin Reichholf, 12002225

ABSTRACT

Image stitching has gained popularity in the recent years in the area of ortho photos as it allows for the use of multiple images for a single ortho photo. This approach allows to cover a much bigger area than a single photograph making it possible to cover kilometers of pavement data to ease road inspection. In this work the application and the adaption of state-of-the-art image stitching techniques is to be examined for the use with pavement cameras and high resolution meshes created from a LiDAR system. The expected outcome of this thesis is a novel approach to the application of image stitching for the use with pavement cameras.

PROBLEM DESCRIPTION

Given a LiDAR point cloud of pavement scans and distance triggered images from pavement cameras as well as their positions at the time of taking the image a high resolution texture accounting for errors in camera registration, different lighting conditions, exposure and color difference is to be found. This texture shall then be used to create ortho photos rendering the resulting 3D model using a orthographic projection.

Research Question: What is the optimal approach for achieving high accuracy image registration and color consistency in the creation of high-resolution ortho photos using image stitching techniques with pavement cameras taking advantage of LiDAR scanner data?

PREVIOUS WORK

Rendering was already done using distance weighted and multi-band blending on a test road with 50 meters. The input images were first distortion corrected and then used to texture a mesh created from the LiDAR data. For prepossessing HSV and vignette correction have been tried resulting in only small benefits. The resulting images were leading to sup par results suffering either from color inconsistencies, blur or other artifacts.

Approaches not relying on blending mostly try to find optimal seam lines between images with a least notable difference avoiding blending artifacts by only using pixel information of a single source image for the resulting stitched-image losing information in the process. [1]

More modern techniques try to take a different approach estimating camera parameters and geometry first and then optimizing a energy function to arrive at a convergent solution for a texture map and geometry taking into account all input images leading to a higher resolution output image. [2] These approaches look most promising as the measured LiDAR data already gives a precise estimate for the geometry as well as lighting information through reflectance.

EXPECTED RESULTS

The goal of this thesis is to investigate how modern approaches to image-stitching using energy function optimization can be applied to and extended by measured LiDAR data in the context of ortho photos to improve color consistency and image registration for higher quality results.

METHOD

To achieve this goal first a literature analysis will be conducted to establish three state-of-the-art approaches in image-stitching with the condition that the used approach will be extendable to the already available LiDAR data.

Then the chosen three approaches will be adapted to include the available geometry and lighting information from the given LiDAR data.

Finally the results will be evaluated in terms of color consistency and accuracy of registration as well as possible image artifacts.

MILESTONES

1. literature analysis **Due date: 17.03.2023**
2. adaption of image-stitching algorithms **Due date: 28.04.2023**
3. evaluation of adapted algorithms **Due date: 12.05.2023**
4. finished thesis **Due date: 23.06.2023**

REFERENCES

[1] Gal, R., Wexler, Y., Ofek, E., Hoppe, H., and Cohen-Or, D. (2010). Seamless Montage for Texturing Models. *Computer Graphics Forum*.

[2] Goldluecke, B., Aubry, M., Kolev, K., and Cremers, D. (2014). A super-resolution framework for high-accuracy multiview reconstruction. *International Journal of Computer Vision*, 106:172–191.