

**CAMERA ALIGNMENT AND IMAGE GUIDED HOLE
FILLING USING LIDAR DATA**

By

Jacob Edward Becker

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Approved:

Charles V Stewart, Thesis Adviser

Rensselaer Polytechnic Institute
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ABSTRACT

A system is presented that consists of two related parts. The first part is an extension of an algorithm that aligns an image from a hand-held camera to a 3d model constructed from one or more LiDAR scans and color images. This part assumes little prior knowledge about the camera. The alignment algorithm consists of steps that (1) generate a set of initial model-to-image mapping estimates, each only reliable to a small region of the model and image, (2) refine each initial estimate through a combination of 3d-to-2d matching, robust parameter estimation, region growth, and model selection, and (3) test the resulting projections for accuracy, stability and randomness. The main extension presented here is a novel region growth algorithm that improves upon the original version of the algorithm. The new algorithm grows along the embedded 2D surface within the 3D model by inserting new octree cell into the previous region's set. As a result, the success rate of images aligned to the model is improved over the previous version.

The second part takes the result from the alignment algorithm to fill-in missing geometry in a single LiDAR scan. While most prior work focuses on using multiple images, we demonstrate that there is enough information from a single image to fill-in holes. Our key observation is that similar texture typically has similar geometry. We leverage this fact to create an example data set of image patch to geometry from the non-hole regions of the scan using a single image. We take care to make sure that these image patches are uniform in scale and orientationally invariant. Our proposed hole filling algorithm iteratively selects the best location to fill based on the amount of supporting geometry, and based on the visual evidence fills a portion of the hole in. This results in visually accurate new geometry. We demonstrate the hole filling algorithm on synthetic and real-world single scans including both interior and exterior architectural scenes.