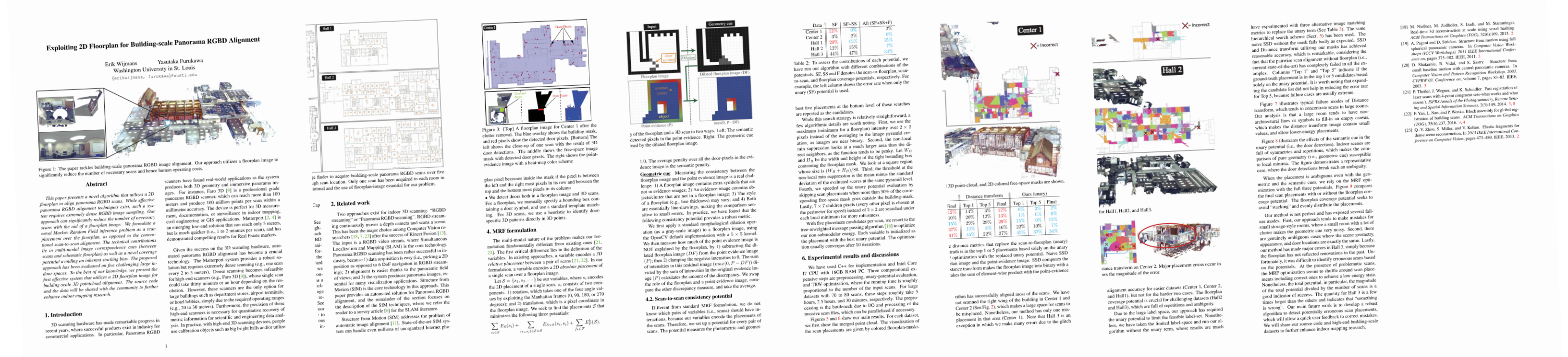

Exploiting 2D Floorplan for Building-scale Panorama RGBD Alignment

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Figure 1: The paper tackles building-scale panorama RGBD image alignment. Our approach utilizes a floorplan image to significantly reduce the number of necessary scans and hence human operating costs.

Abstract

This paper presents a novel algorithm that utilizes a 2D floorplan to align panorama RGBD scans. While effective panorama RGBD alignment techniques exist, such a system requires extremely dense RGBD image sampling. Our approach can significantly reduce the number of necessary scans with the aid of a floorplan image. We formulate a novel Markov Random Field inference problem as a scan placement over the floorplan, as opposed to the conventional scan-to-scan alignment. The technical contributions lie in multi-modal image correspondence cues (between scans and schematic floorplan) as well as a novel coverage potential avoiding an inherent stacking bias. The proposed approach has been evaluated on five challenging large indoor spaces. To the best of our knowledge, we present the first effective system that utilizes a 2D floorplan image for building-scale 3D pointcloud alignment. The source code and the data will be shared with the community to further enhance indoor mapping research.

1. Introduction

3D scanning hardware has made remarkable progress in recent years, where successful products exist in industry for commercial applications. In particular, Panorama RGBD scanners have found real-world applications as the system produces both 3D geometry and immersive panorama images. For instance, Faro 3D [9] is a professional grade panorama RGBD scanner, which can reach more than 100 meters and produce 100 million points per scan within a millimeter accuracy. The device is perfect for 3D measurement, documentation, or surveillance in indoor mapping, civil engineering or GIS applications. Matterport [2, 4] is an emerging low-end solution that can reach only 5 meters, but is much quicker (i.e., 1 to 2 minutes per scan), and has demonstrated compelling results for Real Estate markets.

Given the success on the 3D scanning hardware, automated panorama RGBD alignment has become a crucial technology. The Matterport system provides a robust solution but requires extremely dense scanning (e.g., one scan every 2 to 3 meters). Dense scanning becomes infeasible for high-end scanners (e.g., Faro 3D [9]), whose single scan could take thirty minutes or an hour depending on the resolution. However, these scanners are the only option for large buildings such as department stores, airport terminals, or hotel lobbies, simply due to the required operating ranges (e.g., 20 to 30 meters). Furthermore, the precision of these high-end scanners is necessary for quantitative recovery of metric information for scientific and engineering data analysis. In practice, with high-end 3D scanning devices, people use calibration objects such as big bright balls and/or utilize