

Monocle Prime Measurement Analysis

Steampunk Digital, Co. Ltd.
2021-09-27



Steampunk Digital used a bookshelf for capture reference. In the testing we wanted to check for accuracy, precision, internal consistency, and ease of capture.



Figure 1 - Actual



Figure 2 - Monocle Prime
iPhone 12 Pro Max



Figure 3 - Reality Capture
Sony a7R III, 20mm lens

Figures

1. Actual – Ground Truth with tape measurement
2. Monocle Prime – Captured with an iPhone 12 Pro Max
3. Reality Capture Photogrammetry – Captured with Sony a7R III, with 20mm prime lens

Accuracy

Extremely accurate: less than 0.5% error from actual. Monocle Prime, using an iPhone 12 Pro Max, is consistent with Reality Capture photogrammetry using high-end DSLR Sony Camera and prime 20mm lens.

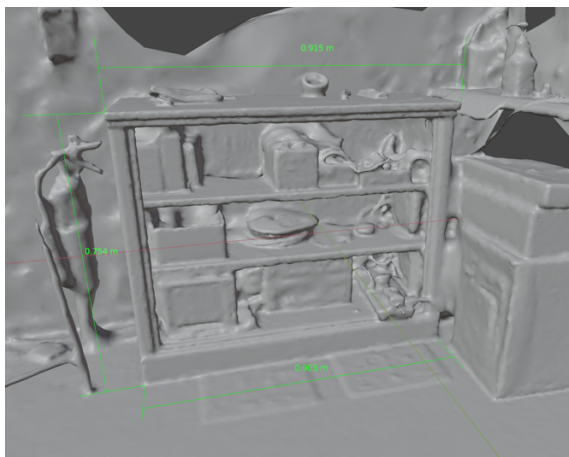


Figure 4 - Monocle Prime Measures

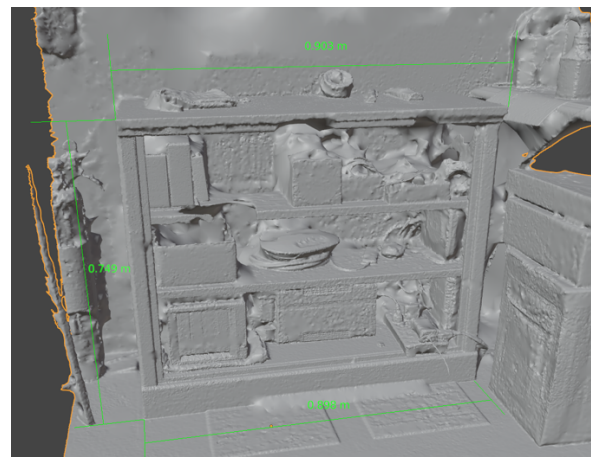


Figure 5 - Reality Capture Measures

Left-side Height

Actual: 0.750m
Monocle Prime: 0.754m (0.5% error)
Reality Capture: 0.749m (0.1% error)

Bottom Width

Actual: 0.902m

Monocle Prime: 0.903m (0.1% error)
Reality Capture: 0.898m (0.4% error)

Precision

Extremely precise: less than 0.01% variability across the capture volume.
This is close to limit of 32bit floating point precision.

Internal Consistency

Monocle Prime produces extremely internally consistent measurements. Processing performed better at finding geometric surfaces of textured surfaces and edges even in dark environments with moderate to high noise. Reality Capture was unable to produce some surfaces of the book shelf (holes), and the model had poorer internal consistency due to a slight twist to the geometry.

However, the wall is a flat white surface, so both Monocle Prime and Reality Capture showed high variability in both cases.

Using CloudCompare to process an iterative closest point alignment, it calculated an RMS error of 2.3% global alignment error across the Monocle Prime and Reality Capture models. This is consistent with the accumulation of error of both model processing methods, and accounting for missing shelf geometry in the Reality Capture model.

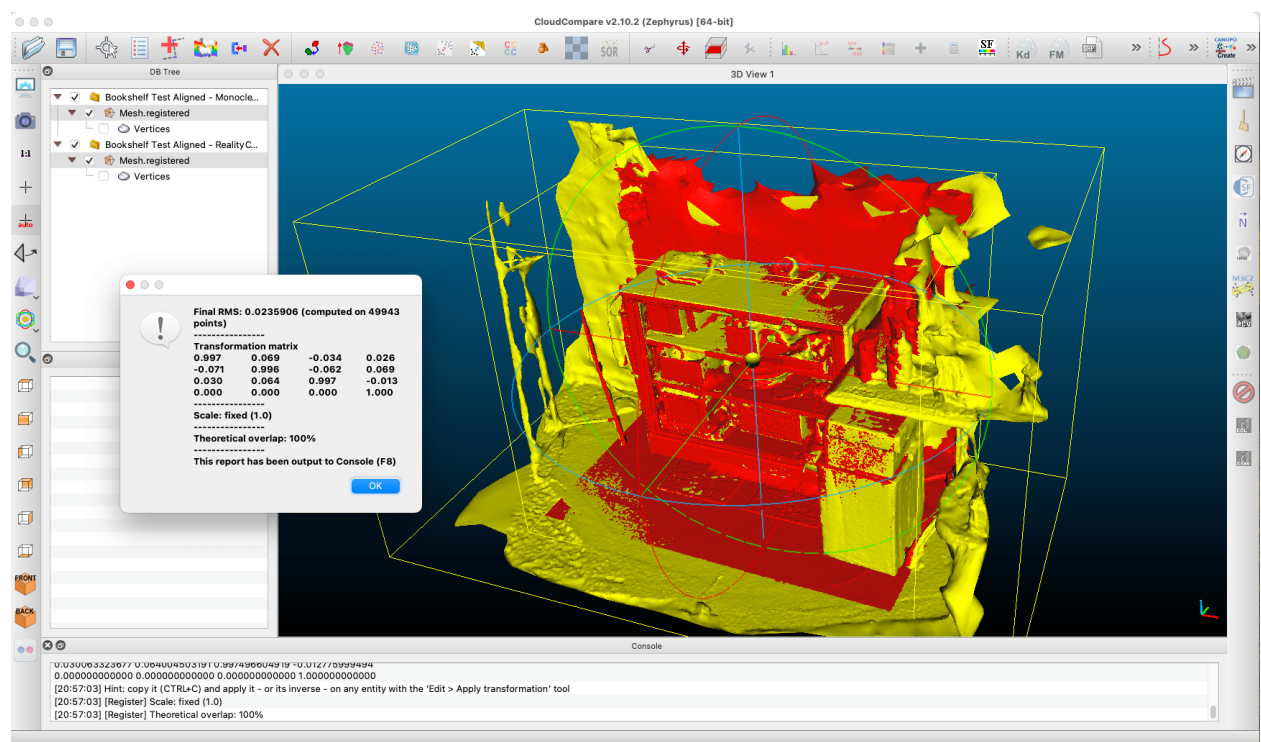


Figure 6 - Cloud Compare - RMS after ICP Alignment

Ease of Capture

Monocle Prime works directly out of pocket, no floor level calibration, nor scale bars are needed.

Whereas Reality Capture photogrammetry requires a DSLR (such as Sony a7R III) with a high-quality lens (such as the Sony 20mm f1.8 prime lens), and PC with Nvidia GPU for processing. Reality Capture also requires considerable time to learn how to use correctly, including how to configure the camera for shooting photogrammetry, create markers, create a ground plane control file, and steps to align and process the 3D geometry. All necessary to get level and scale accurate results.



Figure 7 - iPhone 12 Pro Max



Figure 8 - Sony a7R III, 20mm Lens, with Scale Bar

Conclusion

Monocle Prime aims to be the best option to get scale accurate 3D reference models, without requiring specialized equipment, preparation, or technical knowledge. The prerequisite is an iPhone with two or more rear cameras, good light, and target object with surface detail. The result is a photorealistic 3D model with less than 1% error dimensional accuracy.

iPhones With Two or More Rear Cameras

- iPhone 13 Pro Max (2021)
- iPhone 13 Pro (2021)
- iPhone 13 Mini (2021)
- iPhone 13 (2021)
- iPhone 12 Pro Max (2020)
- iPhone 12 Pro (2020)
- iPhone 12 Mini (2020)
- iPhone 12 (2020)
- iPhone 11 Pro Max (2019)
- iPhone 11 Pro (2019)
- iPhone 11 (2019)
- iPhone XS Max (2018)
- iPhone XS (2018)
- iPhone X (2017)
- iPhone 8 Plus (2017)
- iPhone 7 Plus (2016)