MegaParallax: 360° Panoramas with Motion Parallax

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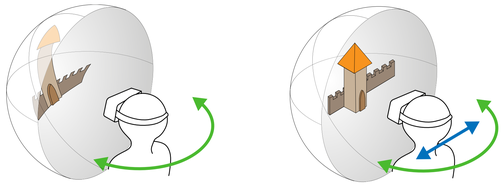
Motivation

State-of-the-art 360° content lacks motion parallax because of a static projection strategy which further produces a distorted perspective. We propose an image-based rendering approach which yields motion parallax and correct perspective in panoramic environments without relying on accurate scene geometry.



Problem

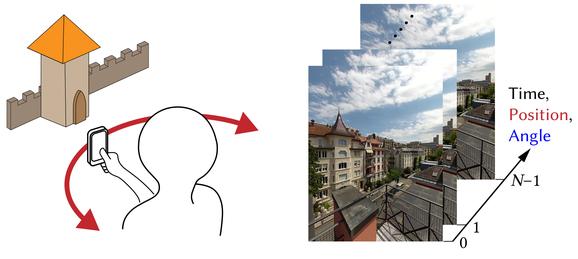
1. The creation of immersive media is usually restricted to dedicated capturing setups such as camera rigs. We operate with video captured by a single consumer camera.

2. State-of-the-art approaches for generating panoramic content introduce a perspective distortion due to a static projection on the projection surface.

3. Commercial solutions for image stitching may not expose enough details in order to create 360° panoramas with motion parallax. We propose a simple end-to-end pipeline from capture, over processing to the actual rendering of the content.

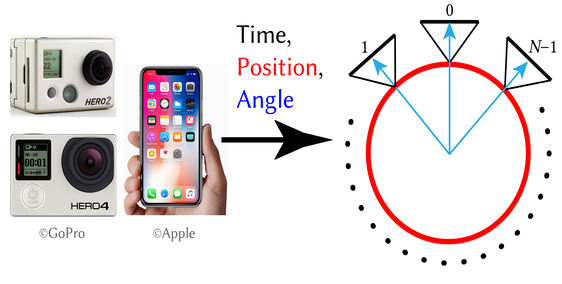
Our Approach

We capture a video with a single sweep, process the individual frames and render a 360° panorama with motion parallax.



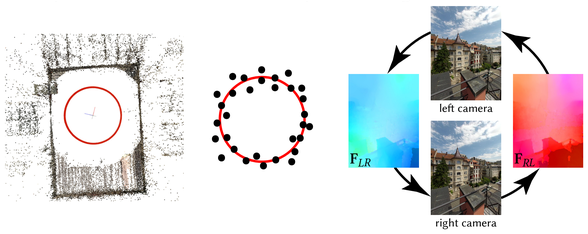
Capture

A GoPro HD Hero 2, Hero 4 and iPhone X were used to capture video to generate 360° datasets with motion parallax.



Processing

We first compute Structure-from-Motion (SfM) of all input frames to obtain fully calibrated views. Then we register a circle to the estimated positions of the views. After that we compute dense correspondences between each pair of neighboured cameras.

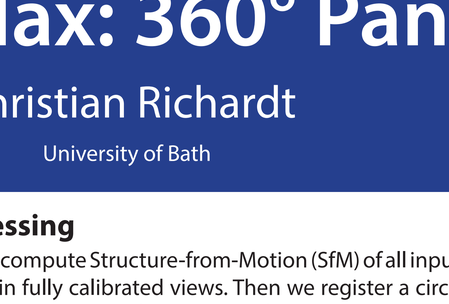


structure-from-motion registration dense correspondences

Rendering

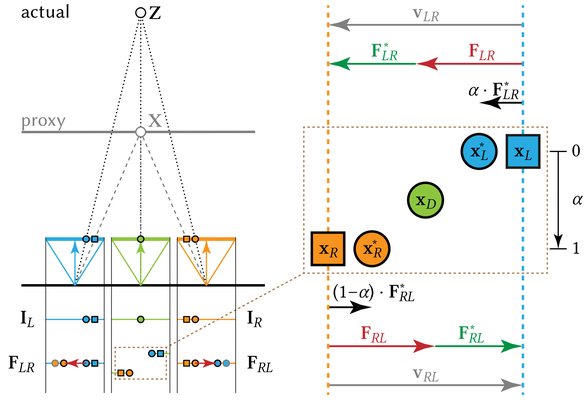
We use a simple two-view image synthesis guided by optical flow to create novel viewpoints within the camera circle obtained in the processing stage.

A novel viewpoint is synthesized by linearly interpolating the pixels of the best camera pair enclosing the viewpoint.



Flow-based blending

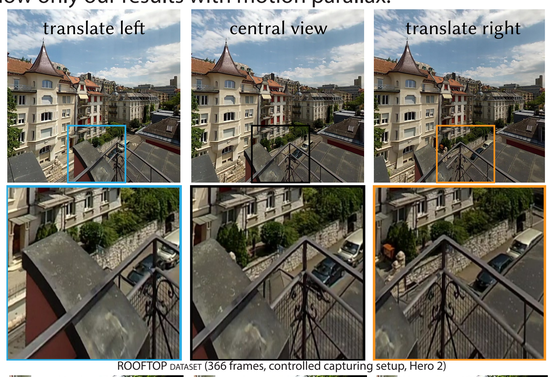
The reprojection error caused by trivial scene geometry is greatly reduced by using optical flow to determine a depth-corrected pixel in the left and right view.



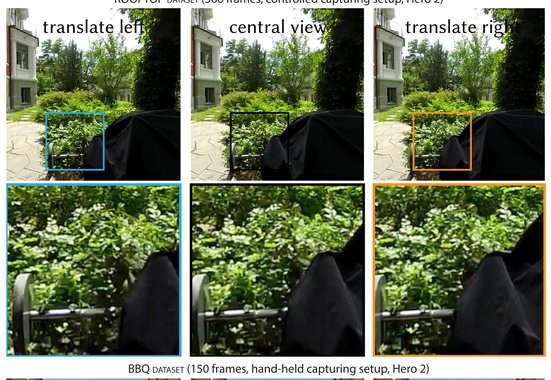
Results

Our dynamic stitching yields correct perpective and motion parallax. The method is simple and accessable to casual consumers.

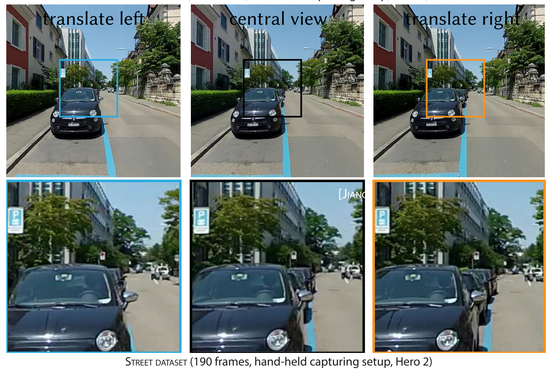
We show further results with hand-held captured datasets. We show only our results with motion parallax.



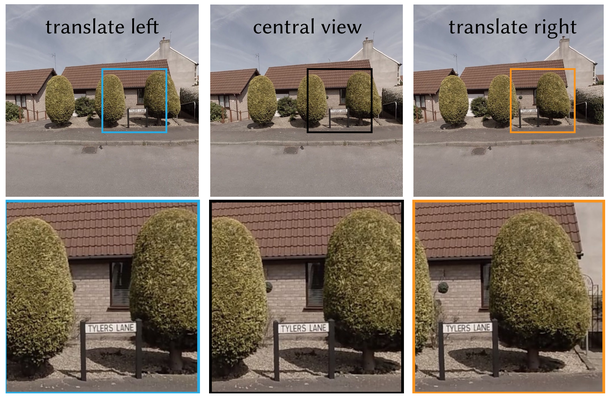
ROOFTOP DATASET (366 frames, controlled capturing setup, Hero 2)



BBQ DATASET (150 frames, hand-held capturing setup, Hero 2)



STREET DATASET (190 frames, hand-held capturing setup, Hero 2)



TYLERS LANE DATASET (300 frames, hand-held capturing setup, Hero 4)

Evaluation

We render novel viewpoints by translating the desired camera to the left and right and observe high quality results. We render full HD frames (one-eye) at 400 fps.

Limitations

We observed strong scene-dependency regarding the quality of the extrinsics estimated by SfM. Capture inaccuracy and drift in the reconstruction lead to loop closing issues. The space in which we can create novel viewpoints reliably is very limited since we do not use an accurate scene proxy.

LAKE DATASET (250 frames, hand-held capturing setup, iPhone X)

References

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Acknowledgements

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