Project acronym: POPART Project number: 644874 Work package: Integration and demonstration Deliverable number and name: D4.3: Deliver dataset	Title: Dataset Work Package: WP4 Version: 1 Date: 01/07/2015 Author: Håvard Espeland
Type: [ ] Report [ ] Demonstrator, pilot, prototype [ ] Website, patent filings, videos, etc. [X] Other	Co-Author(s): Fabien Castan To: Albert Gauthier, Project Officer
Status: [ ] Draft [ ] To be reviewed [ ] Proposal [X] Final / Released to EC	Confidentiality: [X] PU – Public [ ] CO – Confidential [ ] CL - Classified
Revision:	
Contents: Deliverable D4.3: To develop the tracking system, LAB will create an original data-set of footage from a decor containing both natural features and markers. MIK will create a complete virtual set with a photo-realistic rendering and camera motion, in order to dispose of a controlled environment to be used as a reference set with a real ground truth.	

Introduction

The released dataset 'POPART_DATASET' is designed to form a basis for development of algorithms and tools for the rest of the project. Additionally, we expect it to be useful for other researchers and third parties working on camera localization and 3D reconstruction. This release is split in two parts. The first one is a shooting dataset. The second one is a complete virtual set.

Availability

The dataset is available for download from the project website http://popartproject.eu and from https://zenodo.org/collection/user-popart.

Mixed Reality dataset

The identifier for this part of the dataset is 'POPART_DATASET_MIXED_01'. Download link: http://dx.doi.org/10.5281/zenodo.19198

The goal of the camera tracking dataset is to provide a reference for developing a robust tracking system using the fiducial marker CCtags in a studio environment. A virtual cube is to be placed between the two cubes in such a way that the stack looks completely static when watching the composited images. This is a challenging case to track manually since small errors in the tracking data will result in a clearly visible misalignment when viewed from different angles. We provide a manually tracked path for comparison and review.

We have mounted nine 3-crown fiducial markers *CCtags* in the ceiling of the studio. Additionally, six markers are fixed to the front wall. The witness cameras are pointed towards the ceiling while shooting, see Figure 2. By having some markers mounted on the wall, we are able to perform external calibration of the system with the main camera pointing on the wall and the witness cameras upwards. After external calibration, the wall markers are no longer needed, but are left on the wall in this footage.

Figure 1: Shooting the camera tracking dataset in Equippe's Studio 1 in Grimstad, Norway, June 2015.

Technical details

Main camera: RED EPIC Dragon 5.5K (Super35mm) with RED 25mm prime, 1/50 shutter, 25 fps.
Witness cameras: Point Grey Flea3 3.2 MP Mono with Kowa 3.5mm lens, 1/400 shutter, 25 fps.
Encoder: Intel Media SDK Hardware encoder 10 Mbps H.264.
Acquisition system: HAL trigger system with all shutters synchronized by Genlock.

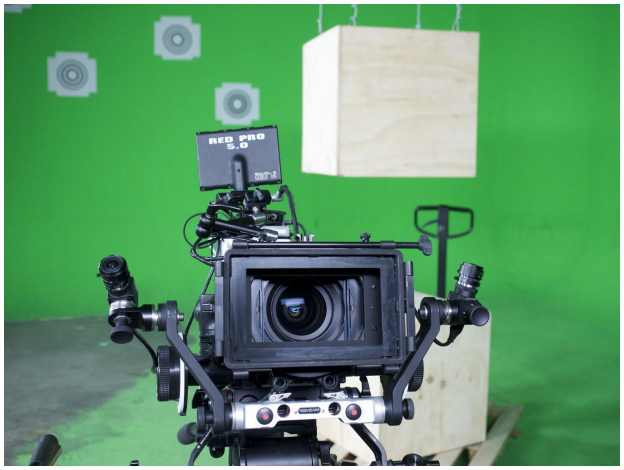


Figure 2: Configuration of witness cameras pointing towards the ceiling.

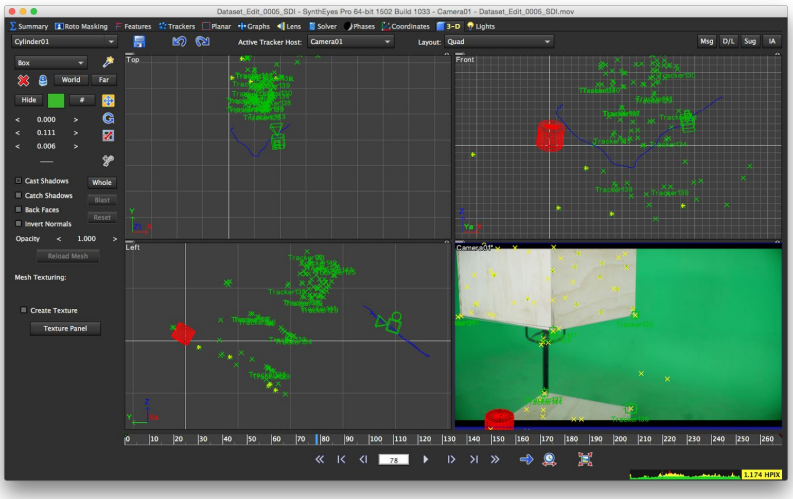
Contents and file structure

For reference, we have provided a camera track of the footage made in SynthEyes. This is made in the traditional way using post tracking of only the main camera, meaning the there may be inaccuracies, even though the results look correct in the composite.

The naming for this project is generic. In a normal production every shot is rarely a VFX shot, but the basic principles of a shot bundle per VFX shot. All video files are transcoded to Apple ProRes 4:2:2.

- Dataset_Edit_????
  - Raw video files of main and witness cameras.
  - SynthEyes tracking setup
- Edit_and_FCP7_XML
  - Editing files created with Adobe Premiere and exported as FCP7 xml.
- Exported_trackerdata
  - Reference post track in FBX and Nuke format.
- External_Calibration_CCtags
  - Dataset to calibrate the witness cameras to the main camera.
  - Includes pictures for building a 3D reconstruction of the setup.
- Lens_Calibration_Maps
  - Checkerboard shots for calibrating lenses.
- RED_RAW

    - Raw datafiles from the main camera.
- 3D Object
    - Virtual asset that fits in the stack of boxes



Post tracking of dataset in SynthEyes.

Virtual dataset

The identifier for this part of the dataset is 'POPART_DATASET_VIRTUAL_01'. Download link: http://dx.doi.org/10.5281/zenodo.19164

We created a 3D scene of urban environment and compute photorealistic 3D renderings. Then we can use these computer generated images as standard shooting data for the 3D reconstruction and camera tracking. The CG world contains the ground truth information and will enable us, for the first time, to truly evaluate the reconstruction error. We will not use the reconstructed point cloud, as we have no ground truth information about it, but we will only evaluate the internal and external calibration of the cameras which measure the quality of the whole reconstruction in itself.
Before this virtual dataset all the evaluations have been done on randomly generated data but always on individual steps (unit tests). With this dataset we will be able to have a global evaluation of the whole workflow (functional tests). That will enable us to evaluate the impact of each change on the final result and ensure that we will not introduce regressions.
As this dataset is only based on rendered images, we will be able to compare our results with external solutions.

Now, we need to implement a function to compare two sets of cameras: realign them and compute the distance between cameras (including the internal parameters).

Technical details

This dataset has been created using an initial 3D reconstruction from real shooting and we have used MayaMVG (POPART) for the photomodeling and Mari (The Foundry) for the texturing.

1. The first dataset is dedicated to 3D reconstruction evaluation

We provide a set of 596 still images at the resolution of 5184x3456. We compute a variant with and without CCtags to evaluate the impact of natural and artificial features on the final output.

2. The second dataset is dedicated to evaluate the camera localization inside the 3D reconstruction

We created a virtual camera motion rendered in 2K with the following rendering options:

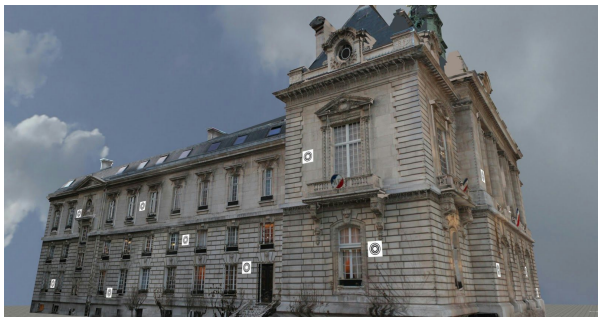
1. basic rendering
2. motion blur
3. depth of field
4. varying focal
5. varying focal + motion blur
6. varying focal + depth of field
7. varying focal + motion blur + depth of field

Images used to evaluate the 3D reconstruction algorithm:

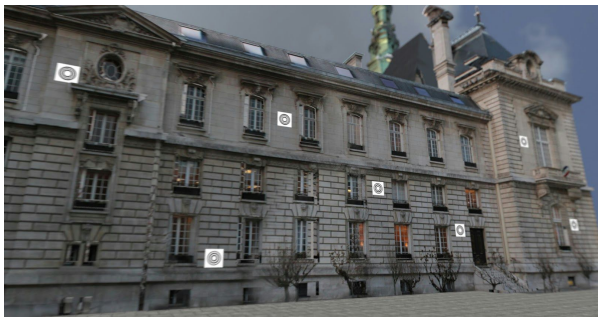
Footage used for the initial reconstruction

Same image rendered in CG

Images of a virtual camera motion to evaluate the camera relocalization:



Basic rendering



With DoF and motion blur

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The virtual camera motion is composed of 374 images at the resolution of 2048x1080.

In the future, it could be useful to add noise, radial distortion, optical center offset in this dataset and maybe rolling shutter to evaluate the impact.

Future additions to the dataset

On request by the advisory board to be present and experience the filming of a complex mixed reality data set with a live preview, we scaled back on the ambition of the mixed reality dataset to something that prioritize functionality rather than aesthetics. We will build a complex set from a slightly post-apocalyptic train station, where everything except the platform and back-light is virtual, and invite the advisory board to be present while shooting this. By delaying this more ambitions scene we expect to be able to provide a live preview of the virtual assets, which was not possible when submitting this in June 2015 due to the fact that the RT components of POPART are not completed yet. We expect to perform this shooting in the autumn 2015, and expand the dataset with this new material. The material in itself will be beneficial to the researchers, but maybe just as interesting for the project; members will be able to work in real time on a large scope with our technology, and reflect upon the process of highly realistic mixed-reality sets. If we are able to do it on a limited budget, it'll bring vital impact to the European film industry by exemplifying how the POPART technology can be used for user-friendly virtual scenography, from pre-production to final images.

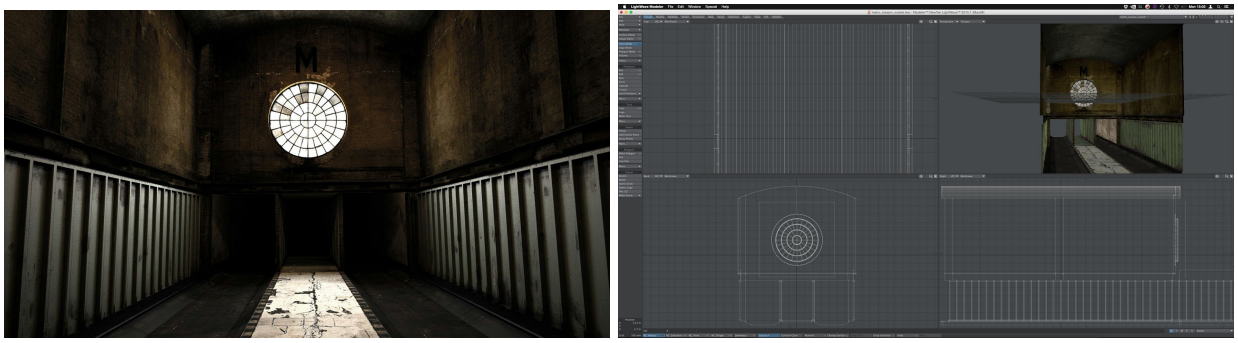

Figure 3: Screenshot of virtual assets in the upcoming mixed reality dataset. Back-light window and platform will be replaced by physical set in the extended dataset.

Conclusion

The dataset released provide a reference for research and development in camera tracking and set reconstruction in the area of film production. It can be used in connection with improving the open source tools released in POPART, or for developing new tools and algorithms in this area.