

IMAGE-BASED 3D RECONSTRUCTION

DEFINITION

Images of real objects to 3D models



Johannes Schönberger - (Crowdsourced) Image-based 3D Modeling - Microsoft

CURRENT METHODS

Online Visual SLAM	Offline Structure from Motion Multi View Stereo
IMMEDIATE 3D RESULTS	HIGH ACCURACY AND RESOLUTION
EASY IMAGE ACQUISITION	3D RESULTS AFTER LONG PROCESSING TIMES
LOW ACCURACY AND RESOLUTION	HARD IMAGE ACQUISITION
LARGE-SCALE PROBLEMS	

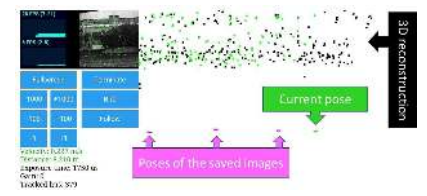
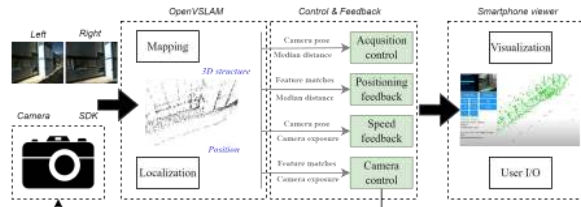
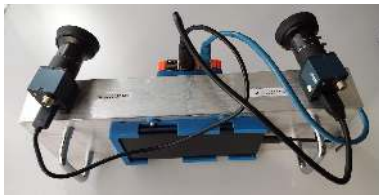
APPLICATIONS

- Cultural heritage:** digital preservation
- Civil engineering:** structural analyses
- Environmental sciences:** soil analysis
- Entertainment:** 3D models for video games or augmented reality applications



GUPHO

GuPho (Guided Photogrammetric system) is our developed system that aims to combine that **advantages** of **both methods**: easy image acquisitions and high accuracy and resolution of the final 3D reconstruction.



Flexible and lightweight components:

- Computational unit:** Raspberry Pi 4B.
- Optics:** two synchronized global shutter 1 MP cameras with changable lenses.
- I/O:** smartphone or tablet.

During the image acquisition, the user is supported by an **online 3D reconstruction algorithm**.

Specific **key performance indicators** are continuously monitored and displayed.

The real-time 3D reconstruction is used to **automatically control** the saving of the images, which will be finally processed with **offline** algorithms.

The **interface** of the system showing:

- Live **image stream** with color-based feedback on distance and speed
- Low-resolution **3D reconstruction** where colors indicate the average acquisition distance
- Current user **pose**, and poses of the saved images

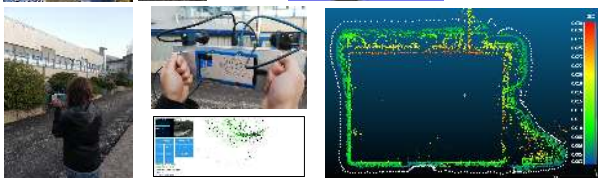
RESULTS

FBK building (Trento)

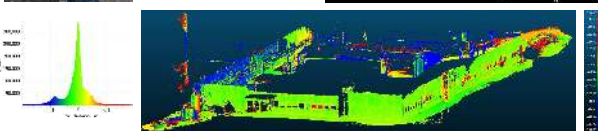


40 x 60 meters - **approximated size** - 25 x 8 meters

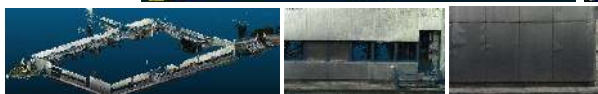
TLS **ground truth** available



Online 3D reconstruction **visible** to the user during the image acquisition. **Colors** encode the acquisition distance, **white dots** are the positions of the saved images

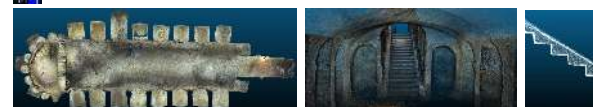
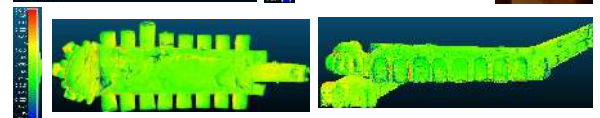
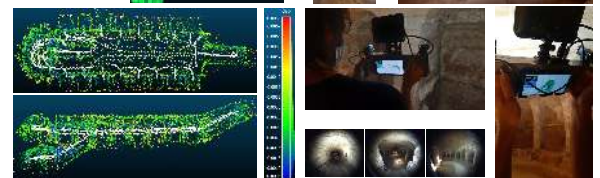
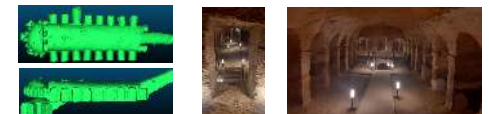


Evaluation of the offline 3D reconstruction. **Colors** encode the **error** w.r.t. the TLS



Some **details** of the offline 3D reconstruction

Camerano Caves (Ancona)



CONCLUSIONS AND FUTURE WORKS

Conclusions: development of a **flexible and lightweight** system that leverages and **online 3D reconstruction algorithm** to **support** the user during the **acquisition** of the images. The saved images, **checked** on the field, are later used to obtain accurate and high-resolution **offline 3D reconstructions**. Results show that it is the system can be **successfully** deployed in complex and extended scenarios.

Future works: increase **resolution** of the online 3D reconstruction for more detailed feedback, different **hardware** setups, **underwater** scenarios.