An interactive image acquisition system for accurate image-based 3D reconstructions

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IMAGE-BASED 3D RECONSTRUCTION

DEFINITION

Images of real objects to 3D models

CURRENT METHODS

Online
Visual SLAM

Offline
Structure from Motion
Multi View Stereo

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 the 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 changeable 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.

RESULTS

FBK building (Trento)

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

Camerano Caves (Ancona)

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

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 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.
