PHOTOGRAMMETRIC APPLICATIONS OF IMMERSIVE VIDEO CAMERAS

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Abstract

The paper investigates immersive videography and its application in close-range photogrammetry. Immersive video involves the capture of a live-action scene that presents a 360° field of view. It is recorded simultaneously by multiple cameras or microlenses, where the perspective centre of each camera is offset from the rotating axis of the device. This issue causes problems when stitching together individual frames of video separated from particular cameras, however there are ways to overcome it and applying immersive cameras in photogrammetry provides a new potential. The paper presents two applications of immersive video in photogrammetry. At first, the creation of a low-cost mobile mapping system based on Ladybug®3 and GPS device is discussed. The amount of panoramas is much too high for photogrammetric purposes as the base line between spherical panoramas is around 1 metre. More than 92 000 panoramas were recorded in one Polish region of Czarny Dunajec and the measurements from panoramas enable the user to measure the area of outdoors (adverting structures) and billboards. A new law is being created in order to limit the number of illegal advertising structures in the Polish landscape and immersive video recorded in a short period of time is a candidate for economical and flexible measurements off-site. The second approach is a generation of 3d video-based reconstructions of heritage sites based on immersive video (structure from immersive video). A mobile camera mounted on a tripod dolly was used to record the interior scene and immersive video, separated into thousands of still panoramas, was converted from video into 3d objects using Agisoft Photoscan Professional. The findings from these experiments demonstrated that immersive photogrammetry seems to be a flexible and prompt method of 3d modelling and provides promising features for mobile mapping systems.
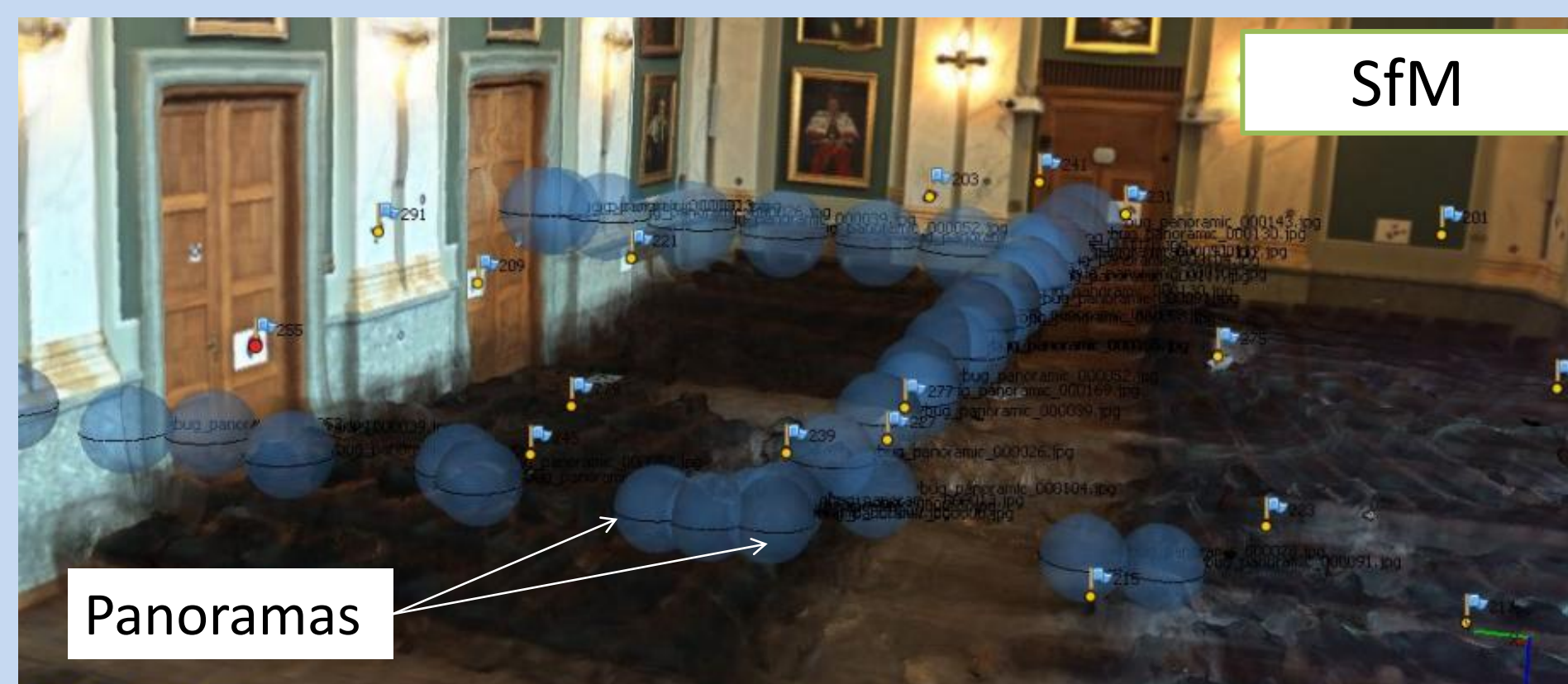
Immersive videography

One frame of 360° immersive video

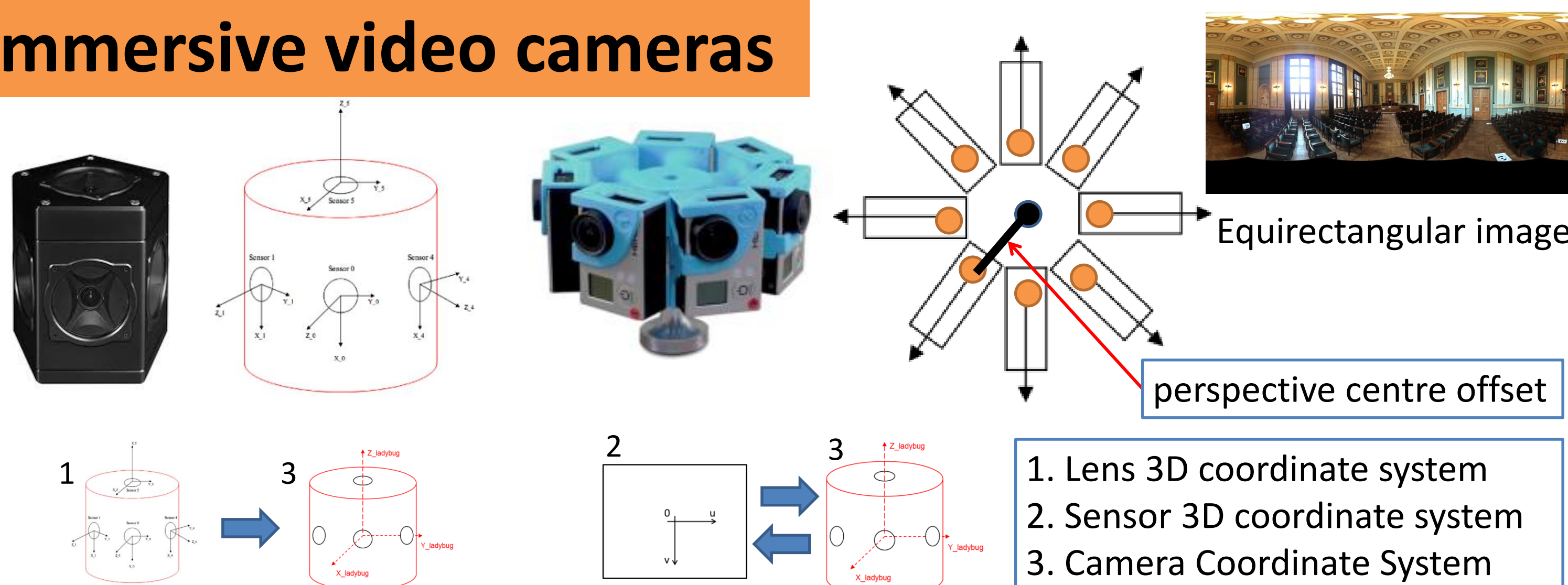Immersive video camera mounted on a car

Recording interiors

SfM

Panoramas

Multiple equirectangular frames from immersive videography

Immersive video camera mounted on a trolley

Immersive video cameras

Equirectangular image

perspective centre offset

1. Lens 3D coordinate system
2. Sensor 3D coordinate system
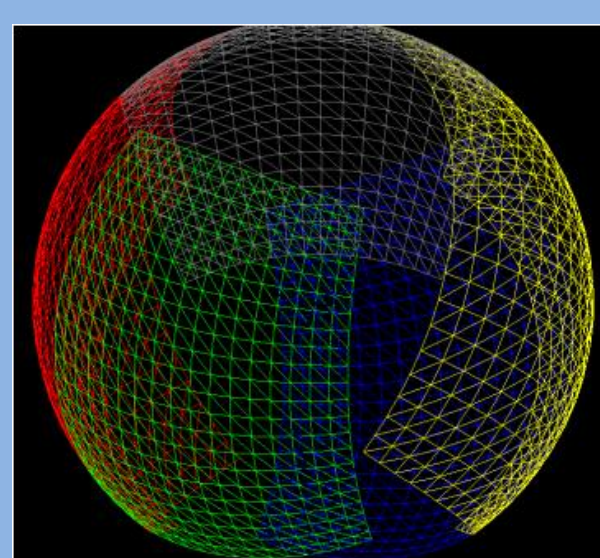3. Camera Coordinate System

Immersive photogrammetry

Spherical photogrammetry

- High resolution of spherical panoramas
- A few high resolution panoramas are used for orientation and calculation
- Time consuming block by block 3d modelling
- Mainly used for outdoor scenes so far (e.g. façades of churches)
- High accuracy

Immersive photogrammetry

- Medium resolution of spherical panoramas created from individual frames of immersive video
- Hundreds of spherical panoramas are imported to Agisoft and camera is calibrated
- Quick process of 3d modelling provides interactive navigable environments within a short period of time
- Approach is good for indoor scenes without moving objects (cars, people)
- Medium accuracy

Stitching immersive video

parameters	Hugin	PTGui
focal length [mm]	13.23	13.22
field of view [°]	104.87907	104.78
a	0.033414873	0.05763
b	-0.10575779	-0.18915
c	-0.17124819	-0.07498
d	-11.654003	-9.11
e	13.760678	11.19

Virtual sphere representing one virtual spherical camera

Calibration of a virtual sphere in Hugin and PTGui

Immersive video → Extraction of individual frames → Calibration of panoramas (Hugin, PTGui)
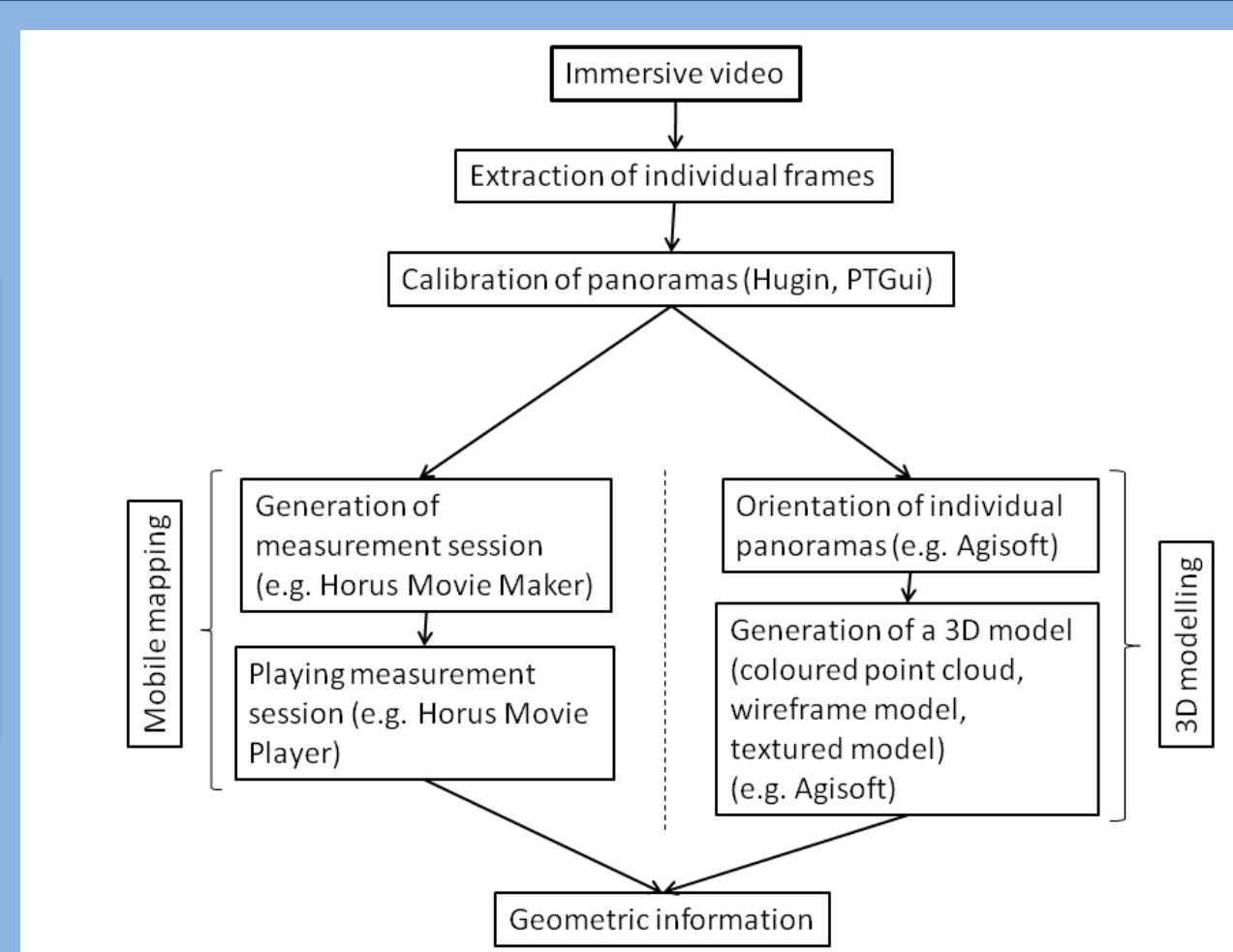
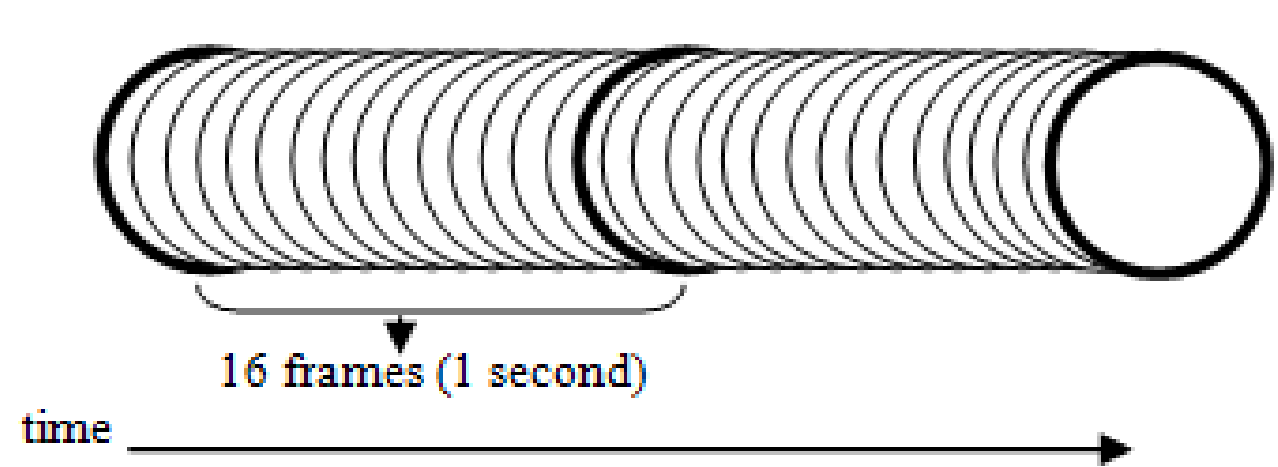The process of applying photogrammetric measurements in immersive video

3D modelling from immersive videography
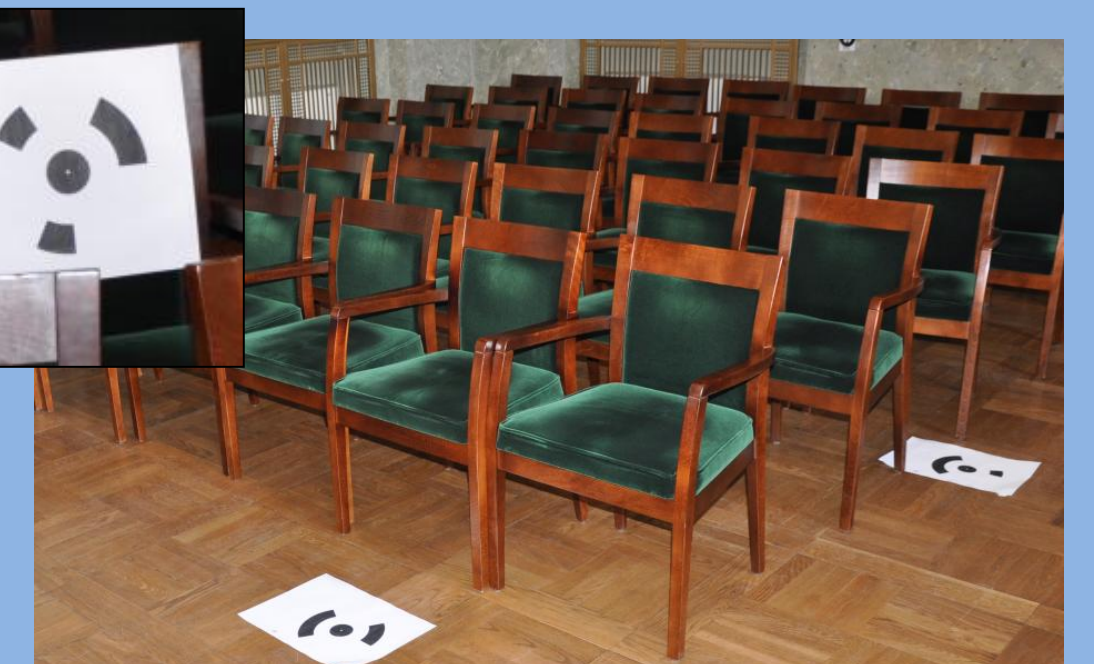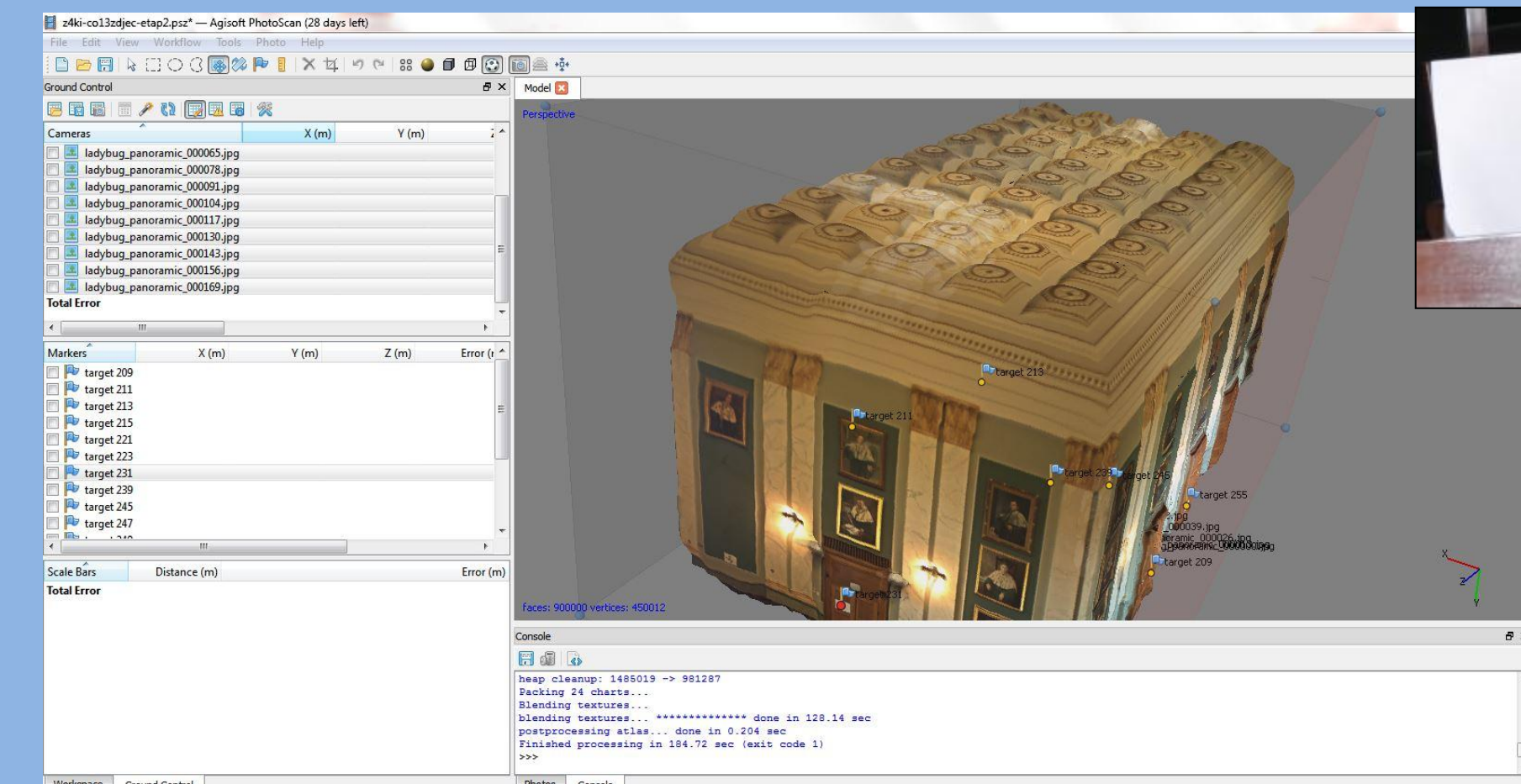
Coded targets (size: A3)

Textured 3D model

Immersive videography in mobile mapping

16 frames (1 second)

A fragment of immersive video divided into 360° frames

Individual frames of immersive video

Multi-click approach. Finding the same corners of banners or billboards on multiple panoramas

New immersive virtual tours

- interactive 3D exploration of CH sites using Flare3D viewer
- quick process of recording interiors using 360° immersive videogrammetry
- Flare3D navigation: mouse (rotation) and keyboard (moving through the recorded space)
- provides potential for filming and game industry
- accuracy about 2 cm
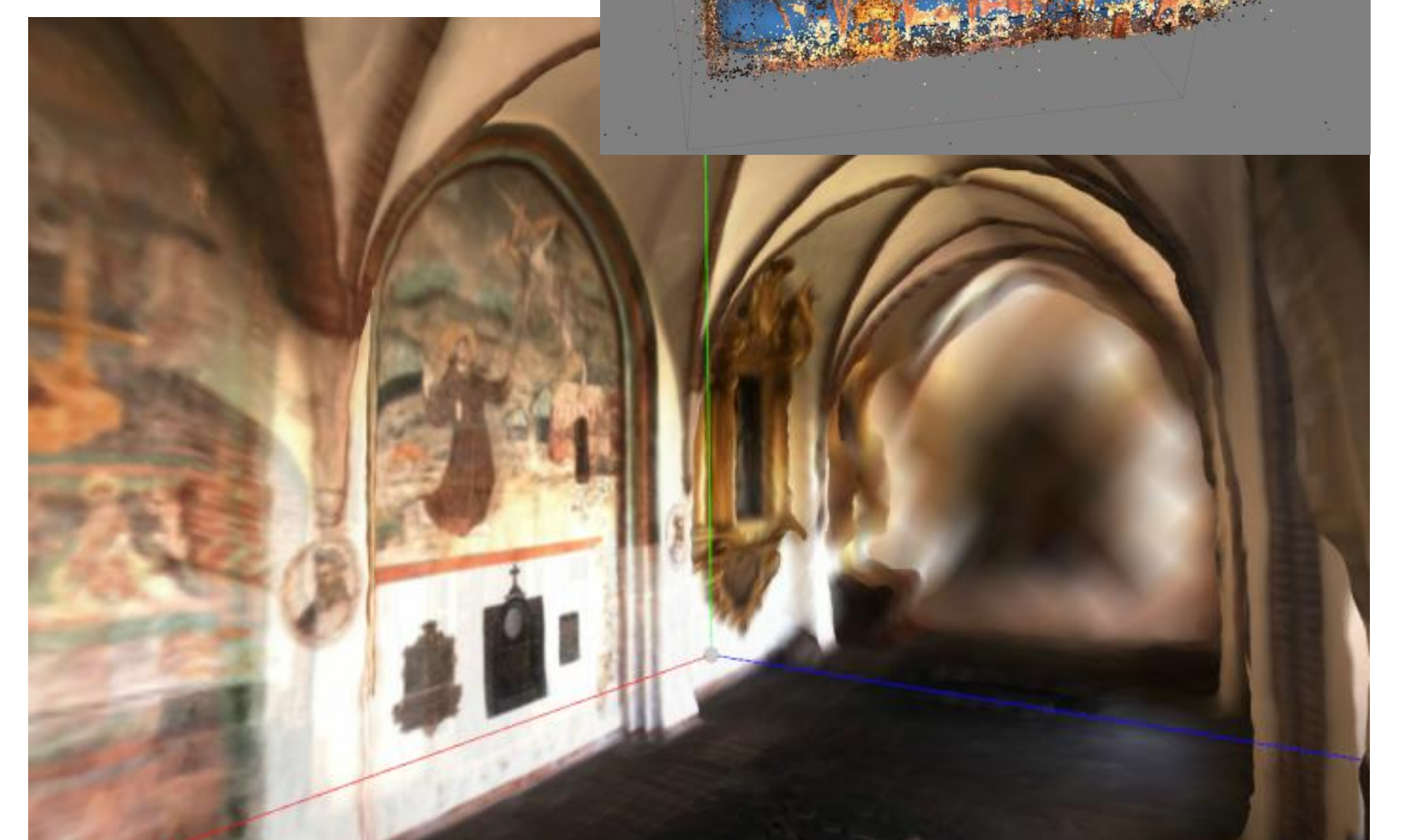
Flare3D viewer enables 3D virtual tour through the object