iSTAR & Agisoft PhotoScan

[Application note – Queensferry Road, Edinburgh]

Date: 12 November 2015
Author: Araceli Perez Ramos, Application Assistant
Organisations involved: NCTech, Agisoft PhotoScan
Products used: NCTech Immersive Studio, iSTAR and Agisoft PhotoScan

Point clouds using NCTech iSTAR 360 HDR images

The iSTAR 360° degree camera provides rapid, automatic HDR (High Dynamic Range) 360° imaging and can be used as a standalone device to create point clouds, especially indoors or in challenging lighting conditions. iSTAR can be used to provide HDR imagery rapidly with up to nine exposures and a total EV range of 27 f-stops. The aim of this report is to test the Agisoft PhotoScan software, using iSTAR images to create 3D point clouds and/or a digital surface model (DSM). The results of the project showed that iSTAR provides the ability to efficiently capture HDR colour images for point cloud creation, even in low light conditions.

00. Content.

The aim if this report is to show the required workflow to achieve a high quality coloured point cloud using NCTech iSTAR imaging and Agisoft PhotoScan.

01. Software installation.

Installing NCTech Immersive Studio:
https://www.nctechimaging.com/immersive-studio/
Installing Agisoft PhotoScan:
http://www.agisoft.com/downloads/installer/

02. Photo Capture.

Before loading photos in PhotoScan it is required to select those most suitable for model reconstruction. Considering general environmental requirements for Agisoft PhotoScan performance:

- Avoid un-textured, shiny, mirror or transparent objects.
- Avoid unwanted foregrounds.
- Avoid moving objects within the scene to be reconstructed

02.01. PLANNING STATIONS. Planning capture strategy in advanced is critical. You should consider the following recommendations:

- Ensure the number of photos gives enough coverage to avoid blind zones. To reconstruct an area, it is necessary for it to be visible in at least two images.
- Image overlapping should be 60% or more.
- The object to be reconstructed should take up the maximum area in the photo.

02.02. CAMERA SETTINGS.

ISO value: in general, the ISO level should be set to the lowest value. The lower the ISO value, the lower the noise. Nevertheless, depending on the light conditions, a lower ISO value may increase the exposure time greater than desired, in which case a higher ISO value can be used.

HDR value: iSTAR can be set as "Single exposure", "HDR ON" (5 exposure levels), or "HDR PRO" (9 exposure levels). In general, "HDR ON" gives excellent results for indoor capture. However, where the lighting conditions are very extreme with very high levels of light and dark shadows to be captured in the same scene, HDR PRO will provide better results for building point clouds.

Img. 02.01. *Low light condition in which iSTAR can provide high quality results working with HDR ON values.*

"Capture with current analysis" iSTAR mode: This is a default iSTAR setting which activates automatically after taking the first photo. When the iSTAR camera takes an image, it first analyses the whole scene to establish the appropriate exposure value averaged across the 360° degree view. These settings are then saved by default, meaning analysis time can be saved between multiple captures within similar conditions. However, for scenes with very changeable light conditions between shots the function should be cancelled by pressing the green arrow on the top left corner, the new scene is then analysed during the next capture.

Img. 02.02. *"Capture with current analysis "mode activated.*

03. General workflow.

General iSTAR workflow within Agisoft PhotoScan differs slightly from standard, which commonly uses frame images instead of panoramas but it is nevertheless still user-friendly. The aim of this section is to explain the general workflow using iSTAR data within Agisoft PhotoScan workflow.

03. 01. PROCESSING PANORAMAS INTO NCTECH IMMERSIVE STUDIO.

Firstly, it is necessary to process iSTAR raw data using NCTech Immersive Studio in order to produce stitched equirectangular images. The Immersive Studio stitching process uses the specific iSTAR calibration file which is created in controlled conditions during NCTech the factory calibration process for each camera. Processing images in NCTech Immersive Studio therefore means the user benefits from this precision calibration with reduced stitching error. AutoPano Giga 4.2 produced by Kolor, can also be used for stitching of iSTAR images as it works with iSTAR raw data.

NCTech Immersive Studio automatically sets the output image resolution to maximum (10K), or alternatively resolution can be selected from several other pre-set options (2K, 4K or 16 Mpixel). Resulting point cloud resolution and therefore accuracy, relates directly to the input image resolution, therefore maximum resolution is recommended.

NCTech Immersive Studio has a simple and user-friendly interface. To process iSTAR raw data in Immersive Studio just *drag and drop* the corresponding image folders on to the Immersive Studio window, or select the corresponding directory. Both options lead to the same result. By default, the output directory is set the same as the input directory, but can be changed easily by clicking on the dotted button. For further information about how to use Immersive Studio visit https://www.nctechimaging.com/immersive-studio/
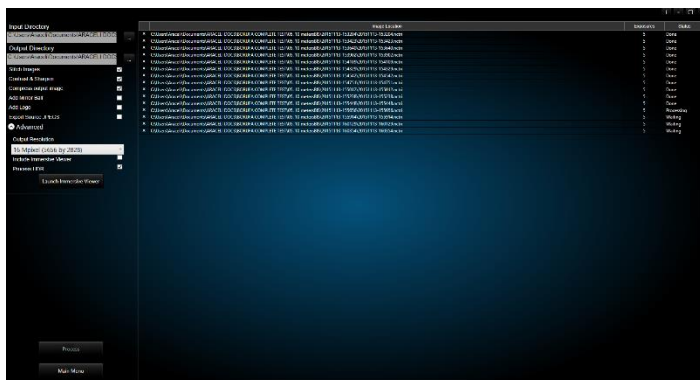
**Img. 03.01.** *NCTech Immersive Studio interface.*

After processing iSTAR raw data in NCTech Immersive Studio, panoramas will appear into an "Output folder" in *.jpg* format.
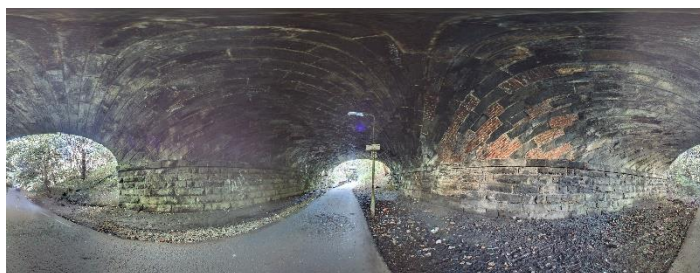
Img. 03.02. *Panorama in *.jpg* format, after processing in Immersive Studio.*

03. 02. LOADING PHOTOS, SENSOR TYPE AND CALIBRATION.

After processing iSTAR raw data, *.jpg* panoramas must be imported into Agisoft PhotoScan (*1. Add Chunk 2. Workflow>Add Photos or corresponding icon*) then select the appropriate sensor type for iSTAR. (*Tools> Camera Calibration, Camera types: Spherical*).
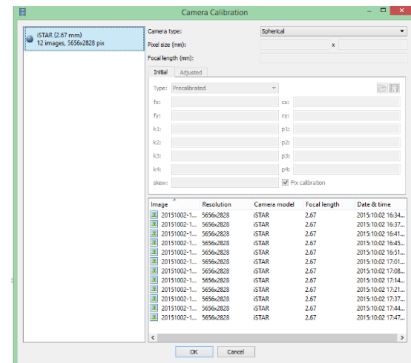

Img. 03.03. *Camera Calibration window in Agisoft PhotoScan.*

Note that calibration parameters are disabled. Because calibration parameter characteristics for each iSTAR camera have already been applied during the Immersive Studio stitching process (See *03.01. Processing panoramas into NCTech Immersive Studio*) no further calibration data needs to be applied in the Agisoft PhotoScan workflow.

03.02. CAMERA ALIGNMENT.

Agisoft PhotoScan searches for common points on input photos and automatically matches them. At this stage PhotoScan calculates the positions of each photo station/placement and its external orientation (*Workflow>Align Photos*) from which a sparse point cloud and camera positions are obtained.
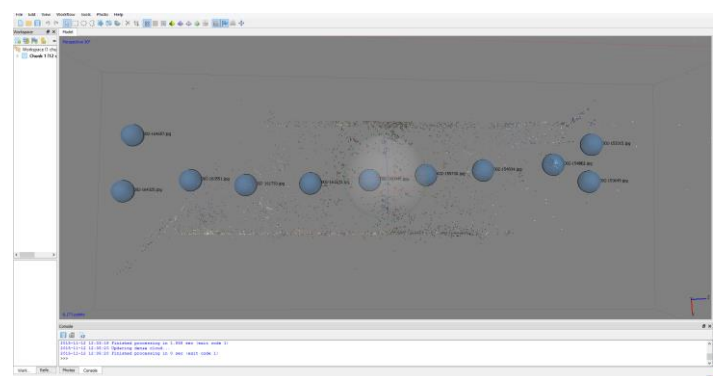

Img. 03.04. *Camera Alignment in Agisoft PhotoScan.*

### 03.03. BUILDING DENSE POINT CLOUD, MESH AND TEXTURING

Building the dense point cloud, mesh and texture doesn't require any change from standard workflow using frame images instead of iSTAR spherical images, so a detailed explanation of these functions are not included in this Application Note. The General workflow corresponding to the specifically required process is however considered to show that it does not change from the frame images common workflow.

Based on estimated camera positions and pictures, a dense point cloud is obtained after camera alignment stage (*Workflow>Build Dense Point Cloud*).
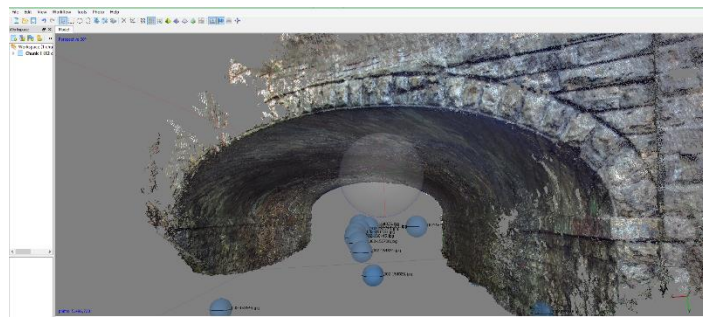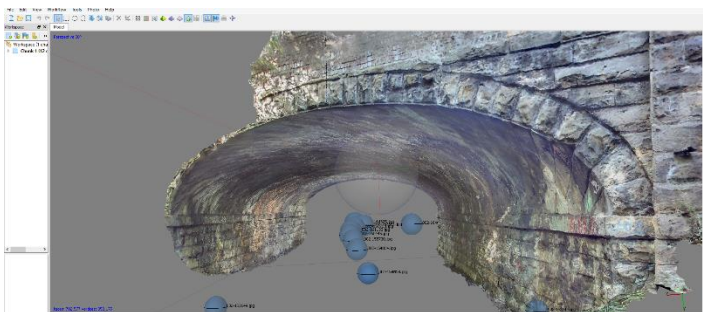

Img. 03.05. Dense point cloud in Agisoft PhotoScan.

PhotoScan reconstructs the 3D polygonal mesh based on the dense point cloud (*Workflow>Build Mesh*).
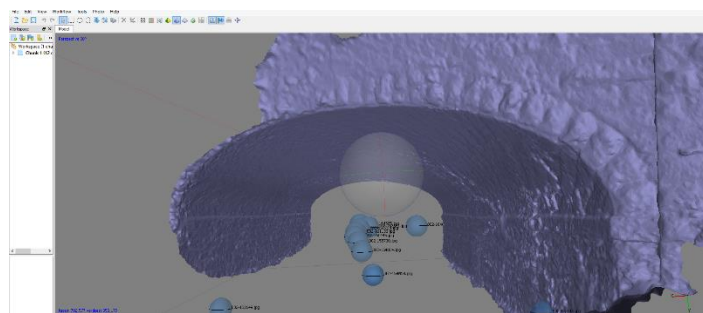
Img. 03.06. Mesh in Agisoft PhotoScan.

After geometry is reconstructed, the model can be textured (*Workflow> Build Texture*).


Img. 03.07. Textured Mesh in Agisoft PhotoScan.

Img. 03.08. Textured mesh. 702,577 faces.

04. Results.

Coloured point clouds, meshes or intermediate outputs of the process can be obtained using the described workflow in Agisoft PhotoScan. The aim of this section is to show the results that can be achieved using the NCTech iSTAR camera within Agisoft PhotoScan.

The project selected for the purpose of this standard workflow explanation required 11 panoramas, 5 of them under the archway and 6 external to it.
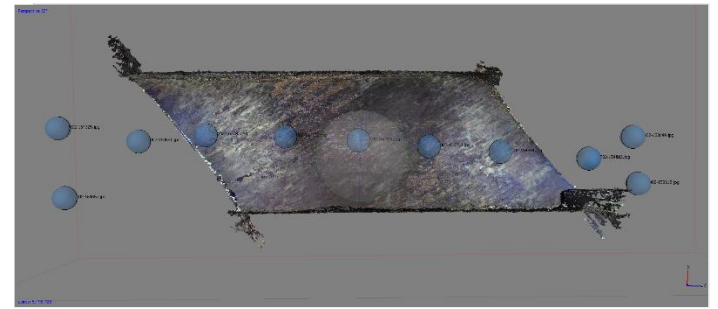
Img. 03.09. Camera positions used in the current project in Agisoft PhotoScan

Img. 03.10. Coloured point cloud. 496.728 points.

From these 11 panoramas a point cloud of 5,496,728 points and a mesh of 702,577 faces was obtained, following the general Agisoft PhotoScan workflow as described above.

Img. 03.07. *Textured Mesh (detail). Notice the quality of texture provided by NCTech iSTAR within Agisoft PhotoScan.*

05. Conclusion.

High quality coloured point clouds can be obtained from using iSTAR within Agisoft PhotoScan, following the general workflow as described here. The benefits of working with NCTech solutions combined with the Agisoft PhotoScan for high quality coloured point clouds and meshes are:

Only one iSTAR shot is needed to cover a 360 environment surface, which means saving time against taking a larger amount of images to cover the same area with a non 360 camera.

Larger surface covered per lens. The iSTAR fisheye lens not only covers a 360 view, but also a larger area per lens.

A knowledge of photography techniques is not needed since iSTAR analyses the whole scene and automatically calculates the most suitable camera settings for the full 360 view.

Simple to use, minimal training needed. iSTAR and NCTech software are designed to be highly automated and user friendly, minimal training is required.

High performance output in difficult lighting conditions. iSTAR can provide high visual quality images in a wide range of lightning environments thanks to automatic HDR settings and EV range of 27 f-stops.

Texture Quality. iSTAR's whole scene analysis in combination with its HDR imaging enables the creation of high resolution models with high quality surface textures.

To conclude, **iSTAR provides imaging which is highly suitable for photogrammetry purposes within Agisoft PhotoScan**. It provides particularly strong benefits in low light or high contrast environments, indoors and where there are complex architectures.

06. Acknowledgements.

NCTech greatly thanks the *Agisoft PhotoScan Team* http://www.agisoft.com/ , specially *Alexey Pasumansky* for their collaboration and technical support in this Application Note.

For further information about iSTAR or NCTech software visit NCTech website **https://www.nctechimaging.com** or contact us **enquiries@nctechimaging.com**