3DUNDERWORLD-SLS v.2.x

"Rapid Scanning and Automatic 3D Reconstruction of Underwater Sites "
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3DUNDERWORLD

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How to use 3DUNDERWORLD-SLS v2.x

Q1. What you need:

A Canon EOS camera, a projector, a calibration board and an object to scan.

Q2. How to scan and reconstruct:

Step1. Set up the camera and the projector in a dark room and connect with computer.

Step2. Take a set of Calibration Images and initiate the scanning process (Q3)

Step3. Calibrate the Camera (Q4)

Step4. Calibrate the Projector (Q5)

Step5. Reconstruct (Q6)

Q3. How do I perform calibration and scan an object:

Step1. Run 3DUNDERWORLD-SLS2012 and select option 3 (option 4 performs a clean scan without capturing calibration images).

Step2. Press 'Enter ', each time taking a photo of the calibration board in different positions and orientations.

Step3. Then press 'Space'; a blue chessboard on a red background will be projected.

Step4. Press 'Enter' each time taking a photo of the calibration board with the blue chessboard pattern projected on it. (Note that all the internal corners of the pattern must be visible in the photos captured by the camera).

Step5. Set the object to be scanned, at the preferred position, and press 'Space'. The projector will start projecting patterns of stripes and the camera automatically will take photos of each projection.

Step6. The application will close automatically when the procedure completes.

Q4. How do I calibrate the camera with MatLab:

Download the photos of the calibration board, from the camera, using Canons's provided software, to calibrate the camera using "Camera Calibration Toolbox for MatLab".

Copy the following parameters to files in the folder *'reconstruction/input/'*:

1. Camera Matrix (3x3) to file *'cam_Matrix.txt'* file.
2. Distortion Coefficients (3x1) to file *'cam_distortion.txt'* file.

Note: The format of the Camera Matrix used in 3DUNDERWORLD-SLS2012 is::

$$\begin{bmatrix} fc.X & 0 & cc.X \\ 0 & fc.Y & cc.Y \\ 0 & 0 & 1 \end{bmatrix}$$

Where fc is the focal length and cc the principal point.

"Camera Calibration Toolbox for MatLab" Link:

http://www.vision.caltech.edu/bouguetj/calib_doc/

Q5. How do I calibrate the projector using MatLab:

Use Canons's provided software to download the photos of the calibration board with the red-blue projected pattern, from your camera, to calibrate the projector using "Camera Calibration Toolbox for MatLab".

Copy Parameters to files in 'reconstruction/input/' folder. As follows

1. Camera Matrix (3x3, Projector Matrix) to 'proj_Matrix.txt' file.
2. Distortion Coefficients (5x1) to 'proj_distortion.txt' file.
3. Rotation Matrix (3X3) to 'proj_rotation_matrix.txt' file.
4. Translation Vector (3x1) to 'proj_trans_vectror.txt' file.

"Projector – Camera Calibration Toolbox" Link:

http://code.google.com/p/procamcalib/

Q6. How to reconstruct 3D geometry:

Download the photos of the scanned object with the gray code patterns projected on it, to the folder 'reconstruction/dataset/'.
 Run 3DUNDERWORLD-SLS2012 and select option 2.
The application will create a 3D mesh of the object. This mesh (*.obj) cloud can be found in 'reconstruction/output/' folder.

Note: In order for 3DUNDERWORLD-SLS2012 to be able to load the photos, they need to have a specific name format: XX.FFF where XX is the number and FFF the format. For example, if you use JPG format, the first photo must be 01.jpg. Supported formats for the current version are JPG, PNG and TIF.

Q7. How to view the 3D mesh:

The 3D mesh is exported in a generic format *.obj that is supported by many applications dealing with 3D geometry.

Suggested free application: MeshLab

Link: http://meshlab.sourceforge.net

Q8. Can I project scan patterns without actually scanning the object?

Yes. Run 3DUNDERWORLD-SLS2012 and choose 5. This option lets you project the patterns without the need of a camera to be connected on the PC. You can manually project the next pattern by pressing 'Enter'.

Q9. Can I save the gray patterns that SLS2012 uses?

Yes. Run 3DUNDERWORLD-SLS2012 and choose 6. This option will save the gray codes in the folder 'gray'.

Q10. Can I customize SLS2012?

3DUNDERWORLD-SLS2012 let you make same customizations through the file 'slsConfig.xml'.

slsConfig.xml parameters:

> **Projector:** Width and height of the projector image in pixels.

> **Camera:** Width and height of the images that the camera will capture in pixels. The ID of the USB camera. If the camera recognized from 3DUNDERWORLD-SLS2012 is not the one you want to use for scanning (i.e. built-in camera/web camera), you should try changing the ID to 1 or 2.

> **Projector Window:** Position of the left top corner of the projector window. The projector window is actually shown in full screen mode, and this setting is used to specify the screen that projector uses.

> **Reconstruction:** Black threshold is a number between 0-255 that represents the minimum brightness difference required for valid pixels, between the fully illuminated (white) and the non - illuminated images (black) - the first two images of the sequence. White threshold is a number between 0-255 that represents the minimum brightness difference required for valid pixels, between the gray-code pattern and its inverse images.