

3DUNDERWORLD-SLS v.1.0

“Rapid Scanning and Automatic 3D Reconstruction of Underwater Sites ”
FP7-PEOPLE-2010-RG - 268256

3DUNDERWORLD

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How to use 3DUNDERWORLD-SLS v1.0

Q1. What you need:

You need a USB 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.

Step2. Take Calibration Images and Scan

Step3. Calibrate the Camera

Step4. Calibrate the Projector

Step5. Reconstruct

Q3. How to take Calibration Images and Scan an object:

Step1. Run sls2012 and select option 1.

Step2. Press 'Enter', to take photos of a calibration board in different positions.

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

Step4. Press 'Enter' to take another set of pictures of the calibration board with the whole blue chessboard pattern projected on it. (Note all the internal corners of the pattern must be visible in the images captured by the camera).

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

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

Q4. How to calibrate the camera:

Use images stored in 'scan/camCalib' folder to calibrate the camera using "Camera Calibration Toolbox for MatLab".

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

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

Note: The format of the Camera Matrix used by 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 to Calibrate the Projector

Use images stored in ‘scan/projCalib’ folder to calibrate the projector using “Camera Calibration Toolbox for MatLab” and “Projector – Camera Calibration Toolbox”

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_vector.txt’ file.

“Projector – Camera Calibration Toolbox” Link:

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

Q6. How to reconstruct 3D geometry:

Copy images from ‘scan/dataset/’ to ‘reconstruction/dataset/’.

Run SLS2012 and select option 2.

The application will create a 3D point cloud of the object. This point cloud can be found in ‘reconstruction/output/’.

Q7. How to open the point cloud:

The point cloud is stored in XYZRGB format, each group of 6 numbers represents a point in the 3D space with RGB color. It can be viewed by any application support this format.

Suggested free applications:

CloudCompare and ccViewer

Link: <http://www.danielgm.net/cc/>

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

Yes. Run SLS2012 and choose 3. This option lets you project pattern images without scanning. You can manually project the next pattern by pressing ‘Enter’.

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

Yes. Run SLS2012 and choose 4. This option will save the gray codes in the folder 'gray'.

Q10. Can I customize SLS2012?

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

slsConfig.xml parameters:

Projector: Width and height of the projector picture 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 SLS2012 is not the one you want to use for scanning, you should try change 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 illumination and the no illumination images (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 pattern and its inverse images.