Master Project Proposal

Improved 3D laser scanning using stereo matching

▪ Background

Laser scanning is one of the most commonly used techniques for 3D-reconstruction and inspection of objects in industrial environments. As shown in Figure 1, the target object is scanned by a laser-plane and the images of the illuminated object are captured by a camera. The images are then processed to 3D reconstruct the object, using triangulation methods.
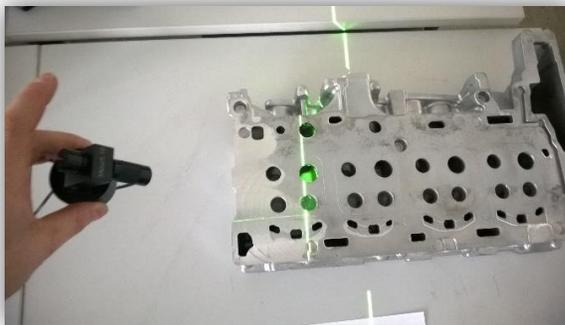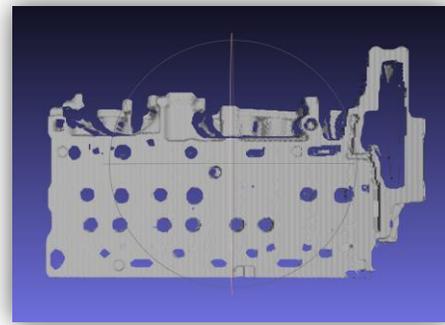

Figure 1.a - Laser scanning

Figure 1b - 3D reconstructed object

Laser line detection on the images is one of the fundamental tasks in this method. This can be sometimes a challenging task due to improper view of the camera, complex object geometry or reflective properties of the surface, which can lead to errors and outliers in the output 3D point cloud.

It is common to use a laser triangulation setup in which more than one camera is installed to help cover more surface area and overcome the occlusions caused by object geometry. Figure 2 illustrates an example of a laser scanner composed of two cameras and one laser.

On the other hand, multi-view geometry theory in computer vision offers us a number of useful consistency constraints when an object is viewed from two or more views. The idea behind this proposal is to apply multi-view geometrical constraints on the obtained images from two cameras (stereo matching) to improve the accuracy of laser line detection and thus to enhance the model reconstruction. Therefore, this topic targets an up-to-date problem and seeks a solution to improve the state of the art methods.
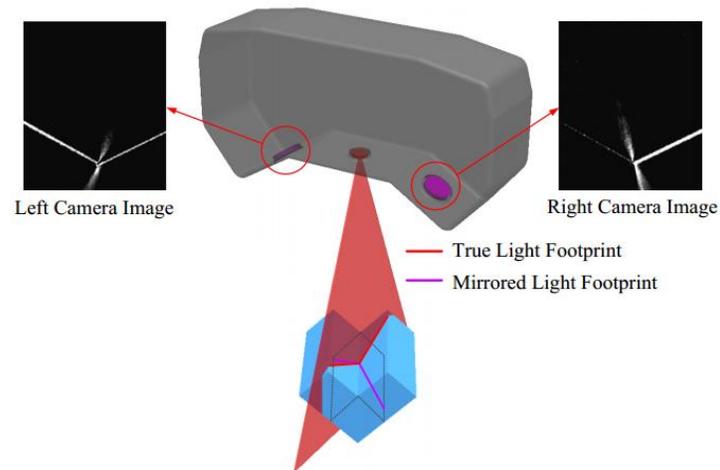
Left Camera Image   Right Camera Image

—— True Light Footprint
—— Mirrored Light Footprint

Figure 2 - Two-view laser scanner[1]

▪ Task Description

In this project, a two-view laser scanner will be simulated. There is already a Mitsuba based simulation framework for laser triangulation systems in IES lab which can be used for this project. Later, proper homography-based data consistency will be developed between the two views of the camera to accurately extract the laser line with sub-pixel accuracy. The result of the 3D reconstruction will then be compared to the 3D CAD model of the object.

▪ Requirements

- Self-motivation and good team-work collaboration
- C++ or Matlab programming skills
- English communication skills
- Preferred but not compulsory : Background in image processing and computer vision

▪ Contact

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Please include your CV with the list of relevant courses.

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[1] Image adapted from: Wang, Yutao. "Outlier formation and removal in 3D laser scanned point clouds." (2014).