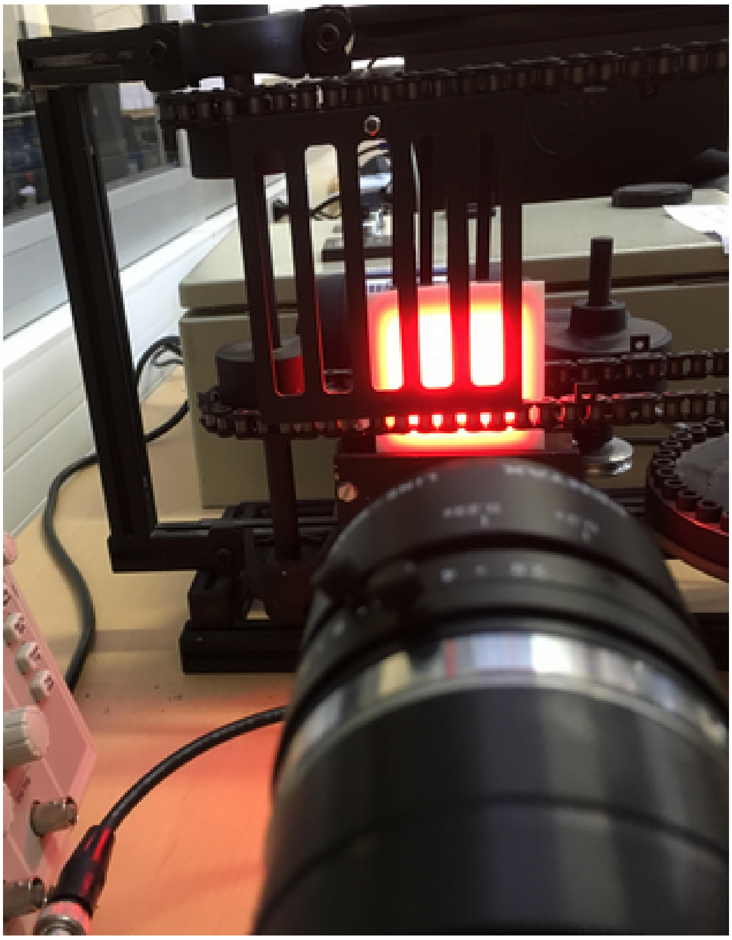
Acquisition Practical

Labs 5 - Moving Object Imaging



Submitted by **Jaafer Al-Tuwayyij, Ivan Mikhailov and Selma BOUDISSA**

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Introduction

Tracking of moving objects is a way used to detect and analyze changes that occur in an object from one frame to the next frame in the video. The purpose of tracking a moving object is to estimate the trajectory of objects in the image plane moved in a scene. Tracking moving objects can help to detect, identify, and analyze such objects. There are three basic steps in tracking a moving object.

1. Detection or select Region of Interest (ROI) of a moving object in a video.
2. Tracking an object that has been selected from the first step of several parts of the frame
3. Analysis of movement of the object toidentify the object's behavior

The ability to obtain visual quality and the precision of the tracked target is highly wished in modern tracking system. The fact that the tracked object does not always seem clear causes the tracking result is less precise. The reasons are low quality video, system noise, small object and other factors. By utilizing the super-resolution images in tracking process are expected to get results tracking moving objects in video more precision. Super-resolution is a technique of constructing the high resolution images from low-resolution images. There are two types of super-resolution based on the input frame.

- Super-resolution
- Multi-frame super-resolution.

Super-resolution single frame has advantages in terms of computation time faster than multi-frame super-resolution. The process of getting high-resolution image on a single frame super-resolution is raising the image of the target so that the process does not eliminate and still contains information prior to the super-resolution. Studies about a small object tracking is still slightly caused by very few of the features available. Therefore, by

integrated super-resolution with tracking can be obtained more features that enable tracking a small object. There is a difficulty to detect relatively small objects that will be track. The problem would be too much noise appears and objects are relatively small because it would be difficult to distinguish the object from the noise.

Objectives

The goal of this lab is to study and analyze moving objects by using a Digital Camera (DALSA S2-1X-02K40) and CamExpert software to understand the different settings of this Camera and what effect they going to do to the output result. Also using an external signal from a signal generator and synchronize it with the camera to trigger it.

Chapter 1

Study of the camera

For this lab project we will use a linear camera which is a little bit different from a classical camera. Linear camera permit the line by line acquisition of an object moving past the camera. This scrolling method of imaging is very efficient when implemented with, fr example, a conveyo belt quality detection system.

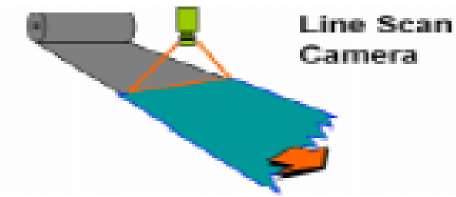

Figure 1.1: Linear camera schematic

Description: Linear camera implement a row of pixels to efficiently describe scenes where the image in question can be viewed by scrolling in one axis.

1.1 DALSA S2-1X-02K40

We will use the linear camera from DALSA S2-1X-02K40. The Spyder2 is a small and cost effective camera boasting a full feature set and a Camera Link interface. Its requires less lighting, and offers precise control over key performance variables such as gain and offset. The Spyder2 does not require a new optics design because pixel size and fill factor remain unchanged from the original Spyder.

1.2 Features

- Resolution from 512 to 2K
- High responsitivty
- 8 or 10 bit selectable output
- Single 12V to 15V power supply
- Compact design

1.3 Specifications

- Sensors: CCD type
- Scan type: Line
- Pixel size: 14 µm
- Data format: 8 to 10 bits
- Size: 50mm x 85mm x 53.7mm
- Operating temp: 10°C-50°C
- Data: Shared with Control

1.4 Programmability

- Programmable pixel to pixel correction
- Adjustable analog and digital gain
- Adjustable integration time and line rate
- Test pattern, line statistics and camera diagnostic

1.5 Benefits

- Low cost
- Continous image
- Reduced distorsion of moving object
- Even illumination of large area/objects

1.6 Disadvantages

- Must be correctly calibrated otherwise dark line of pixels appear.
- The exposure time is short so the light intensity must be relatively important.

1.7 Applications

This type of camera can be use in many domain of our real life for example:

- Web inspection
- Pick and place
- Fax machine
- Document scanning [...]

Chapter 2

Camera setting

2.1 Satisfactory image process

Our first task was to start image registration, and obtain satisfactory results, which implies a certain level of sharpness, light and periodicity of image capturing, allowing us to discern all most of the details of the aforementioned object and without missing any crucial parts.

Below you can see the first grabbed image without any additional changes. We can observe that it is mostly unfocused, in low resolution, and even though we can't observe this from this image alone, line rate was not corresponding to the movement speed of the object, so some parts of the chain were skipped by the sensor.

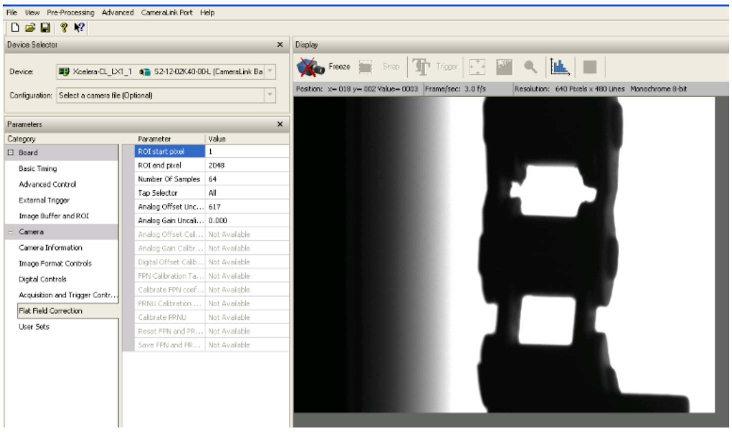

Figure 2.1: Satisfactory image

2.1.1 Explanation about the parameter setting

To improve the situation, we applied several changes, such as increasing of the resolution and various changes in the line rate (Hz), which should always be changed in correspondence with the object movement. If the chain moves at the set speed, and we will gradually increase the line rate, the image will become stretched and distorted, because several lines will be captured while the chain stays in approximately the same place. On the other hand, if the speed of the machine is increased, and the line rate stays the same, some parts of the chain will be omitted by the sensor, because the period between captures will be too large.

It is important to notice the resulting image is composed based on the movement of the object, so if the object is not moving , the camera will be taking the same line all the time, and the image will become static. That?s why the resulting image is highly dependent on the line rate.

Exposure time is usually set automatically if the line rate value is high. It happens due to the maximum amount of exposure time decreasing proportionally with increasing of the line rate, due to the lines being captured more often, which leads to the limiting of the maximum exposure time. On the image below you can see the improved situation, with line rate 1000 and increased resolution.

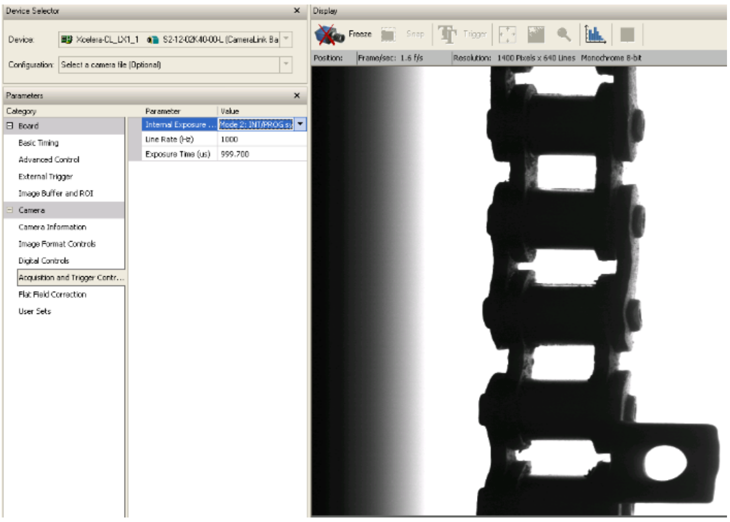

Figure 2.2: Parameter setting

Explanation: This line rate was chosen according to the speed of the machine and to the lighting of the scene, to provide more light to the resulting image.

Chapter 3

Camera triggering by external signal

3.1 Configuration setting

In this second section instead of using an internal software generated signal, external signal generator was used, and it's parameters were seen on the oscilloscope to be sure the timing is respected.

Steps:

1. Connect signal generator to the oscilloscope and adjust the external signal provided by the generator.
2. Connect cables of the camera, frame grabber and oscilloscope in order to trigger the camera by external signal provided by the generator.

Figure 3.1: Generator setting

Explantions: We generated the signal of 20Hz, and made various changes to correspond with the machine speed and frame per second (fps).

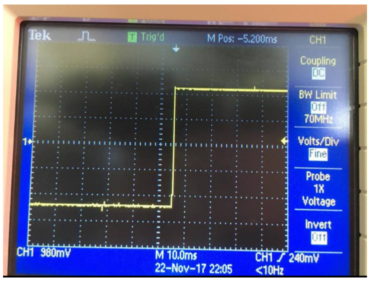

Figure 3.2: Oscilloscope result

Observations: As you can see on the above image the oscilloscope display a square signal inferior to 10 Hz.

This configuration needed to be done in order to tune the whole system, because the grabbing is not possible if the speed of the external trigger is faster than the camera frame rate.

3.2 Image registration

These parameters provided us with clear images, which were grabbed according to the external trigger.In the end, the frame rate was 1.9 fps, and the generated signal 20 Hz. The effect can be observed on the picture below.

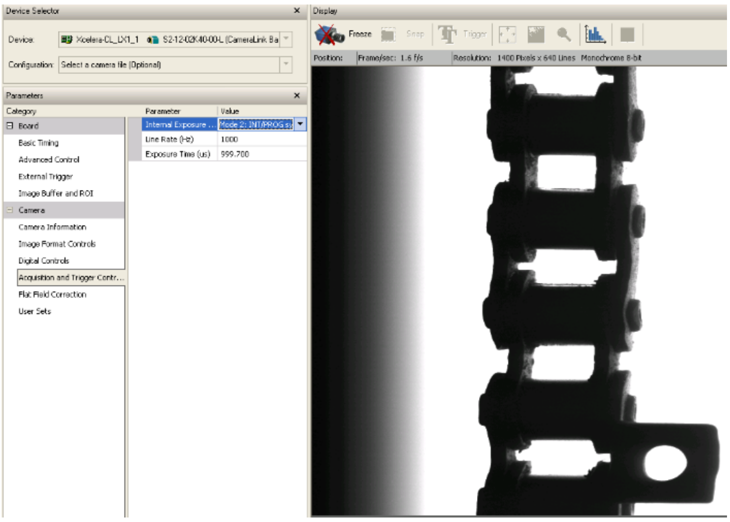

Figure 3.3: Camera triggering result

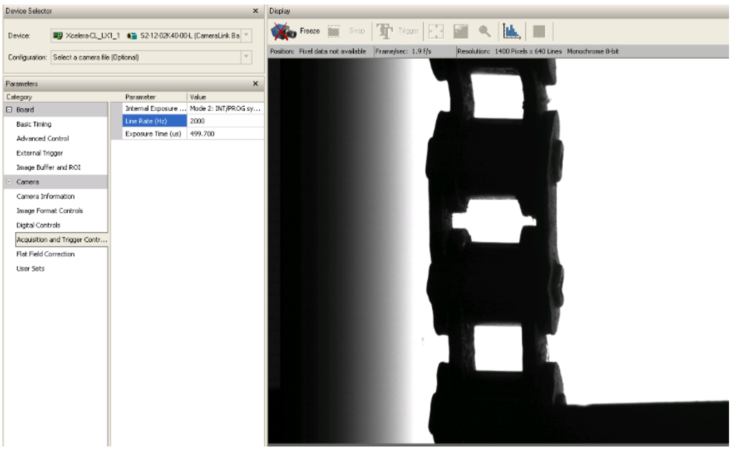

Figure 3.4: Camera triggering result

Modification of the frame rate: We can analyze by dereasing the frequency on the signal generator we get a augmentation of the frame rate from 1.6f/s (Figure 3.3) to 1.9 f/s. We can observe that we move slowlier as you can see in the Figure 3.4 comparing to the Figure 3.3. So the frequency have a effect on the frame rate which will end by the obtention on slowlier images from the linear camera.

Chapter 4

Conclusion

To conclude this lab project help us to analyze the effect of the frequency on the frame rate and the images resulting. The configuration of camera triggered by external signal can be used in different applications for example when the inspection of discreet object, it is necessary to synchronize the start of image acquisition with the arrival of the component/object.

References

1. **Datasheet of the sensors of the DALSA camera** https://www.1stvision.com/cameras/sensor_specs/IL-P3-B_datasheet.pdf
2. **User manual X64 Xcelera-CL LX1**
3. **Camera specifications** http://www.rauscher.de/downloads/public/datenblaetter/Spyder2-S2-1x-xxx40-Produc pdf
4. **Lab4-Linear Camera, Skylar LAHAM, Meldrick Ferdinand**