RASPBERRY PI BASED LASER BEAM PROFILER

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For more information

Introduction

The SLR Riga station is operating since 1957. First using photographical equipment and then a laser, the principle of satellite tracking remains the same; to aim satellites with a laser to get data about its exact location.

This paper proposes a low-cost solution to extract the characteristics of the laser source used for tracking satellites and get its profile.

For this purpose, we developped a graphical user interface (GUI) (Figure 1) written in Python using a single bard computer (SBC) Raspberry Pi and a 5 Mpx visible-IR sensible camera.

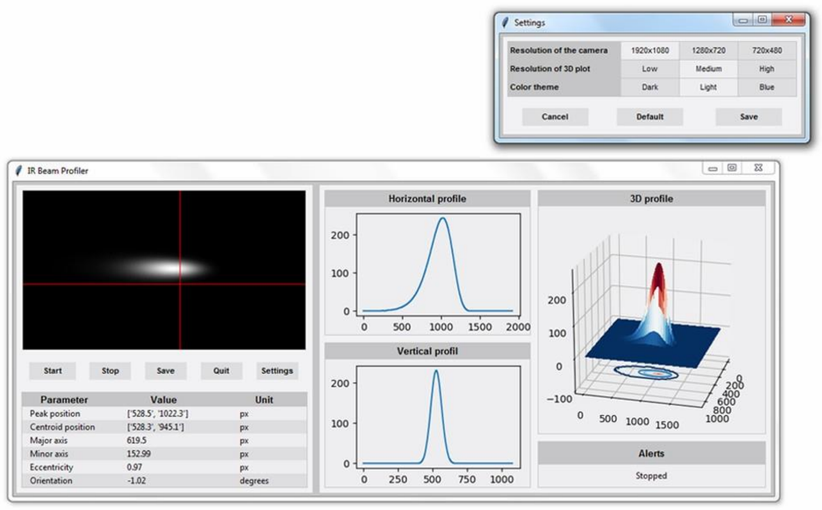

Figure 1 - Main window

Software

The GUI is composed by a main and settings windows.

On the main window user can run, stop, quit, select new settings and save data and frames which are plotted. The plots are the following:

- Raw image captured by the camera (.jpg)
- 3D mesh and iso curves
- Profiles along X and Y axis

Note that you can change the localisation where profiles are plotted.

Data (Figure 2) are also displayed and corresponds to the peak position, centroid position, length of the major and minor axis, eccentricity and orientation.

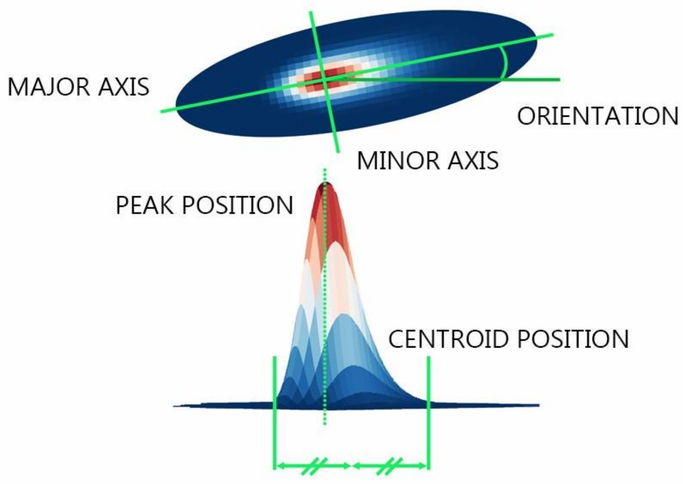

Figure 2 - Schema of corresponding data returned by the GUI

Settings offer the possibility for users to select the colour theme, the size of the captured image (720x480, 1280x720, 1920x1080 px) and the resolution of the 3D mesh.

Both of these two last options are directly related with the time to process each frame more than any part of the software. The next table (Figure 3) sums up the time (in seconds) for processing in different configurations: it is predictable that the higher are the resolutions, the higher is the processing time.

Note that a micro-SD card with a fast read speed can also improve this rate.

Resolution	720x480 px	1280x720 px	1920x1080 px
Low	3.5	5.7	10.8
Medium	4.1	6.4	11.9
High	8.5	14.1	26.7

Figure 3 - Time to process one frame for different resolution formats and 3D resolution plots

Hardware

Only several pieces of equipment were needed for this project. All the components are listed on the schema below (Figure 4). Note that we used a 10 Hz Nd:YAG pulsed laser at 532 nm with neutral filters to decrease the energy received by the camera and avoid damages. In addition, a keyboard, a mouse and a monitor are connected to the SBC to make the interface between the software and user. Using a 3D printer, we also designed a camera holder and legs for the SBC support.

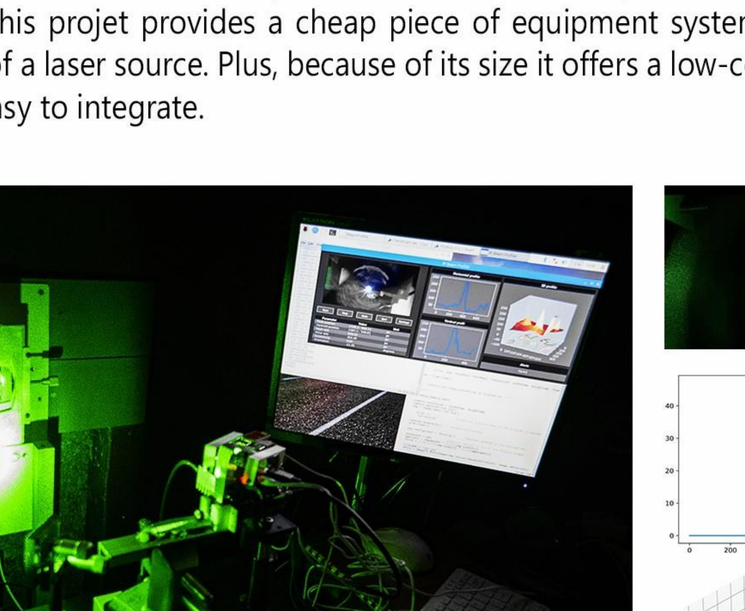

Figure 4 - Schema of the setup

Conclusion

Even if performances of this beam profiler are limited in comparison with commercial systems, this projet provides a cheap piece of equipment system to get the beam profile of a laser source. Plus, because of its size it offers a low-cost functionnal solution easy to integrate.

Figure 5 - Experimentation photos and results

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