Laser Spot Size Measurement Using A Webcam

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Project Description
What is LIBS?

• Type of atomic emission spectroscopy which uses a highly energetic laser pulse as the excitation source.
• The laser is focused to form a plasma, which atomizes and excites samples.
• LIBS can analyze any matter regardless of its physical state, be it solid, liquid or gas.
Energy requirement for LIBS - every material has a different threshold energy for its breakdown. Knowing the Spot size enables us to accurately tune the laser to the threshold requirements of that particular material under study.
Motivation for a new method

- The usual method of using a knife-edge or blade is very labor intensive.

- Our method can be performed by a single individual in a very short amount of time.

- This method is also cost effective since it uses an everyday webcam.
Apparatus for Webcam Method

- He-Ne Laser
- OD Filters
- Focusing Optics
- Webcam - Microsoft LifeCam VX-700
The procedure of this method has two parts:

- Image Acquisition
- Image Processing
Mainly, 3 tools from MATLAB feature in our method.

- `imtool`
- `improfile`
- `cftool`
fitresult =

General model Gauss1:
fitresult(x) = a1*exp\((-((x-b1)/c1)^2))

Coefficients (with 95% confidence bounds):

- \(a1 = 125.9\) (121.9, 129.8)
- \(b1 = 22.61\) (22.38, 22.84)
- \(c1 = 9.002\) (8.675, 9.328)
We use the FWHM of the fit(b1) to determine the spot size.

The results of the fit are obtained in terms of pixels.

The physical size of each pixel on the sensor is 4.8 microns.

Using this knowledge, the spot size of this iteration of the experiment is calculated as 108.528 microns.
MATLAB GUI for the method
## Results

<table>
<thead>
<tr>
<th>Iteration #</th>
<th>Approx. Angle wrt X-axis</th>
<th>FWHM in pixels</th>
<th>Spot Size in microns</th>
<th>Theoretical spot size</th>
<th>%error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45</td>
<td>22.61</td>
<td>108.528</td>
<td>128.409</td>
<td>15.48256</td>
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<td>25.11</td>
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<td>128.409</td>
<td>6.13742</td>
</tr>
</tbody>
</table>
Advantages

- This is a low cost method since it uses only an ordinary webcam.
- This method involves no moving parts, leading to a decrease in the possibility of errors.
- This method does not require multiple persons to implement and hence is less labour intensive than the other methods.
THANK YOU