VISUAL CORTEX INSTRUMENTS

Lab 1: Error Analysis & Equipment Orientation

Introduction:

During the next 15 weeks you and your teammates, will gain an experimental understanding of physics concepts using devices typically employed in engineering applications. During the semester, you and your team will have to find your own solution to specific problems formulated in the context of engineering projects. The solution to these projects will require a clear understanding of the underlying physics concepts as well as skills in the engineering implementation of such solutions.

Like in real engineering applications, for each project you will be provided a description of:

- **the project's goal:** written in general terms; the final functionality that is needed of your solution. It is up to you and your teammates to develop a solution or framework to achieve that functionality.
- **the available equipment**: the equipment available to your team to achieve the project's goal.
- **the solution specifications:** a working set of necessary functions, features, and tolerances that your solution must adhere to.

In addition, like in any real project, you will be required to provide a written report summarizing the methodology and findings of your project.

Basic Equipment Introduction:

The goal of today's training is for you to become familiar with the specifications and use of the various pieces of lab equipment you will be using to complete your projects, as well as the concept of error propagation.

The lab equipment includes:

- Camera & Python readout
- Computer Numeric Control (CNC) apparatus & Python control
- DAQ with Python control and readout

Each piece of equipment has its own limitations in terms of placement, movement, resolution, accuracy, and error. Your instructor will provide you with instructions on how to use and operate each piece of equipment, followed by time for you to explore the equipment on your own. By the end of this training session, you must be familiar with this equipment as they will be used extensively with future projects.

Error Propagation:

Every measurement you take has an inherent unreliability called *uncertainty*. Uncertainties arise from *systematic* and *random errors* in experiments. Whenever you use a measurement with an uncertainty in a calculation, the uncertainty of the resulting value is determined through *propagation of error*. Your lab supervisor will discuss these and further information is available in your manual.

In order to demonstrate the concept of error propagation, you will take part in a measurement and data analysis project involving uncertainties on the measured length and width of your student ID card.

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Equipment:

- Calipers or meter stick
- Student ID card

Specifications:

- Following the instructions from your instructor, take measurements of the length, width, and area of your student ID card and enter them in the test entitled “Lab 01 measurements” which can be found in the Submission Box of the eCampus multisection site. Please take care to enter your measurements correctly (including the correct units!), and only enter one set of measurements per student.
- After all students have completed their ID card measurements, the instructor will distribute a data file containing the measurements taken by all students. You will be expected to analyze the collected data, calculating the following quantities:
    - Mean and standard deviation on the measured width
    - Mean and standard deviation on the measured length
    - Mean and standard deviation on the measured area You should also take into account any outliers in the reported data, and deal with the deviant measurements appropriately.

Presentation of the solution:

Please submit your results of this lab INDIVIDUALLY in your section’s submission box. (Note: Labs 2 -7 are done as teams and submitted as teams. This will be the only individual submission.)