Experiment A1
Meter Stick Measurements
Procedure

Deliverables: Checked lab notebook, tech memo

Recommended Reading: Ch. 1 of *Undergraduate Lectures on Measurements and Data Analysis*

Overview

In this lab, you will each be given an official AME 20216 meter stick. At a glance, the meter stick is the most basic scientific instrument. However, it can be used to measure complex and abstract phenomena with a bit of ingenuity. In particular, you will use it to measure the velocity of a moving fluid. The overall goal of this lab is to illustrate the basic concept of a "transducer" and show that scientific tools and instrumentation are only as good as the person using them.

Part I: Fountain of Youth

In this exercise, you will use your meter stick to determine the velocity of a jet of water as it leaves the nozzle of a fountain.

1. Find a fountain on campus with a jet that makes a nice parabolic arc.
2. Measure the dimensions of the parabolic arc use them to calculate the initial velocity components v_x and v_y of the water as it exits the nozzle.
3. Use Bernoulli's law to estimate the stagnation pressure inside the nozzle in units of Pascal

$$P_0 = \frac{1}{2}\rho\left(v_{x0}^2 + v_{y0}^2\right) \qquad (1)$$

   where ρ is the density of water.
4. Record the location and sketch the arc with dimensions in your lab notebook.
5. Take several photos of the arc to illustrate its parabolic shape. Frame the photo so that the parabolic jet fills the frame.

Deliverables – Create the tables, schematics, plots, and other deliverables listed below. Save the plots as PDF or EPS files, import them into either Microsoft Word or LaTeX, and add an intelligent, concise caption. Additionally, write 1 – 3 paragraphs describing the items below. Any theoretical formula you used in your analysis should be included as a numbered equation within these paragraphs.

For this lab exercise, deliverables should be presented in **SI units.**

1. A photograph of the parabolic fountain jet you measured with the dimensions superimposed over it in *symbolic form*.
    a. This graphic must be produced using computer software, such as Power Point, Adobe Illustrator, Photoshop, etc.
    b. Label the dimensions with variables like R and H that match the variables used in your equations.
    c. Make sure the font sizes are large enough to read.
    d. Choose good colors for your label that contrast the background color of the image.
    e. The parabolic jet should *fill the frame*. (Crop the photo if necessary.)
2. Equations that you derived for the initial velocity components v_{x0} and v_{y0} in terms of the jet's dimensions.
3. A table summarizing all of the values you reported with appropriate SI units.
    a. Values for the physical dimensions of the parabolic fountain jet.
    b. Values for the initial velocity components v_{x0} and v_{y0} in units of m/s.
    c. An estimate of the stagnation pressure inside the pipe of the fountain.
    d. Use the Internet to look up typical household water pressure. (Be sure to include a references and a citation in the table, i.e. "[1]" next to the value in the table.)

Suggested Talking Points

- What are the sources of error in your measurement?
- How does the value or a typical household water pressure compare to the stagnation pressure that you calculated from your measurements? Why might this be?

Appendix A

Equipment

- Official AME20216 meter stick
- Smartphone with camera