http://numericalmethods.eng.usf.edu/experiments

Sample Project: Flow rate in a pipe

This is **NOT** an Assigned Project

Background: The motivation behind the experiment is to find the flow rate in a pipe if the velocity is known at discrete points along the radius of the pipe.

Exercises to do (A 1000 points but the points do not matter):
Use Matlab to solve problems (2 thru 6). Use comments, display commands and fprintf statements, and sensible variable names to explain your work. Staple all the work in the following sequence. **Use USCS system of units throughout.**

0. Signed typed affidavit sheet.
1. Handwritten data taken in the lab on a separate sheet of paper. This should have your name, group number, date on it.
2. Find the regression curve that relates the velocity of the water as a function of the radius.
3. Illustrate the plot of the data points and the regression curve.
4. Find the flow rate of the water using the regression curve found in #2.
5. Find the flow rate from the (Average velocity $\times$ Area) formula.
6. Use another scientific method of your choice to find the flow rate.
7. In 100-200 words, type out your conclusions using a word processor. Any formulas should be shown using an equation editor. Any sketches need to be drawn using a drawing software such as Word Drawing. Any plots can be imported from MATLAB.

Conclusions

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Flow Rate Project

The flow rate Q in a pipe is given by

$$Q = \int_0^a v(r)dA = \int_0^a 2\pi r v(r)dr \qquad (1)$$

where

v(r)= velocity along the radial location, *r*

a = radius of the pipe.

I used three methods of finding the flow rate.

1. In the first case, the velocity vs radial location data was regressed to a second order polynomial and then substituted in equation (1).
2. In the second method, the average velocity $\overline{V}$ was found and the flow rate was simply given by

   $$Q = \overline{V} \times A$$

   where *A* is the cross-sectional area of the pipe.
3. In the method of my choice, I chose the Trapezoidal rule with unequal segments.

So why are the results from methods (1) and (3) so different from method (2)? This is because the integrand in equation (1) is $2\pi r v(r)$ and not *v(r)*. If I had averaged $2\pi r v(r)$ instead, I would get a better estimate of the flow rate just like obtained in Methods (1) and (3). I would have tried this method also as a learning experience, but I had ICE and HVAC tests to study for and I promised my BFF that I will go to see *Sex and the City* with her.