ME 646 - Pressure Tap Lab
Spring 2017

A pressure tap should exhibit the dynamics of a second order system. The system dynamics of a pressure tap are explained in the "Pressure Measurement Lecture" and in Chapter 9 section 8 in the Figliola and Beasley text. This experiment will show how well a pressure tap-sensor measurement system behaves. You are asked to compare the actual performance to ideal performance.

In lab tasks:

A diagram of the setup has been provided in lecture. The pressure transducer is a differential diaphragm transducer manufactured by Validyne. The specifications are included as a separate document.

The pressure tanks will be charged to 10-15 psi. You are provided with three pressure tap tubes of differing length. Use the measuring tape to measure the tube length and use a caliper to measure the inner diameter of the tube. Record the data in your notebook.

Use the oscilloscope to record the pressure pulse from a popping balloon and from flipping a manual valve switch for each tube length. Record the output from the sensor alone when the input is tapped with the supplied paddle. Save the data for subsequent analysis.

Analysis:

Do your best to extract the damping ratio and the damped natural frequency from each dataset. Provide comparative (overlay) plots showing the predicted response for a step pressure pulse using the code provided in Lecture 5 slides 14 and 15. You should have six individual plots (both pressure pulses for each tube length). The scales will be very different because the pressure for the balloon is much lower than the pressure in the tank.

Create the plots described on slide 14 of the pressure measurement lecture (using your best estimates of damping ratio and damped natural frequency) for both pressure pulse methods. The assumption of this model is that the transducer volume is small with respect to the tube volume. The data sheet provides the transducer volume and you can calculate the tube volume. Do the slopes of the two plots agree with the model predictions? (You must evaluate the model predictions to answer this question).

Deliverables:

All plots must be carefully labelled. Use dashed lines for simulations and solid lines for data. A small fraction of you have been submitting plots that have a smudgy appearance. Smudgy plots will be assigned half credit (so come see us to figure out how this is happening).

1. Six plots comparing the actual p-t response to the simulated response. Each plot should have a caption that describes which situation the plot refers to. List the value of ω_d and ζ on each plot.
2. Two plots showing of the natural frequency and the damping ratio as a function of length or inverse length.
3. Comparison of the observed slope of the plot to the predicted slope from Equations 9.30 and 9.31. Describe your prediction and list the values of the constants in the equation.