**Today, we will**:

- Discuss some miscellaneous items about velocity measurement
- Do some review example problems to help you prepare for the final exam


**Final Exam**

- Please sit in every other seat.
- The final exam is **comprehensive**.
- **Format:** The exam consists of two parts, a closed-book part and an open-book part, roughly equal in weight.
- <u>**Closed portion**</u>
  - o No notes, no calculators, no sheets of papers - *nothing but a pencil*! A few equations and tables will be provided as needed.
  - o This part will test your understanding of concepts and terms (Multiple choice, True/False, and short completion - *limited or no partial credit*).
  - o This part will be similar to the quizzes at the Testing Center, except it will be on paper instead of on the computer.
- <u>**Open portion**</u>
  - o You may bring: your class notes, web lecture notes, tablet PC notes from the web, tables from the web, lab manual for this course, graded lab reports, graded homeworks, a calculator, and Professor Cimbala's homework solutions.
  - o At a minimum, print out and bring the **Outline and Equation sheet** and **The 12 pages of tables.** This should be all you need to do well on the final exam.
  - o You may *not* bring: any books, exams or homeworks from *other* courses, anything from previous semesters of this course or its predecessors (M E 82, M E 382, or M E 345).
  - o Only a basic calculator is permitted. It must be a *calculator*, not a cell phone, ipad, tablet, etc., or any device that can store notes, example problems, etc.
  - o The instructor and TAs will proctor the final exam - cheating will not be tolerated.
  - o No cell phone usage during the exam (turn it off).
  - o This part will be *problems* similar to homework problems and class example problems - show all your work and calculations in the space provided on the exam (*there will be partial credit.*).
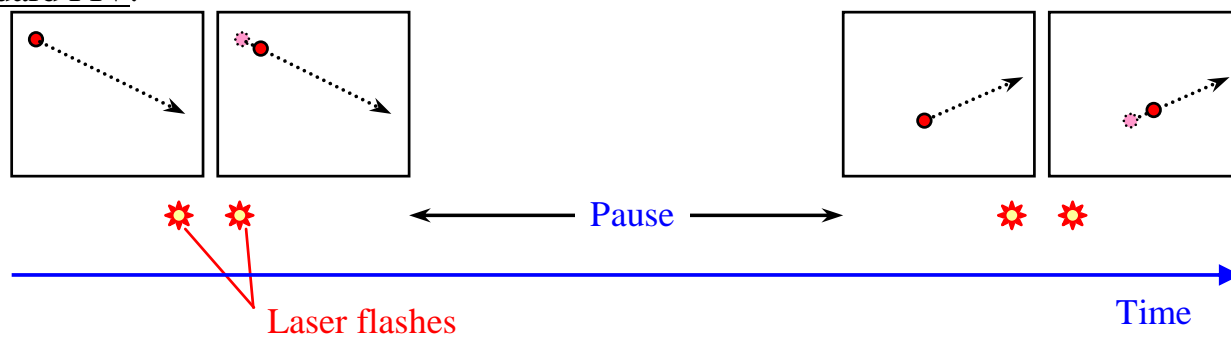
# Additional Notes: Constant Temperature Hot-Wire Anemometry Circuit

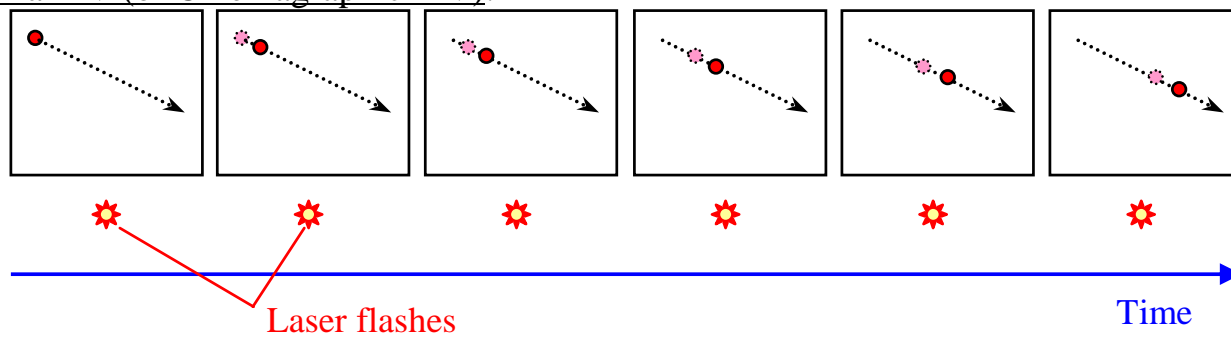[A clever Wheatstone bridge circuit!]



$V_o$ is also the supply voltage for the Wheatstone bridge
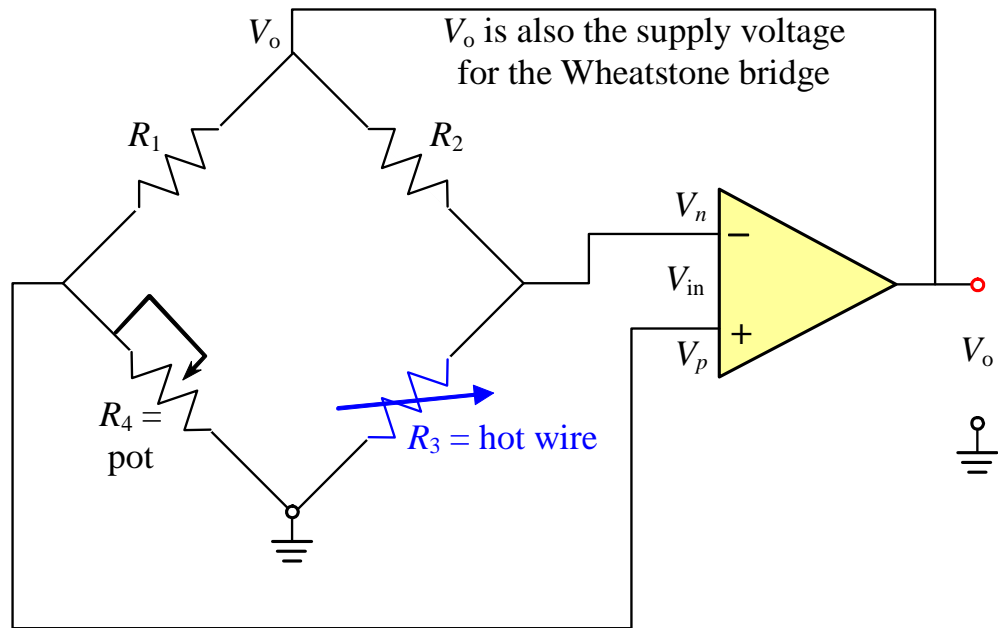
**Additional Notes: Standard vs. Cinemagraphic PIV**

Standard PIV:



Pause

Time

Laser flashes

Cinema PIV (or Cinemagraphic PIV):



Time

Laser flashes

**Example: Review for Final Exam**
**Given**:   A voltage output has a DC level of 2.0 V and two frequency components: a 30 Hz signal of amplitude 3.0 V, and some noise at 180 Hz of amplitude 0.66 V. Unaware of the noise, Jenny samples the signal at 80 Hz.
**(a)    To do**: Sketch the frequency spectrum of this signal.
**Solution**:

**(b) To do**: Suppose we are using Excel to do our spectral analysis. [Recall that Excel's FFT algorithm is limited to powers of 2 (..., 64, 128, 256, 512, 1024, ...).] We sample at 80 Hz for 5 seconds, but we have to throw away some of the data because of Excel's limitations. Calculate the frequency resolution in Hz (to four significant digits).

**Solution**:

**Example: Review for Final Exam**
**Given**:   Voltage is not a primary dimension, but current is.
**To do**:   Write the dimensions of voltage in terms of primary dimensions.
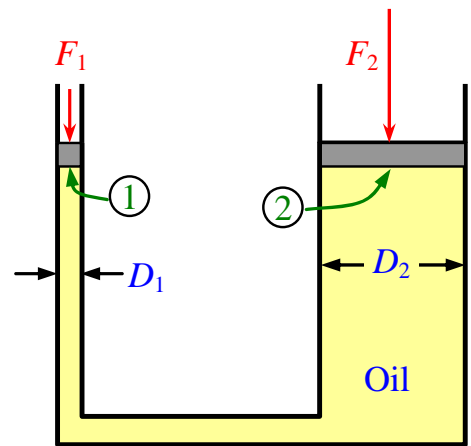**Solution**:

**Example: Review for Final Exam**
**Given**: A hydraulic jack is constructed with the large piston diameter equal to 12.7 cm (5.00 inch) and the small piston diameter equal to 0.635 cm (1/4 inch).
**To do**: How much weight (in lbf) can a person lift with the jack if he exerts a force of 30.0 lbf on the small piston? *Give your answer to three significant digits.*
**Solution**:

## Example: Review for Final Exam
**Given**:  A signal ranges between –0.30 V and 1.20 V. The signal is to be sampled by an A/D converter that has an input range of 0 to 5 V. For maximum resolution, the signal is to be conditioned such that it fits the full input range of the A/D converter. Obviously, a DC offset must be added to the signal, and then the modified signal must be amplified.
**To do**:  Calculate the required DC offset and amplification (gain).
**Solution**:


## Example: Review for Final Exam
**Given**:  A sixth-order Butterworth low-pass filter is used to attenuate a 100-Hz noise frequency. The cutoff frequency of the filter is set to 40 Hz.
**To do**:  By how many decibels is the 100 Hz noise attenuated?
**Solution**:


## Example: Review for Final Exam
**Given**:  Rita is calibrating an electronic pressure transducer – using a U-tube manometer. When the true (exact) pressure is 5.000 mm of mercury (as measured by the manometer, she takes 10 readings with an electronic pressure transducer. The readings are (lowest to highest): 4.94, 4.96, 4.96, 4.96, 4.97, 4.98, 4.98, 4.99, 5.00, and 5.00 mm of mercury
The mean value of these 10 measurements is 4.974 mm of mercury.
**To do**:  Estimate the bias error of the electronic pressure transducer in units of mm of mercury.
**Solution**: