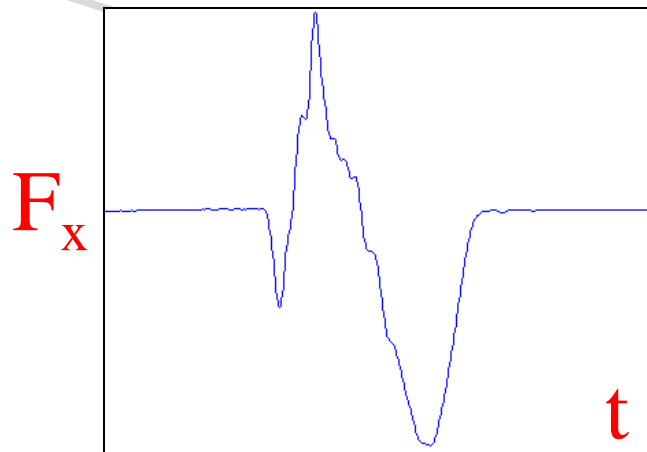
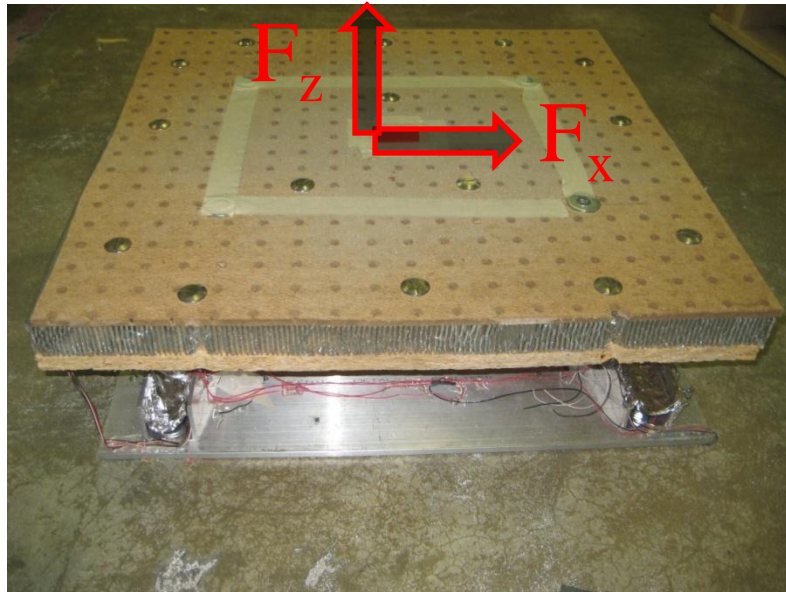
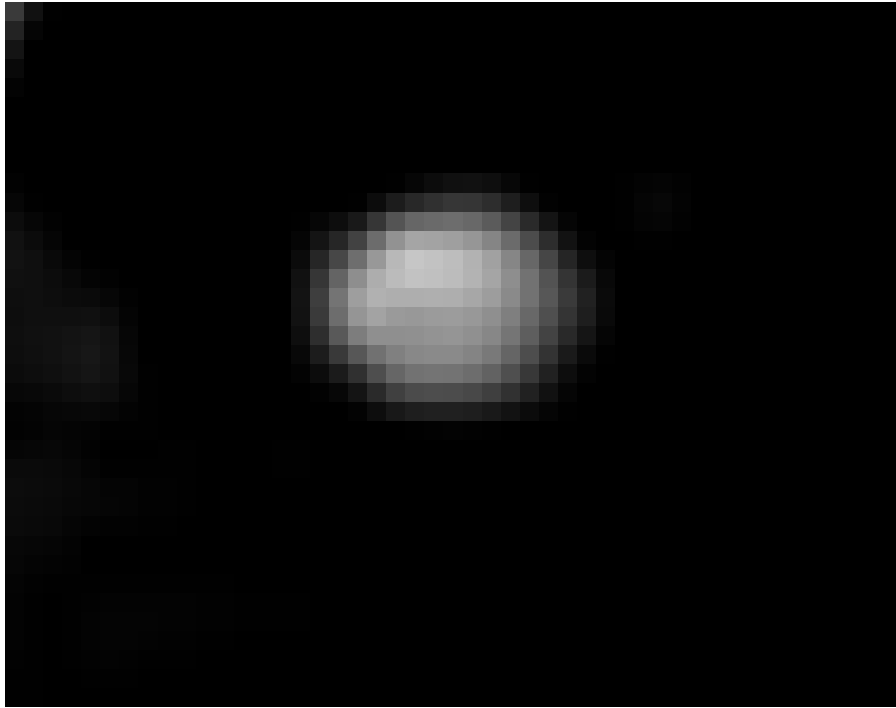


Goal: measure ground reaction forces during locomotion



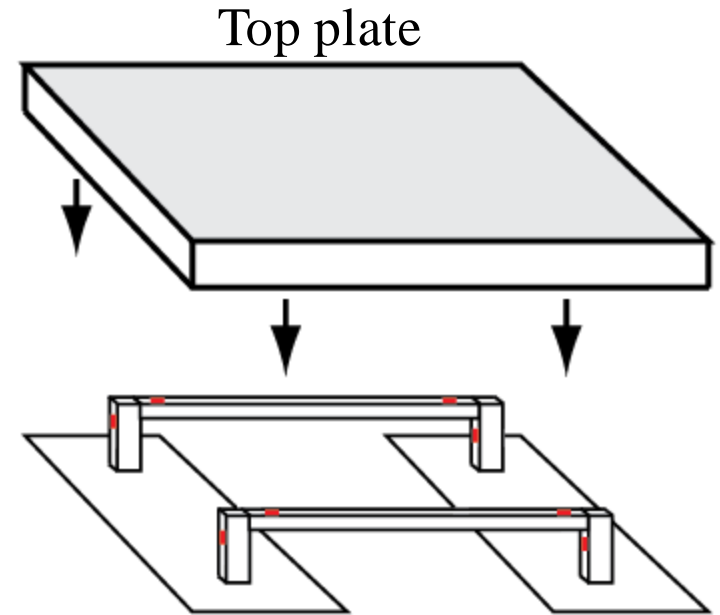
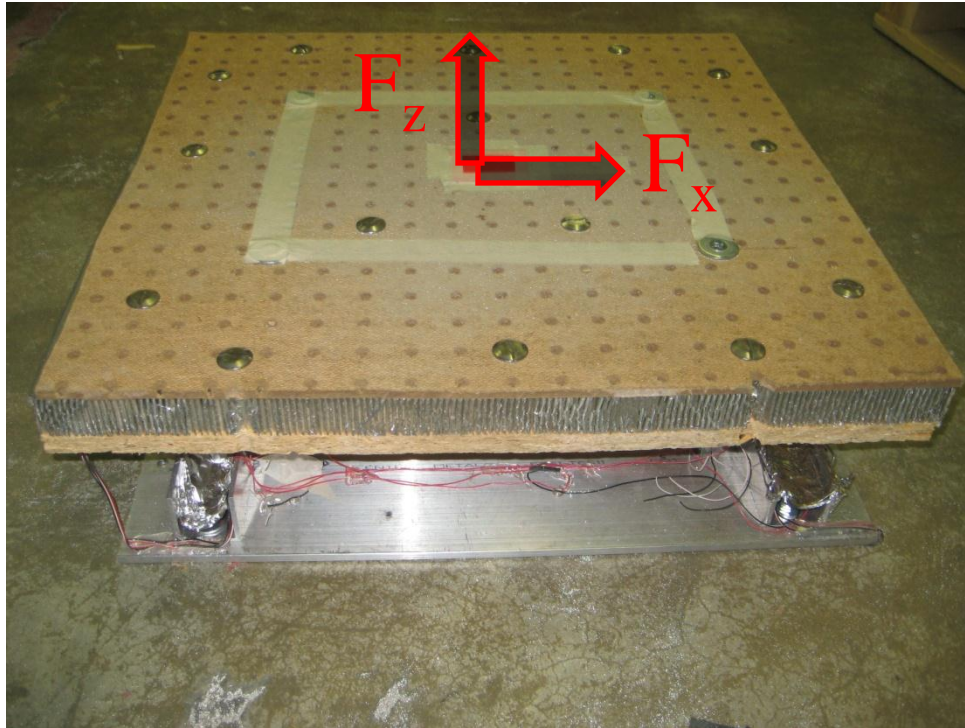






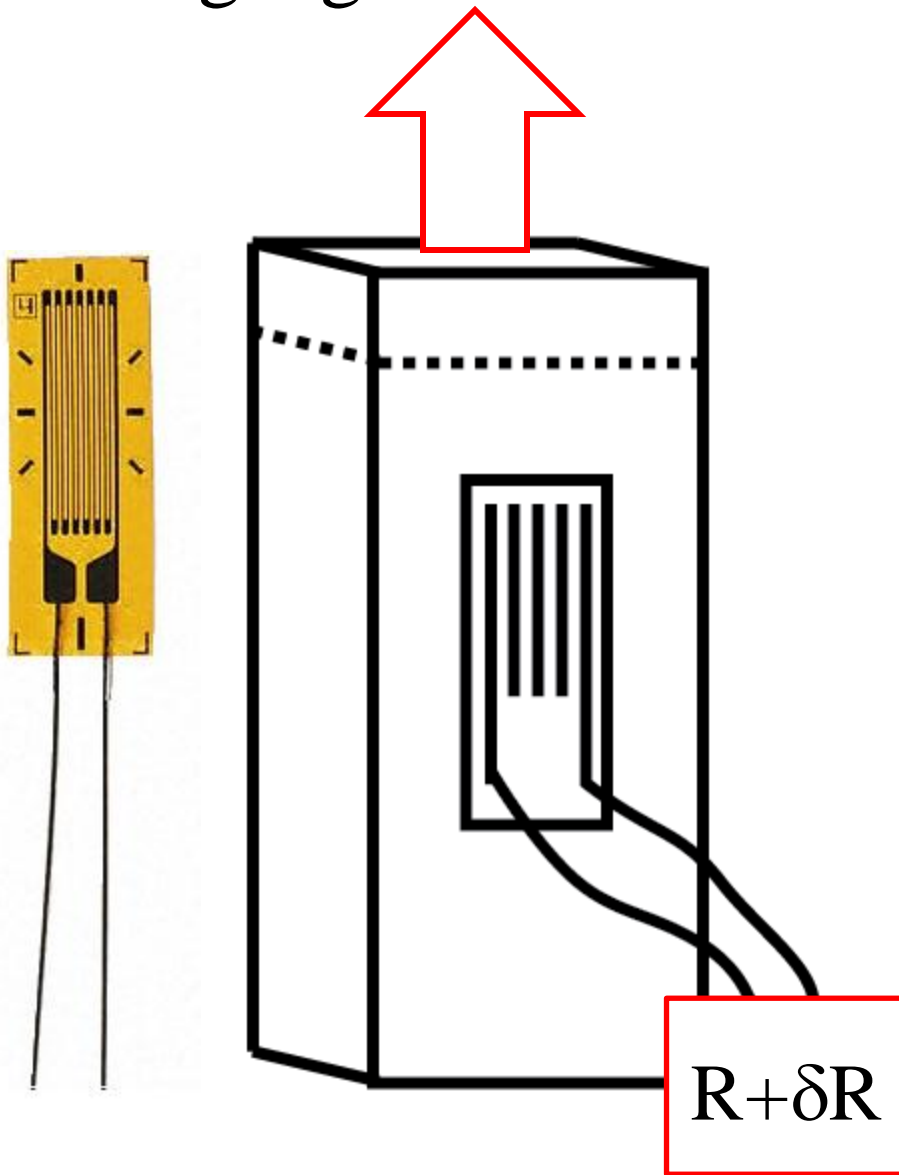
We will also track locomotion kinematics by monitoring the position of the center of mass during walking/running.

Two axis force platform

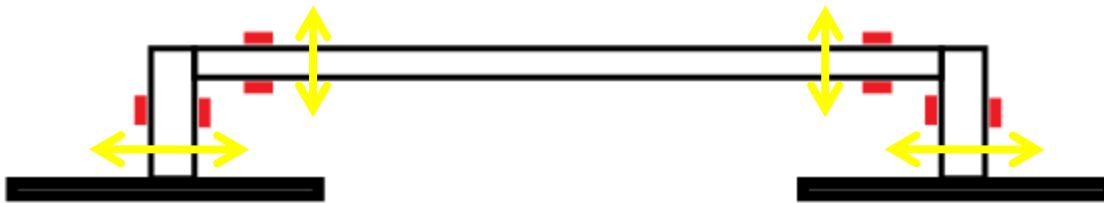
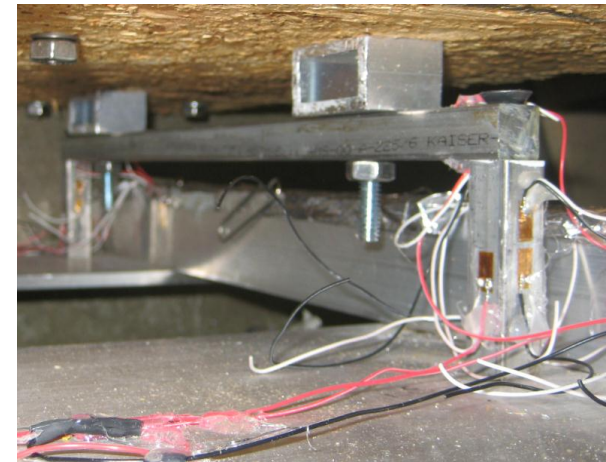
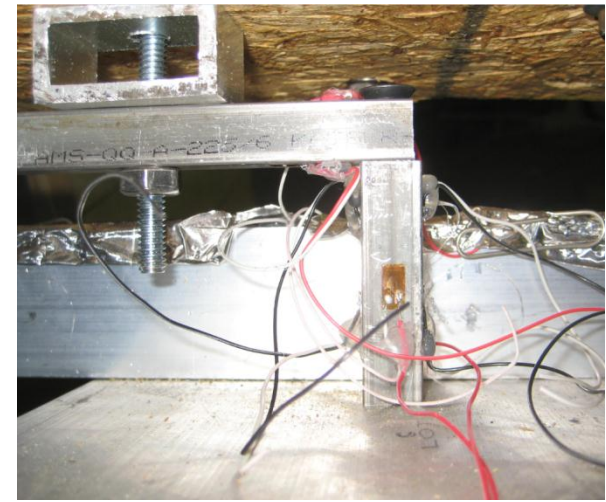
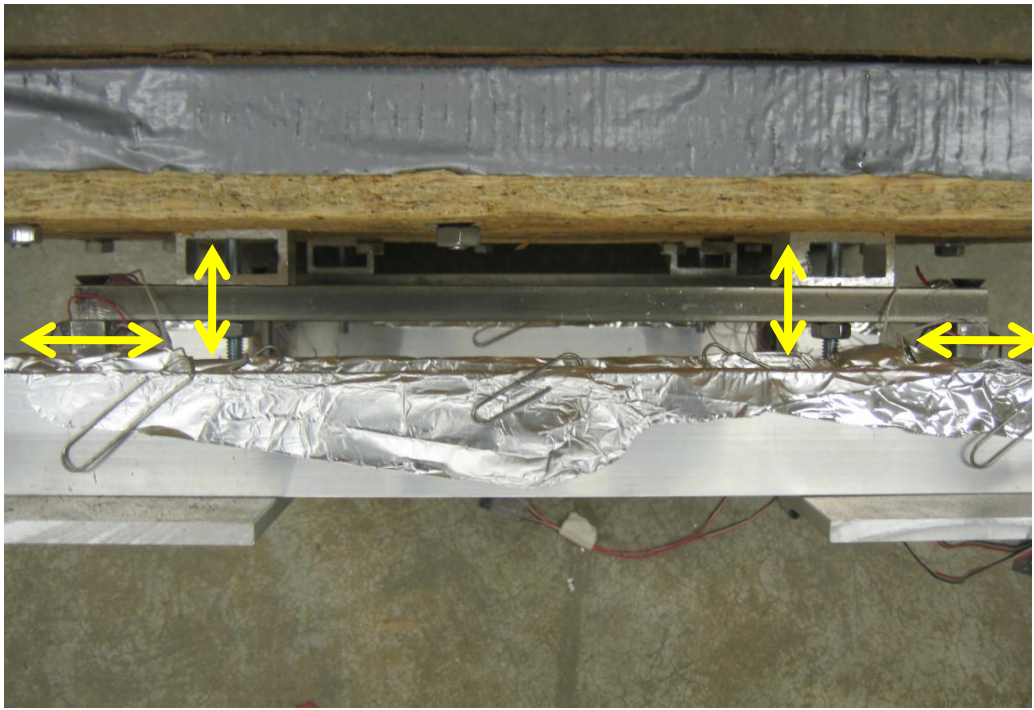


Bottom supports and beams mounted with strain gauges (highlighted in red)

Strain gauge



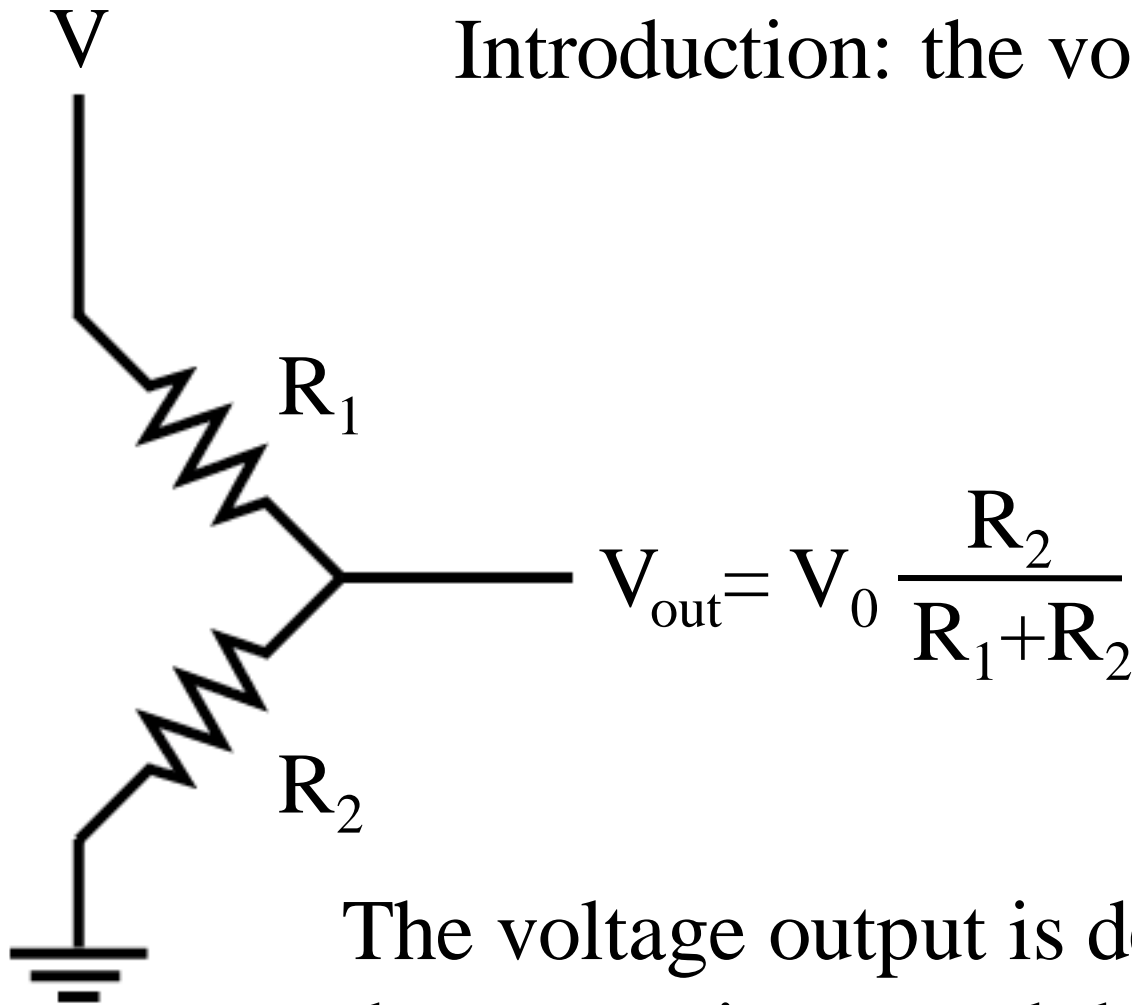
As strain gauges stretch or compress they change in resistance by a very small amount. To measure strain a sensitive technique to measure changes in resistance is needed



Beams mounted with strain gauges to measure bending along the fore-aft and vertical directions

Strain gauges are bonded directly to the beams using crazy glue

Introduction: the voltage divider

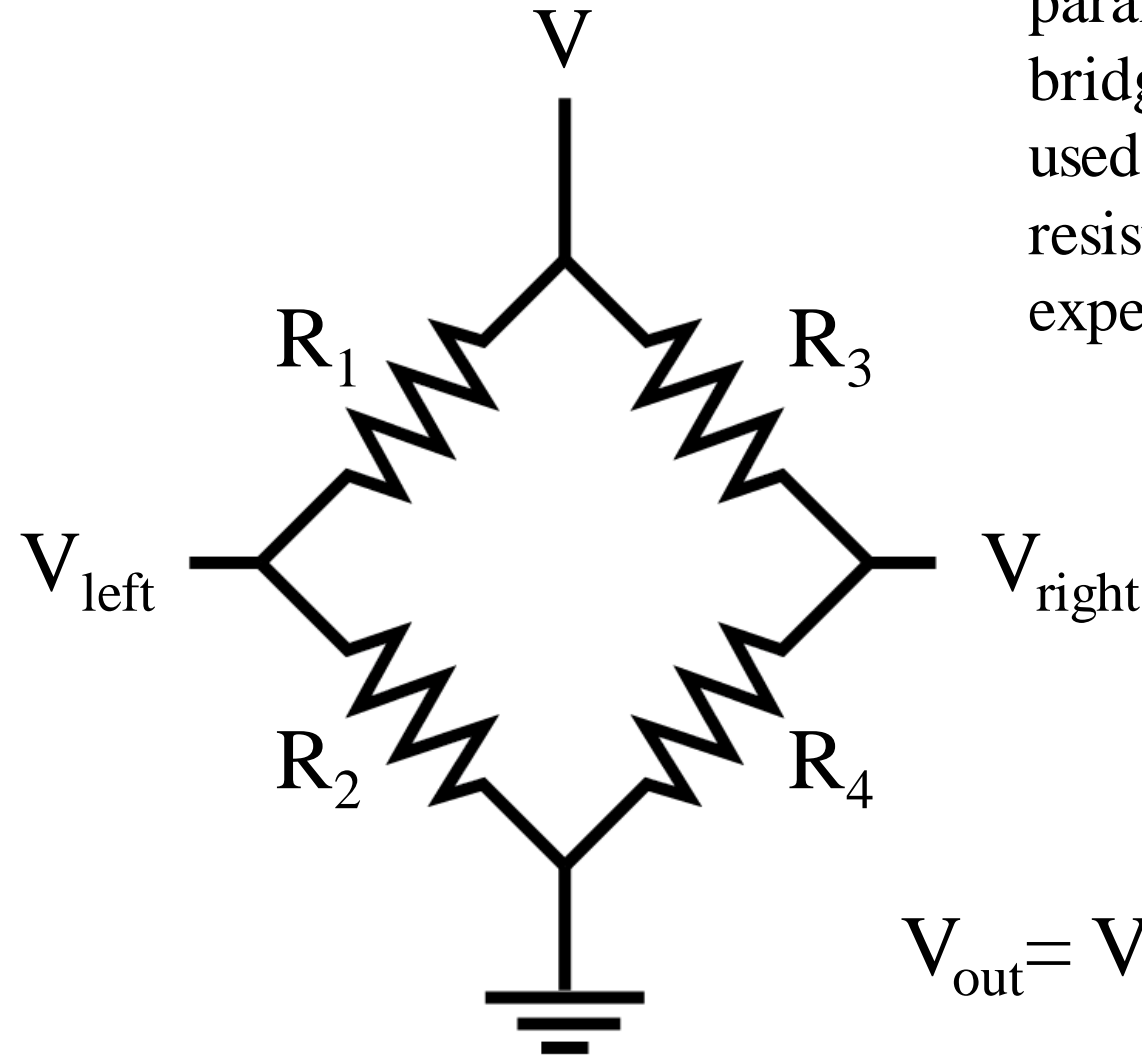


The voltage output is determined by the two resistors and the input V .

Note when $R_1 = R_2$ the voltage drops by a half, $V_{\text{out}} = (1/2)V_0$

Wheatstone bridge

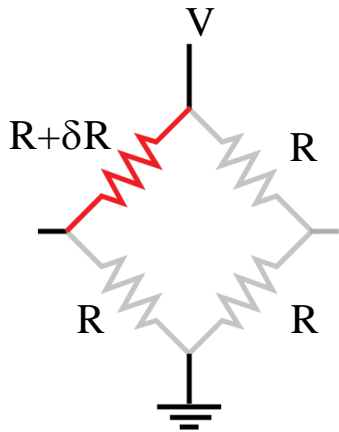
Placing two voltage dividers in parallel creates a Wheatstone bridge, the prototypical circuit used to measure changes in resistance in many scientific experiments



$$V_{\text{out}} = V_0 \left[\frac{R_2}{R_1 + R_2} - \frac{R_4}{R_3 + R_4} \right]$$

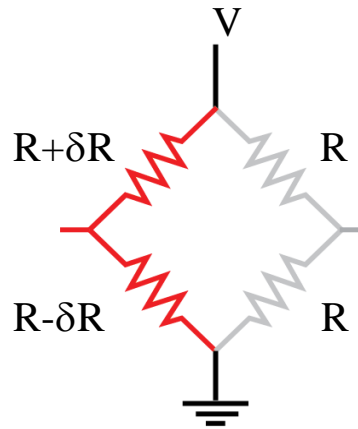
Wheatstone bridge circuits can be arranged in three basic configurations

Quarter-bridge



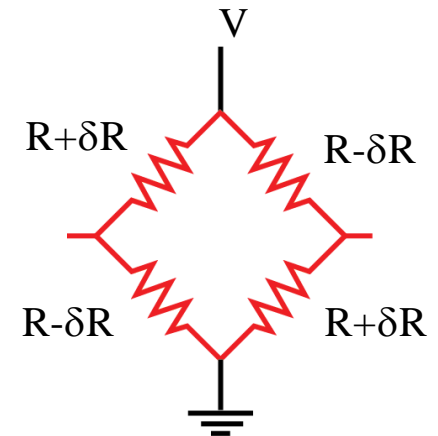
- Simplest bridge circuit, one active element
- No temperature compensation
- Only linear for small resistance changes

Half-bridge



- Two active elements
- Temperature compensation

Whole-bridge



- Four active elements
- Temperature compensation
- Twice as sensitive as half-bridge

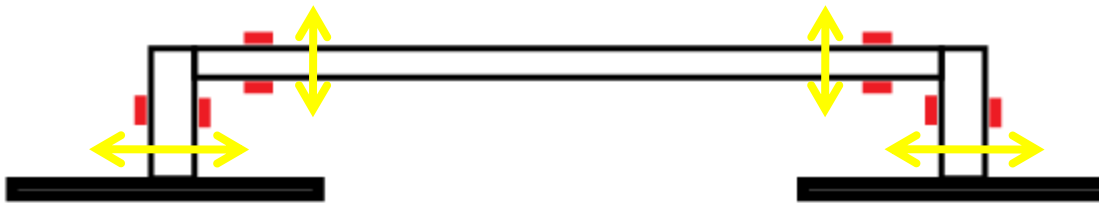
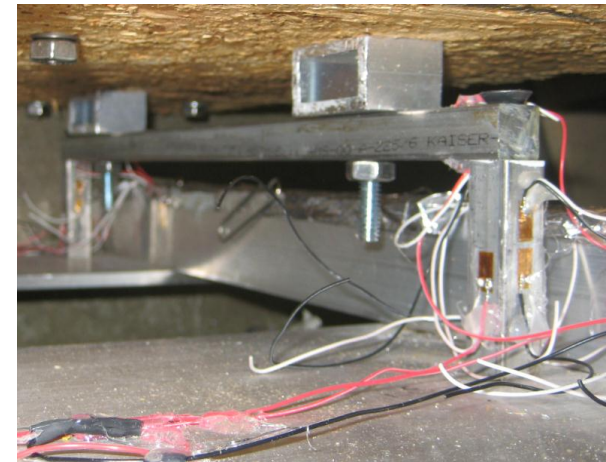
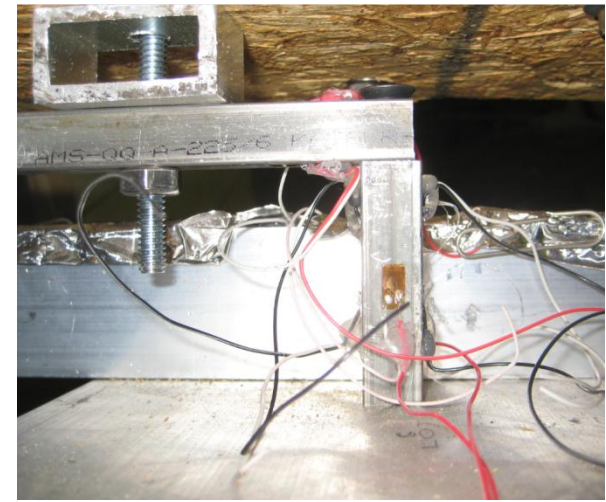
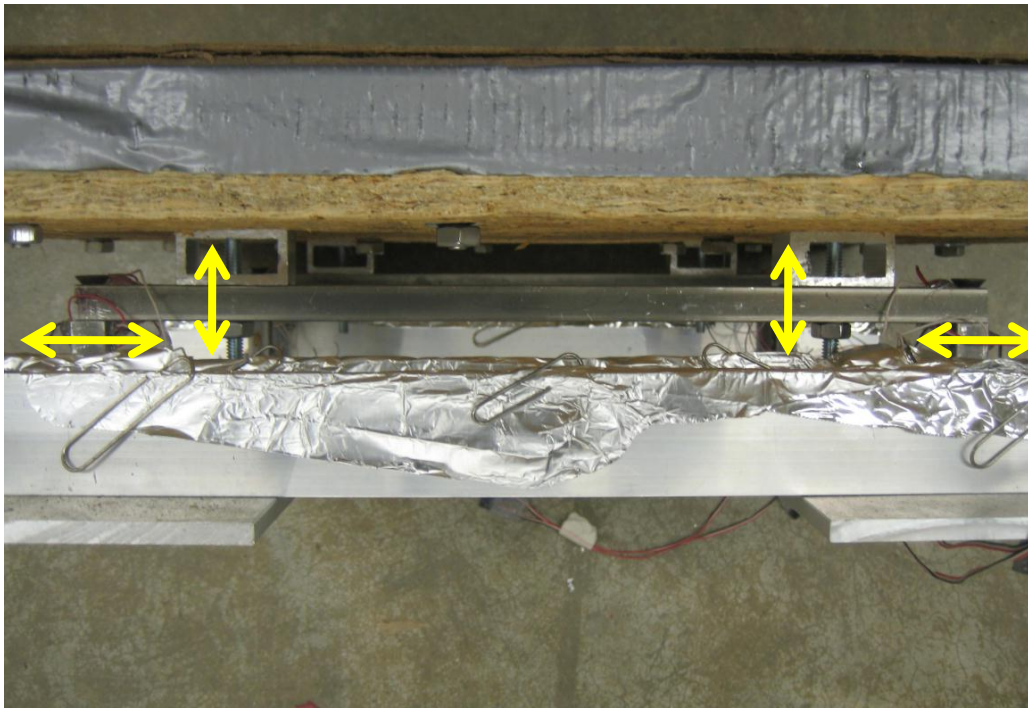
Other great online strain gauge resources

<http://zone.ni.com/devzone/cda/tut/p/id/3642>

<http://zone.ni.com/devzone/cda/tut/p/id/4172>

<http://www.omega.com/literature/transactions/volume3/strain.html>

Above sites are included in the session folder, additionally for more “hands on” work with strain gauges come to our tutorial session on Wednesday



Beams mounted with strain gauges to measure bending along the fore-aft and vertical directions

Strain gauges are bonded directly to the beams using crazy glue