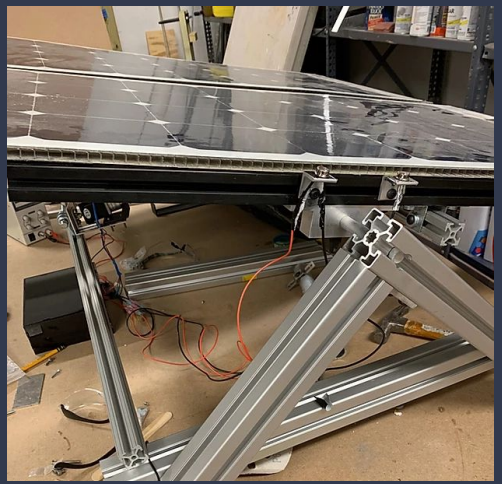
Solar Tracker

David Oke



Carnegie Mellon Solar Racing

We design, build, and race solar powered boats to practice engineering and to promote clean energy sources.

Purpose of Solar Tracker

- At competition, we charge our batteries in between races with our solar panels
- **Status quo:**
  - Tedious process
  - Inefficient (15%-30%)
  - Manual

Project Description

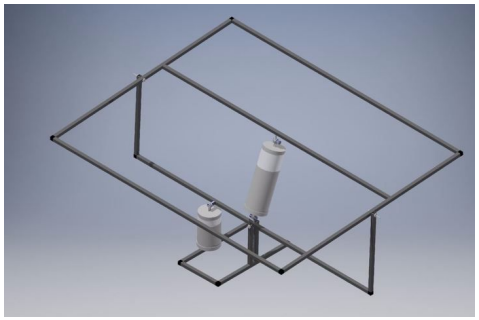
- Goal: Design & build a Solar tracker that
  - Maximizes charging efficiency
  - Automated
  - Portable & light
  - Can hold 2-4 large solar panels
  - Inexpensive

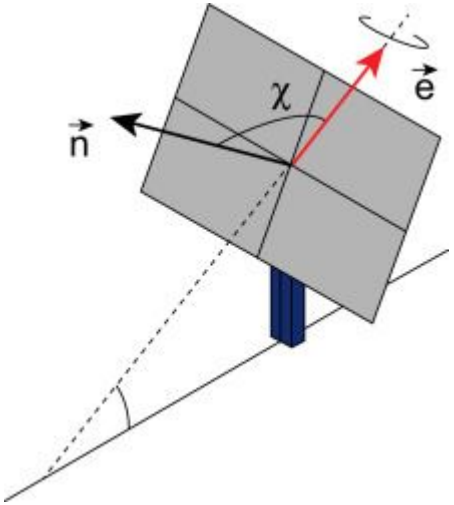
Challenges

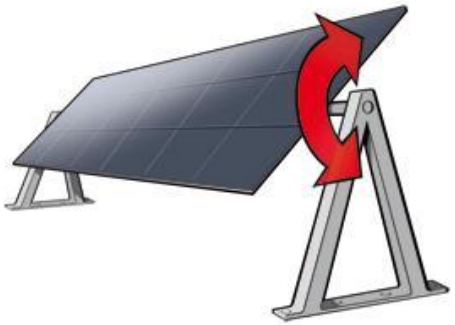
- Minimal familiarity with circuitry and EE
- First lead role on a project
- Have to guide 8 freshman engineers through the entire process

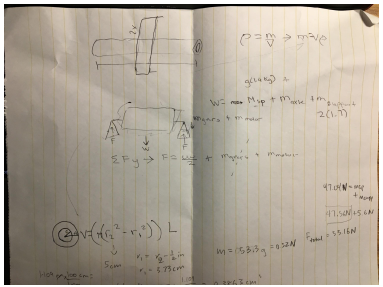
Brainstorming

- Dual axis or 1 axis?
- Power supply
- Support structure
- How do you track the sun?



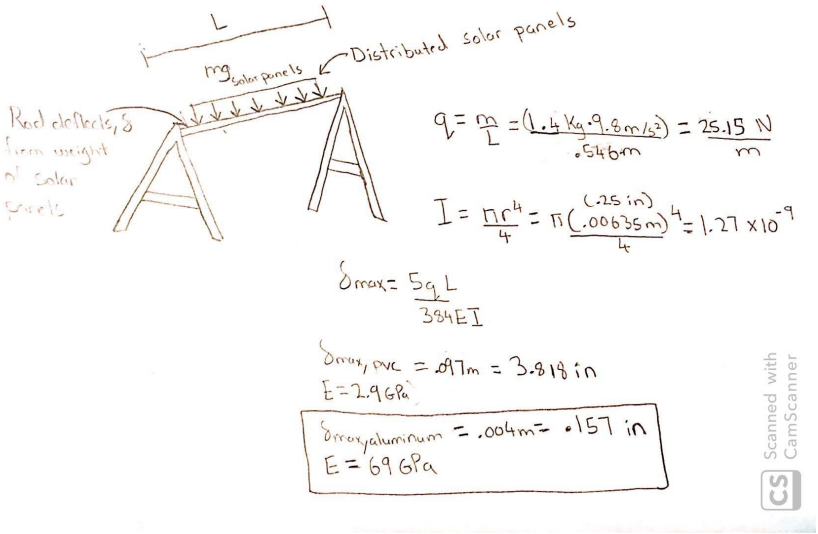




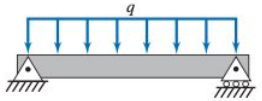


Hand Calculations & Assumptions

- Deflection of rod ~ 0.2 in



G-2.6



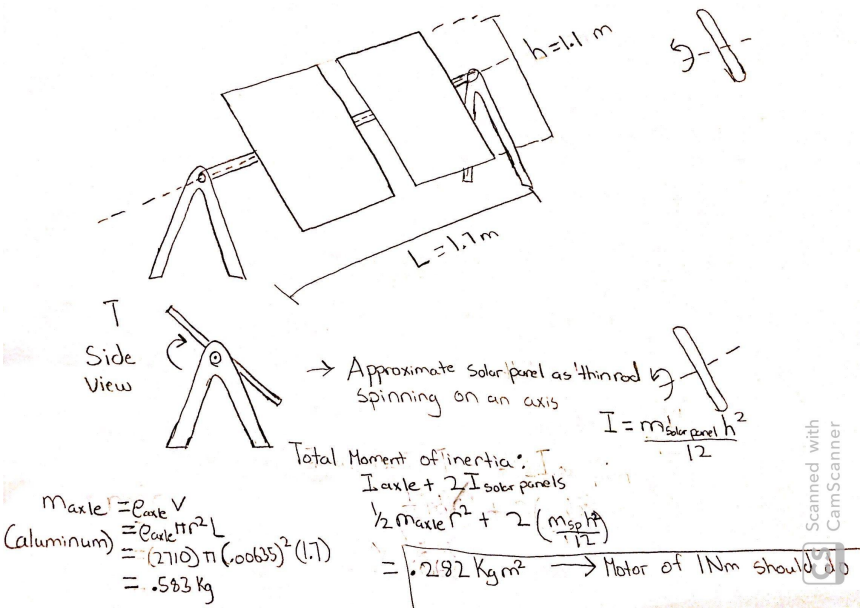
$$v = -\frac{qx}{24EI}(L^3 - 2Lx^2 + x^3)$$

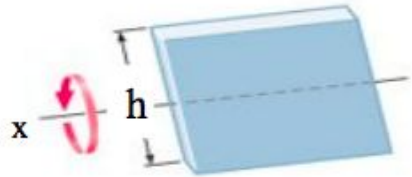
$$v' = -\frac{q}{24EI}(L^3 - 6Lx^2 - 4x^3)$$

$$\delta_C = \delta_{max} = \frac{5qL^4}{384EI} \qquad \theta_A = \theta_B = \frac{qL^3}{24EI}$$

Calculations & Assumptions

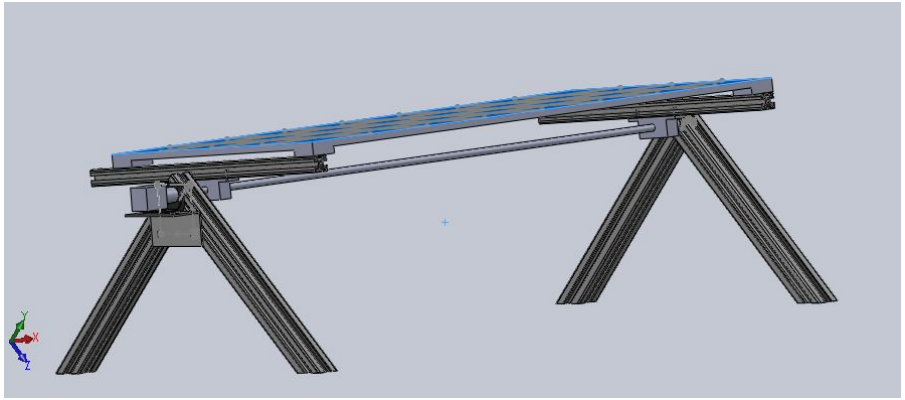
- Overall Moment of inertia ~ .0.282 kg*m^2

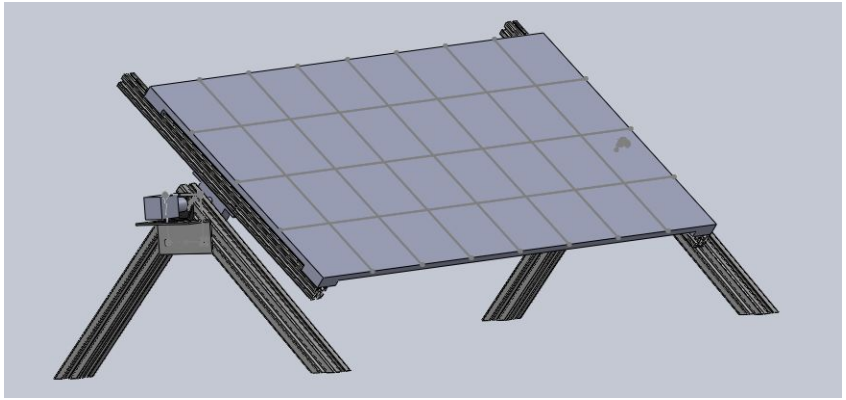




CAD Modeling

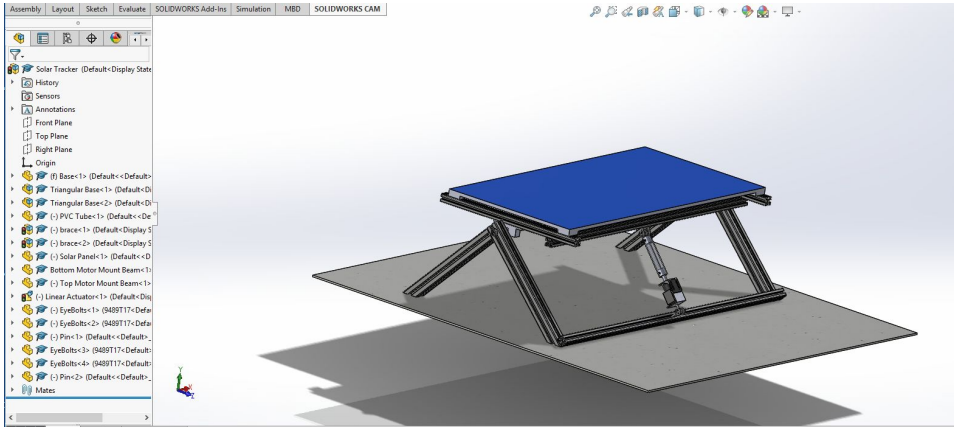
- Initial CAD
  - Motor mounted directly on axle
  - Requires constant torque
  - Solar Panels attached to aluminum t-slots via velcro

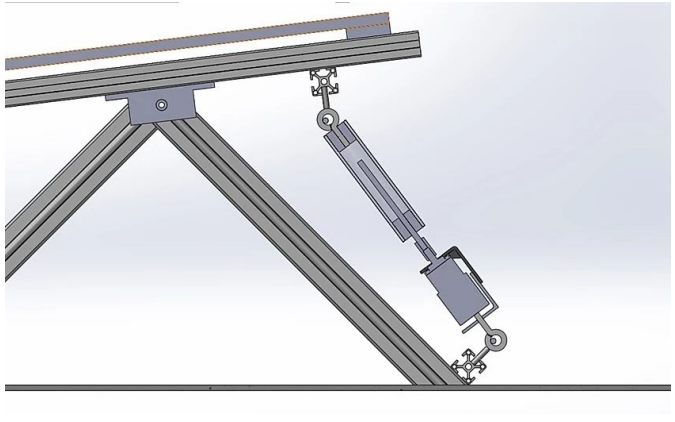




CAD Modeling

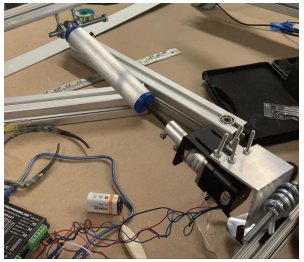
- Final CAD
  - Replaced motor with linear actuator
  - Can hold a position with no torque
  - Requires no gearing

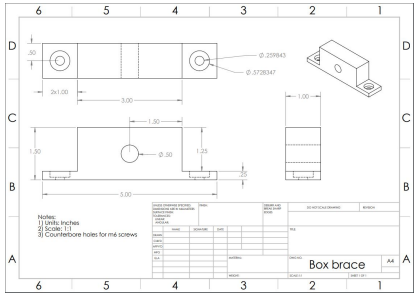


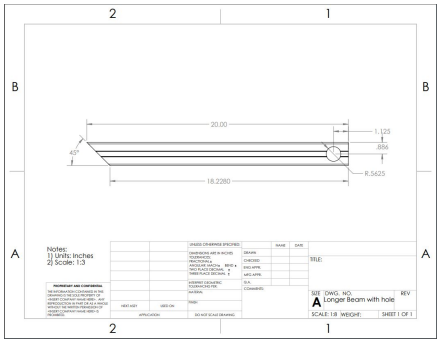


Fabrication & Manufacturing

- Frame made of Aluminum T-slots
- Linear actuator
- Machined on mill & lathe

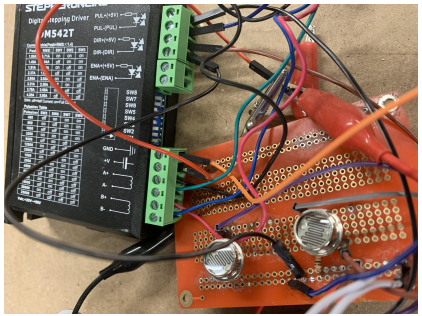


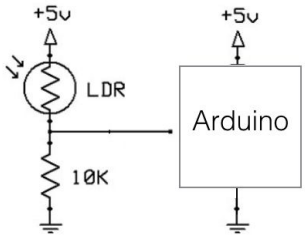


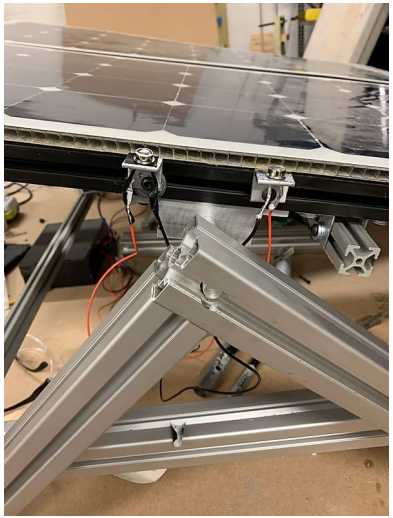


Circuitry & Wiring

- NEMA 17 Stepper Motor & driver
  - 0.45 Nm stall torque
- Photoresistors
  - Detect varying amounts of sunlight
  - In series with a resistor to form a voltage divider







Demo


WHEN I BEGIN BLOCKING THE OTHER
PHOTORESISTOR WITH MY FINGER,
THE DIRECTION OF ROTATION

Next Steps

- Improve tolerancing on parts
- More thorough testing before competition