University at Buffalo The State University of New York | REACHING OTHERS

The Trekker Solar Tracker

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Abstract

Energy in the form of electricity has become virtually ubiquitous in our modern society. You can either tether yourself to a nearby outlet or eliminate the chord and carry the energy with you in a battery. Although this system serves the majority of energy consumers well, it still has its limitations. Electricity is flowing around us almost everywhere but we don't always have access to it, and battery charges have a relatively short shelf life given how much energy is actually demanded. With the advent of renewable energy sources, such as solar panels, a new degree of freedom has been added to the range of energy consumption. In designing a mobile solar tracking sun panel we hope to investigate the integration of the current paradigm of macro-scale energy production with an individualized renewable source so as to bring about new possibilities with respect to energy consumption.

Challenge and Objective

Safe and Stable:

- Ensure stability both during operation and transportation
- Reduce weight to minimize stresses imposed on the system

Cost:

- Minimize the price of the system while maximizing its efficiency

Quality and Longevity:

- Incorporate weather resistant and durable materials

Weather Resistant:

- Operational from May until September
- Elements of weather include rain, debris, and strong winds

Performance:

- Track the sun and rotate about a vertical axis to an optimal position to produce maximum power output

Methods

Structural Analysis

- Identify high risk failure points
- Calculate static and dynamic loading values
- Evaluate final factor of safety

Finite Element Analysis

- Identify critical load bearing elements
- Estimate worst-case loading scenario
- Perform simulated finite element analysis

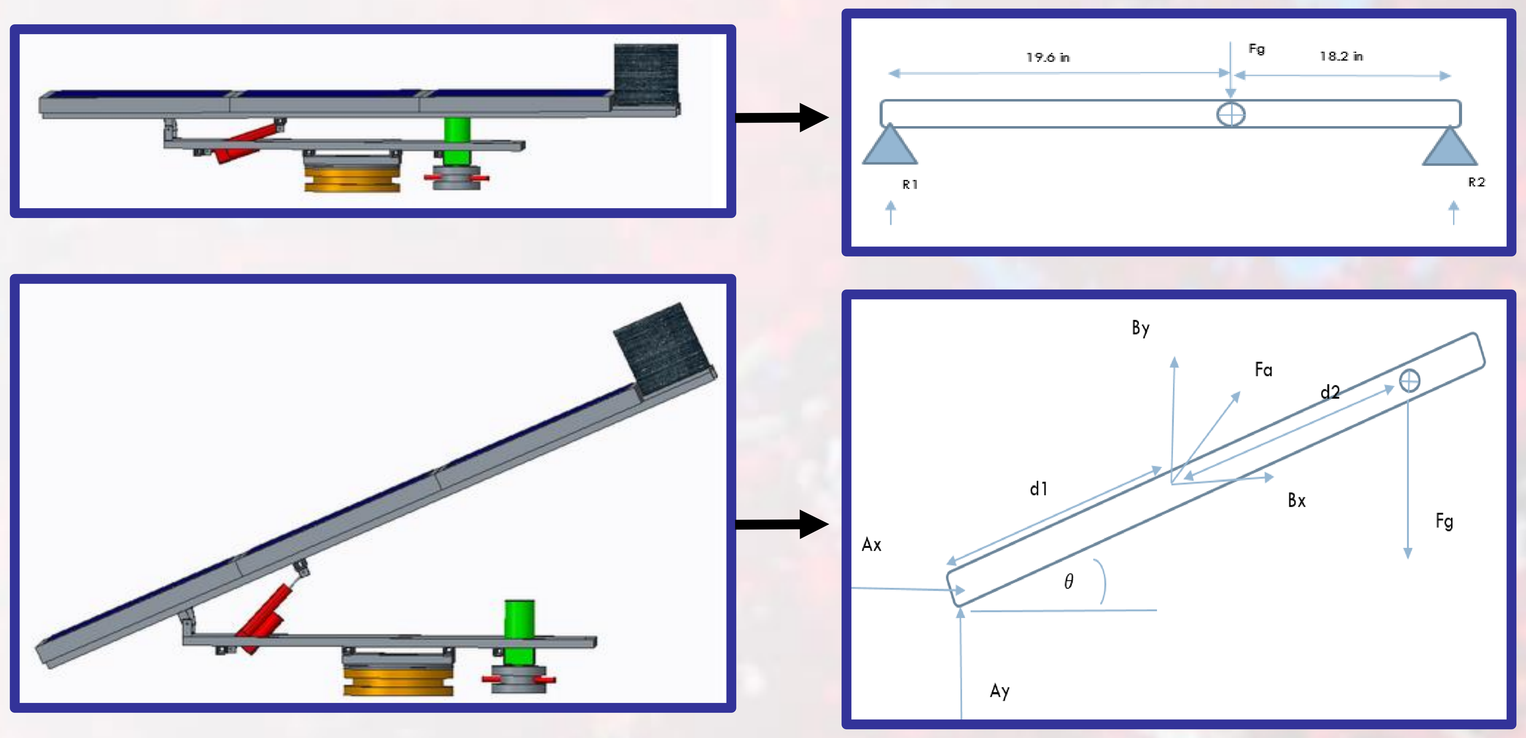
Angle Optimization

- Collect historical data pertaining to incidence of solar radiation in region of operation
- Estimate energy output for non-automated solar panel configuration
- Estimate and optimize pitch angle to the sun
- Compare fixed energy estimation with single axis automated solar tracking energy estimation

Methods

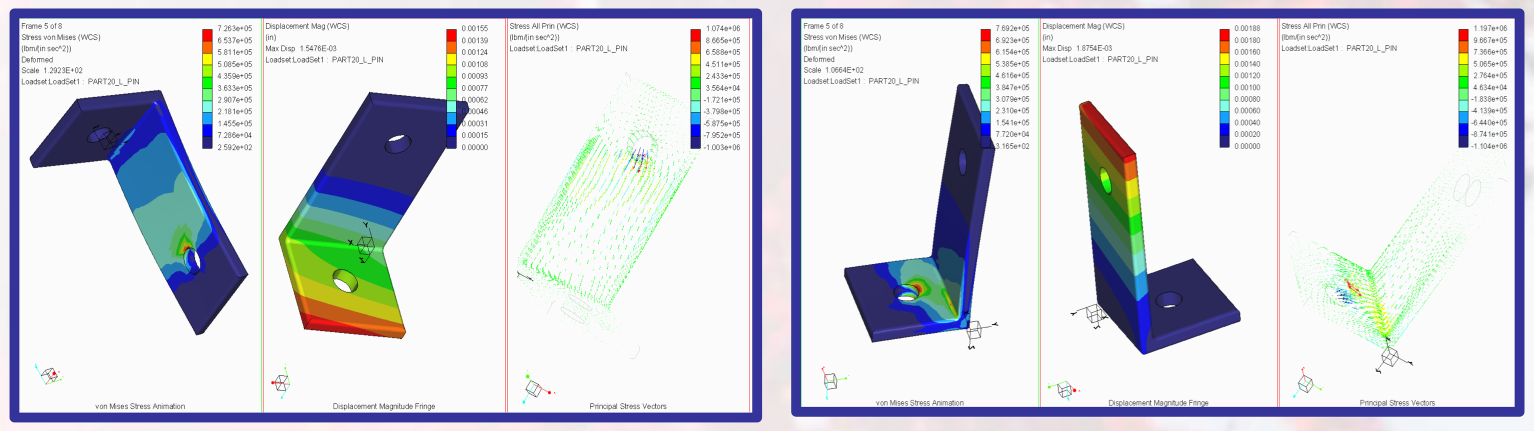
Free Body Analysis

- Simplify design of structure
- Estimate loading
- Calculate loading required by linear actuator



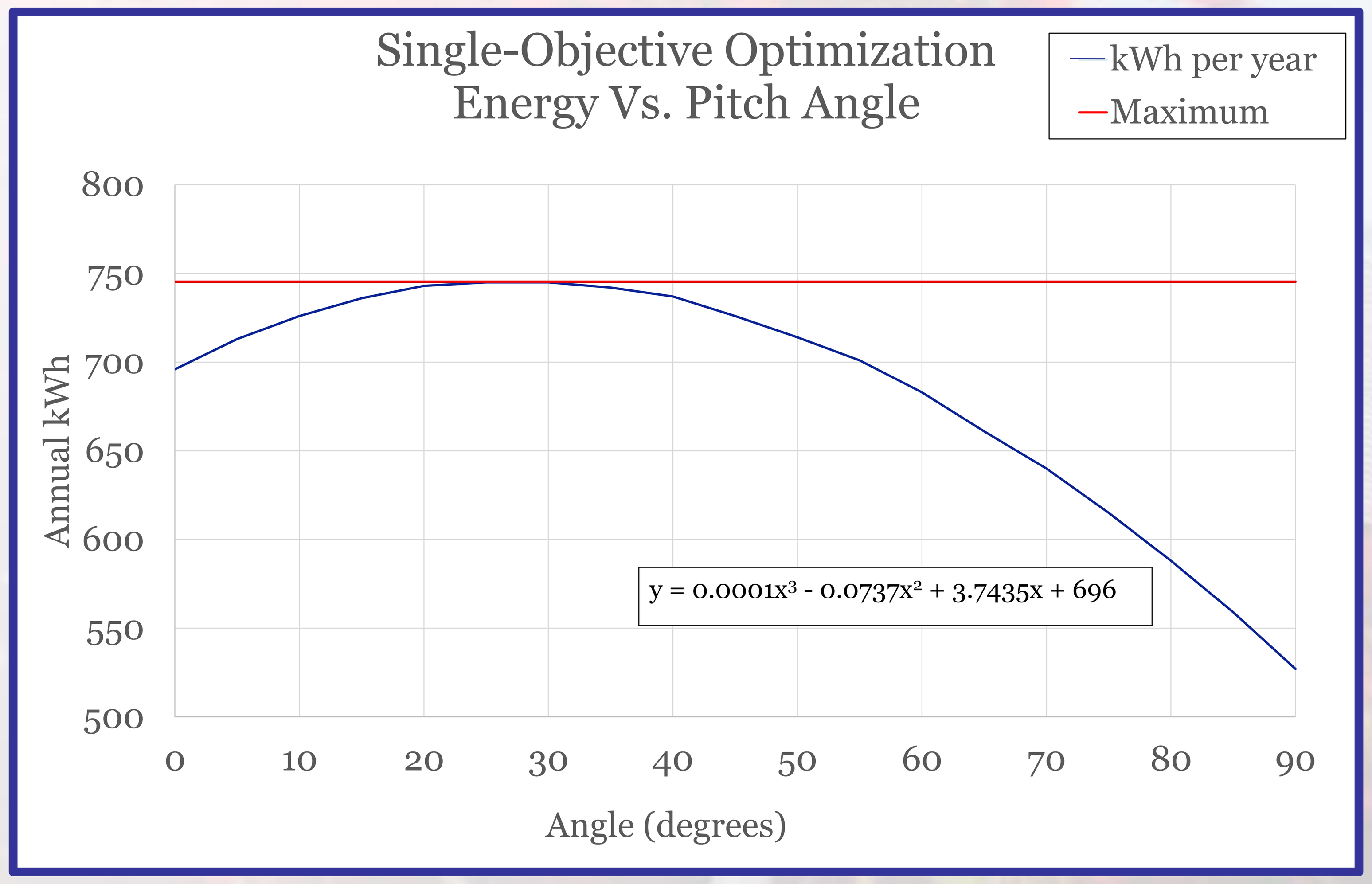
Finite Element Analysis

- Replicate critical load bearing component
- Simulate worst-case scenario
- Perform stress analysis



Angle Optimization

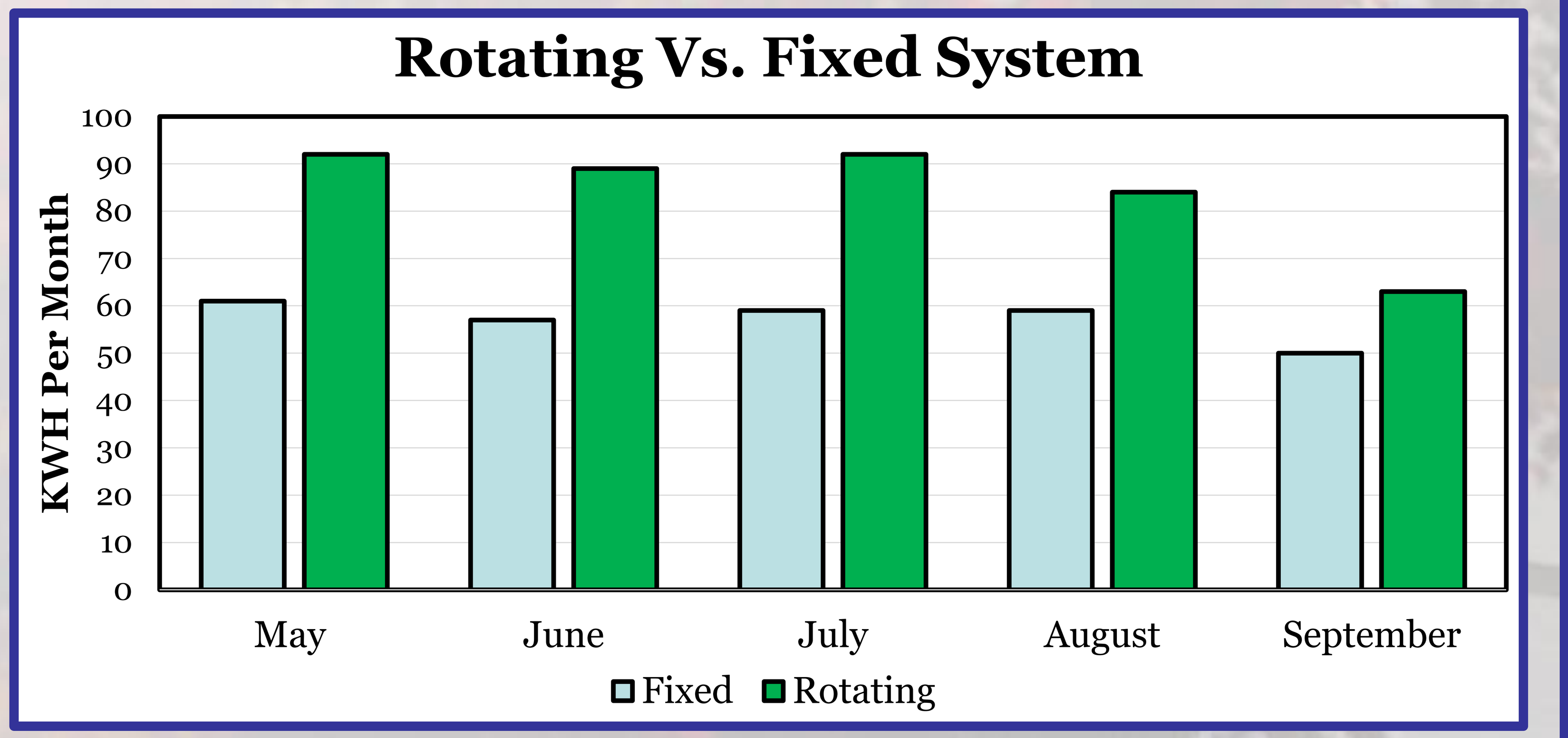
- Establish a range of pitch angles
- Estimate annual kWh produced per angle
- Plot estimations to determine optimal angle from the range



Results

Optimization Results

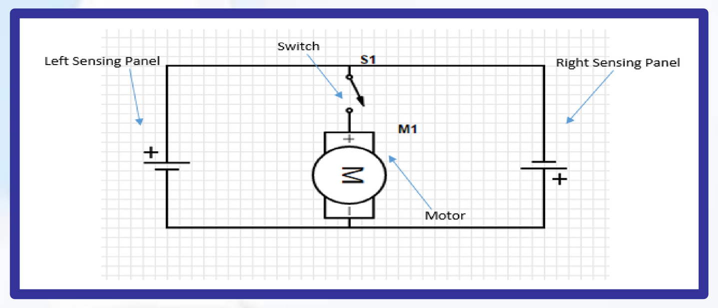
- 73% Improvement in overall power output when comparing a fixed system to the developed rotating system



Results

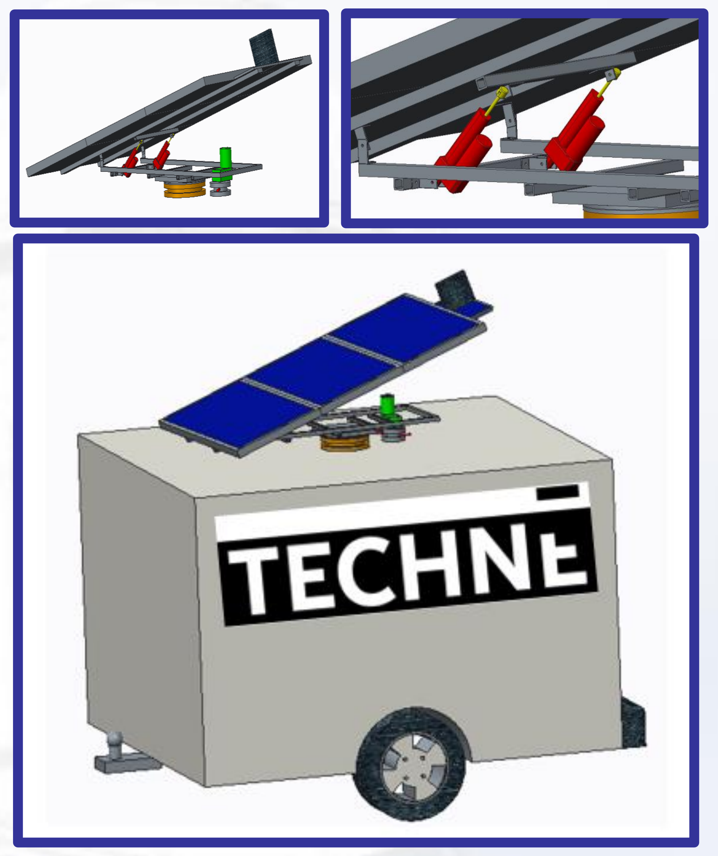
Tracking System

- Schematic view of solar tracking system



Stability and Mounting

- Two 225 lb actuators serve as support and lifting mechanism
- 1/8 in 6061 Aluminum framing
- Galvanized steel turntable
- 12v .5amp indirect drive parallel DC motor



Conclusion

Based on the results obtained by our calculations, it can be concluded that this system is very effective in satisfying its initial goal of increasing power output. Since this system will be used to supplement the supply of power to educational and artistic devices, there was not a heavy emphasis on ensuring that the system would eventually pay for itself with saved expenses on grid supplied energy. However, it can be concluded that with better solar capturing equipment (solar panels), this system can be used to significantly increase the power output of static solar power systems. Further research can be conducted to determine if scaling up this system model would have an impact on return on investment or possibly lead to full energy independence.

Acknowledgments and References

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