Team #2: Solar Car
FINAL PRESENTATION

COE Advisors:

ECE Department

- Dr. Simon Foo
- Dr. Jim Zheng
- Dr. Mike Frank

ME Department

- Dr. Pat Hollis
- Dr. Kamal Amin

Team Members:

Matthew Bosworth – EE

Christopher Dresner – EE

Ahmad Farhat – EE

Daniel Green – ME

Joseph Petit-Homme – ME

Thierry Kayiranga – EE

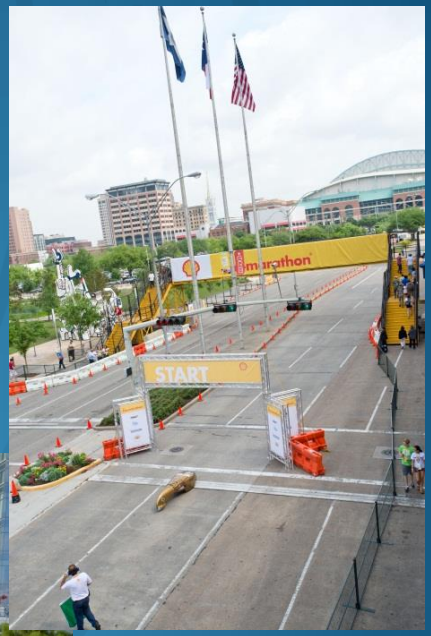
Clay Norrbin - ME

Outline

1) The Competition
2) Splitting Work into Two Years
3) Mechanical Design
    1) Chassis
    2) Roll Bar
    3) Front Steering
4) Electrical Design
    1) Motor
    2) Solar Array
    3) MPPT Converter
    4) Batteries
5) Budget
6) What's Left?
7) Questions

What is the Shell Eco-Marathon?

- The Shell Eco-Marathon challenges student teams to design, build and test ultra energy-efficient vehicles.
- The winners are the teams that go the furthest using the least amount of energy.
- New “Solar-Battery Electric Class” for 2014
- Safety First
  - Bulkheads, Fire retardant materials, exit strategy, roll bar, maximum voltage requirements, limitations on battery type, protection circuits, etc.
- Size and weight limitations



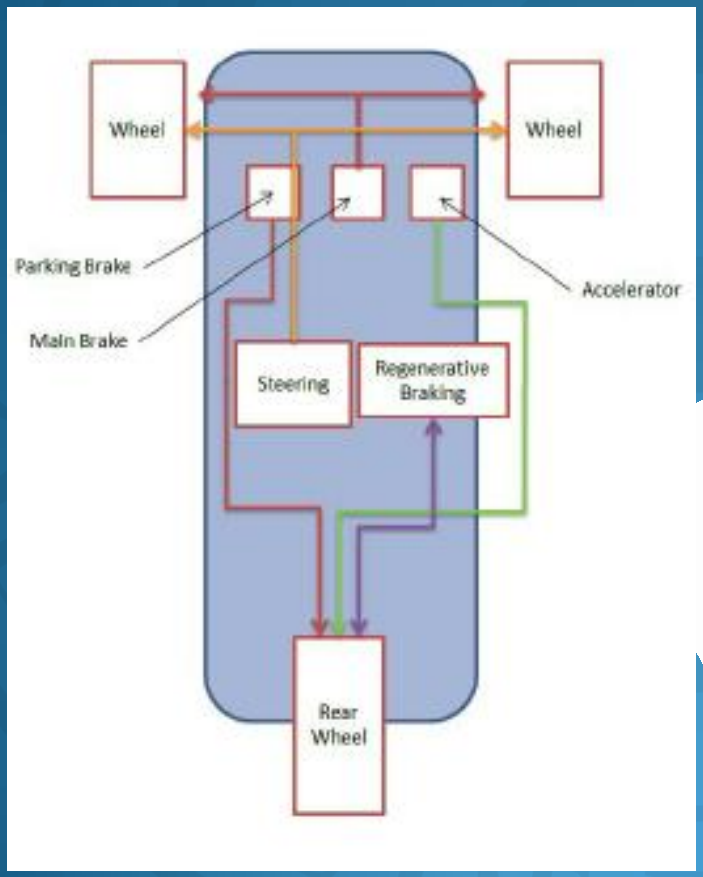
Splitting Up the Work

- Year One
  - Mechanical
    - Design, simulation, and fabrication of the of a chassis capable of rolling.
  - Electrical
    - Design, purchase and simulate all required electrical parts for a working solar car.
- Year Two
  - Mechanical
    - Design, simulate and fabricate all extra components required for a working solar car capable to compete.
  - Electrical
    - Install electrical components onto car and make sure all components work together properly and efficiently.

Mechanical Sub Design

Clay Norrbin

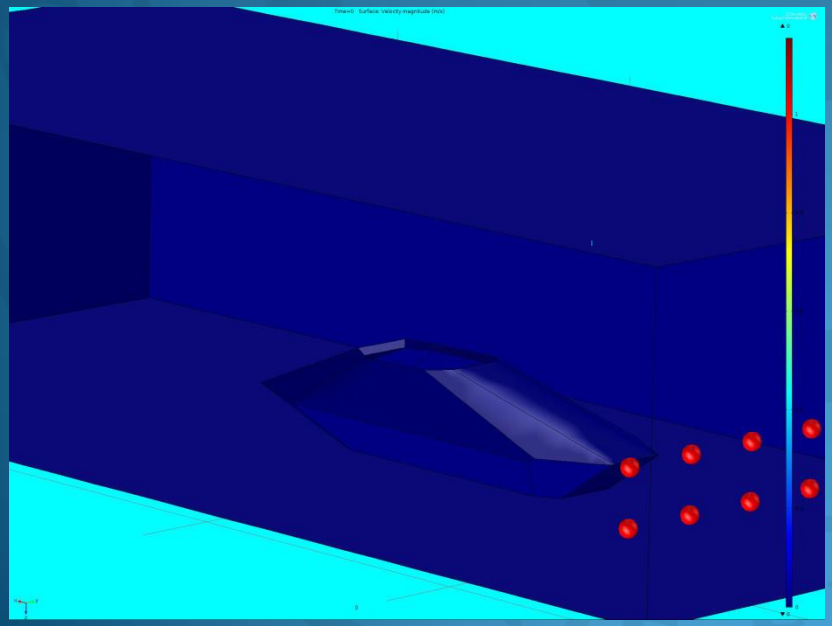
Overall Design

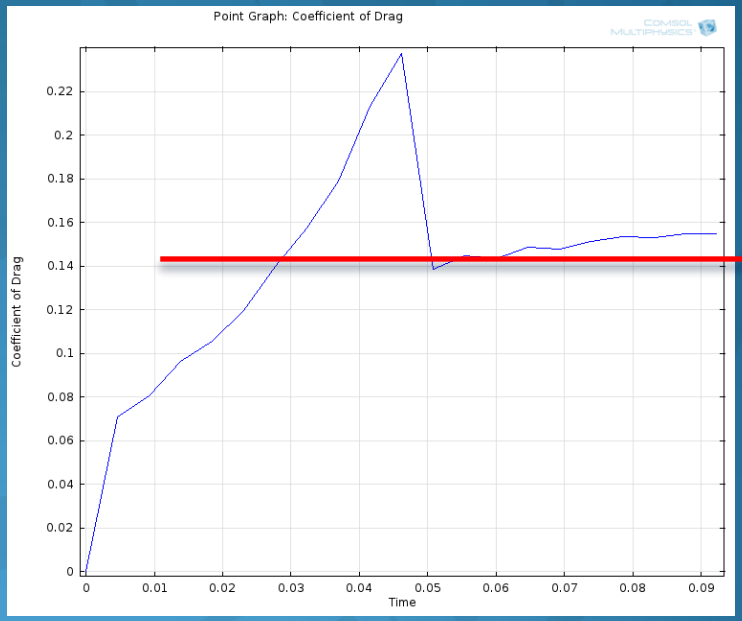


Clay Norrbin

Chassis Design

Aerodynamic analysis in COMSOL led to suitable drag coefficient



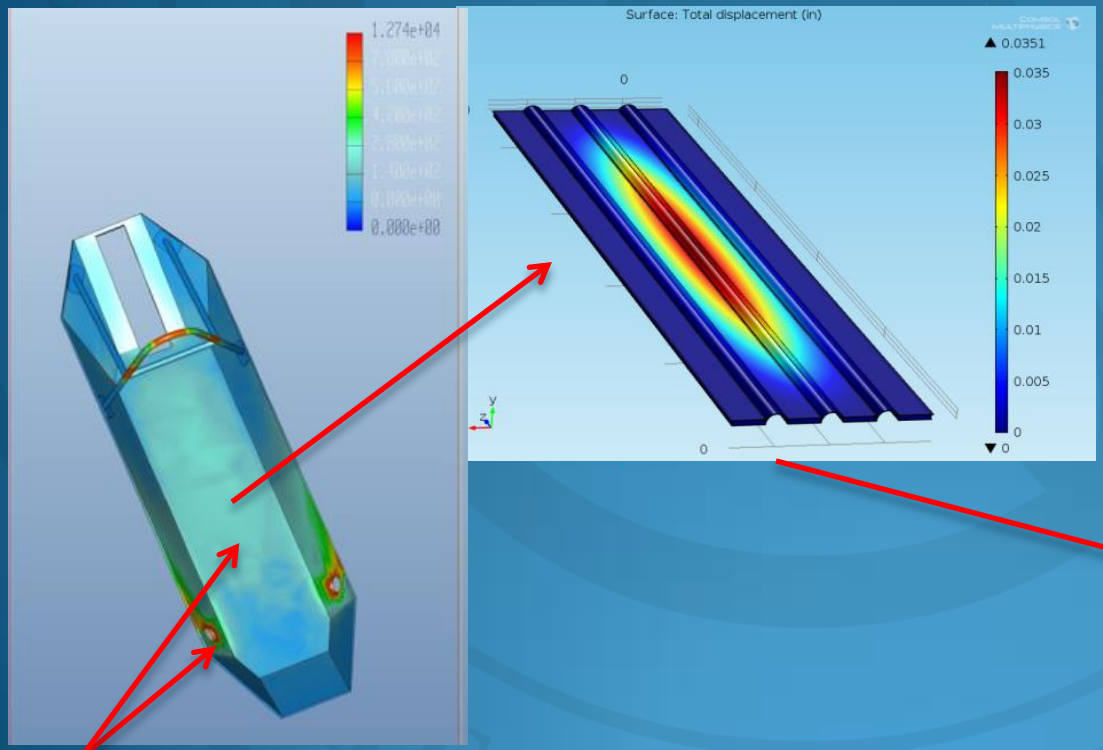


Cd = 0.155

Clay Norrbin

Chassis Design

Stress analysis was done to determine material thickness's and composition



	Max Stress (MPa)	Max Deflection (in)	Weight (lbf)
Carbon Plate	1964	97	4.8
Carbon with Geometry	227	0.25	6.5
Carbon with Balsa	50	0.29	13.5
Carbon with Geometry and Balsa	91	0.16	12.6

Clay Norrbin

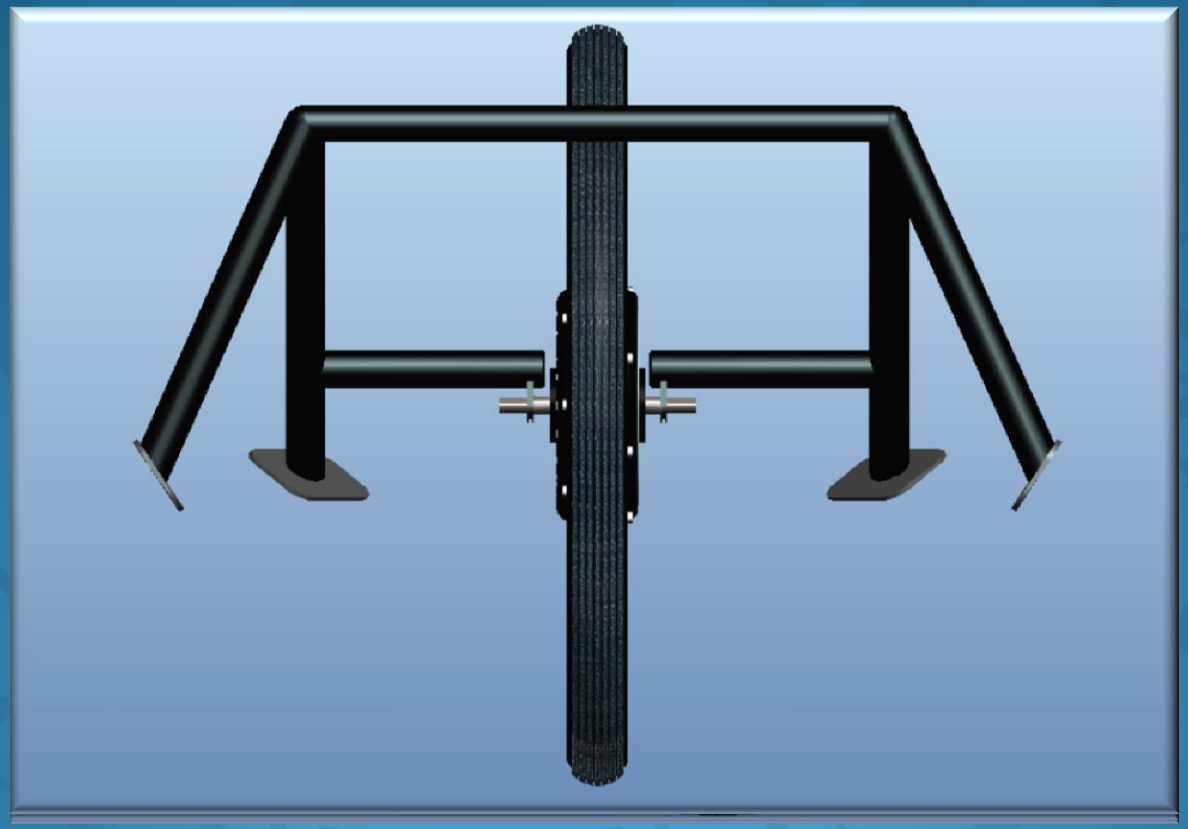
Chassis Construction

Infusion based carbon fiber process was used. This required to make a hand made mold to preform the process

Daniel Green

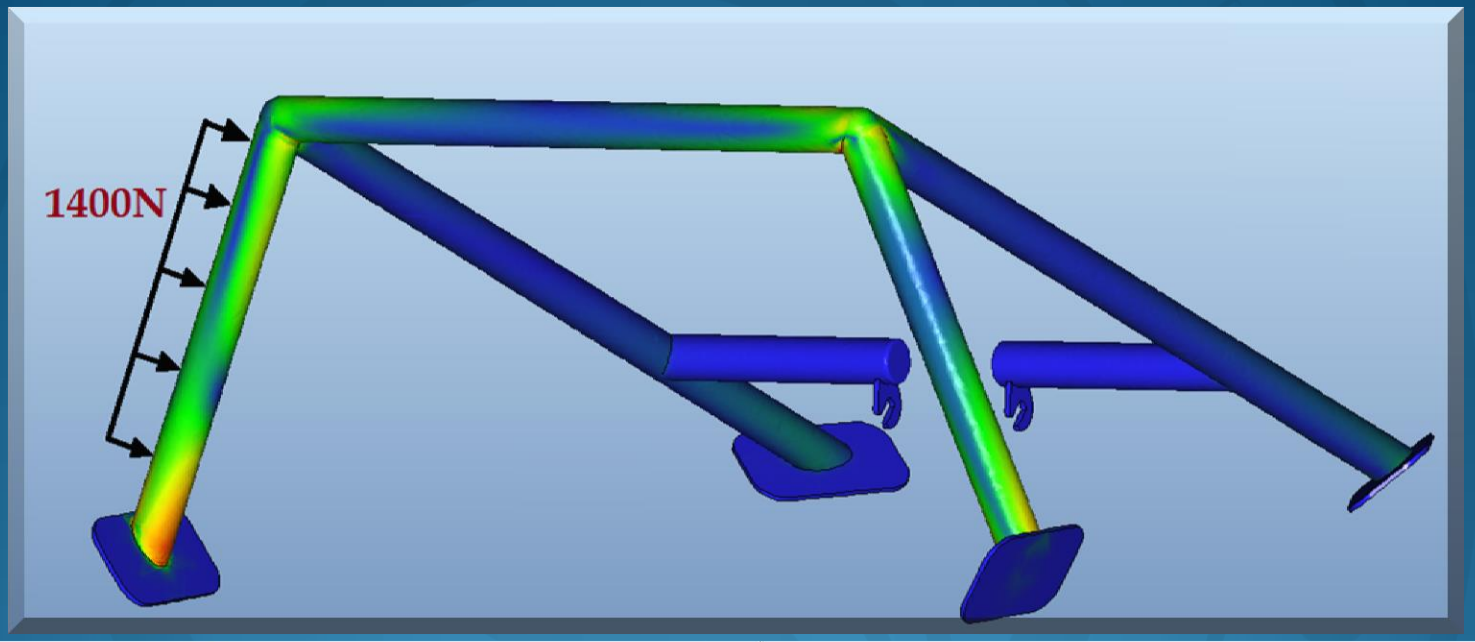
Roll Bar

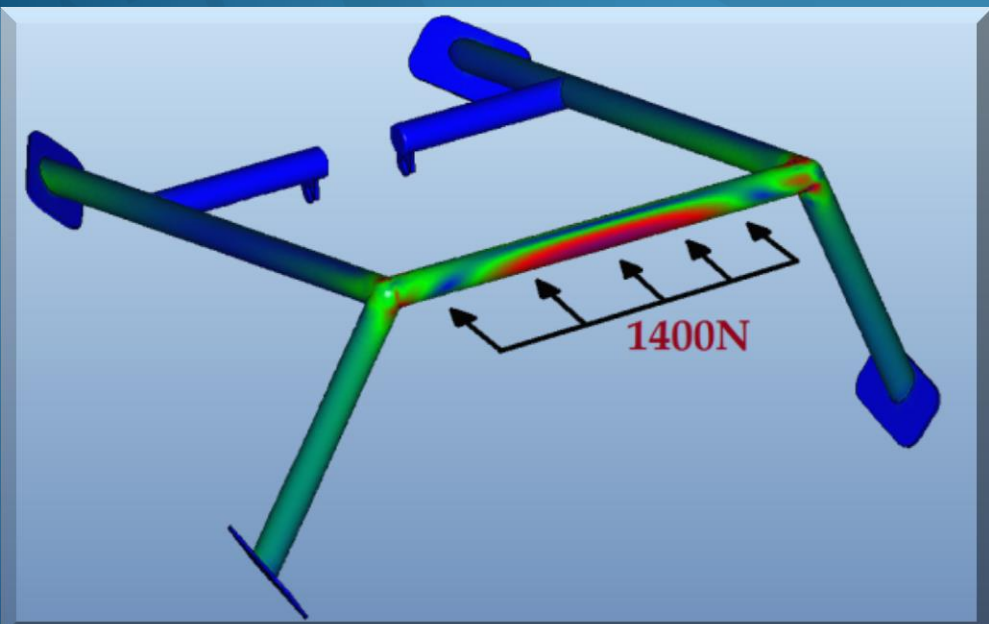
4130N chromoly steel tubing, 1.25” x 0.065”

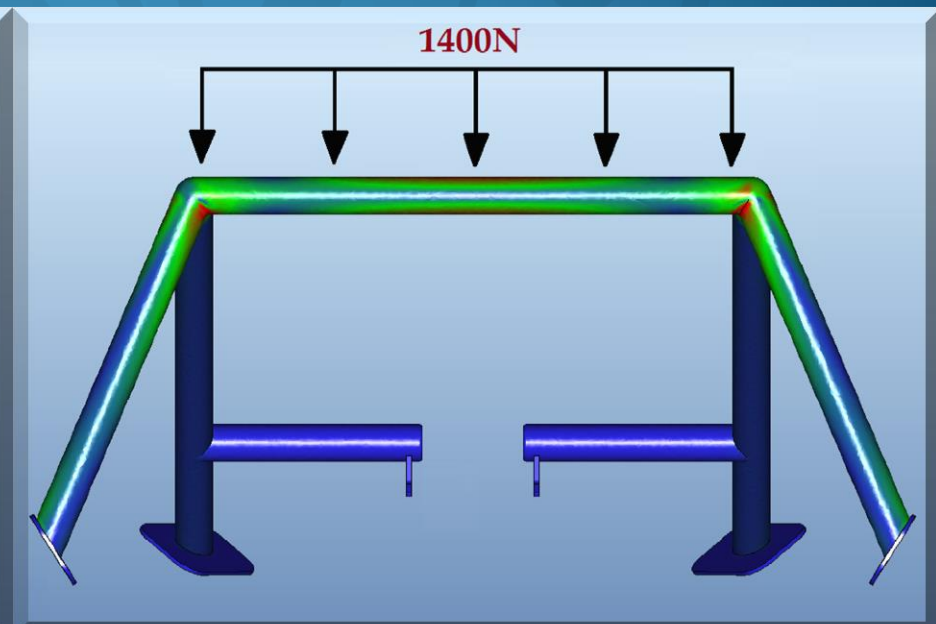


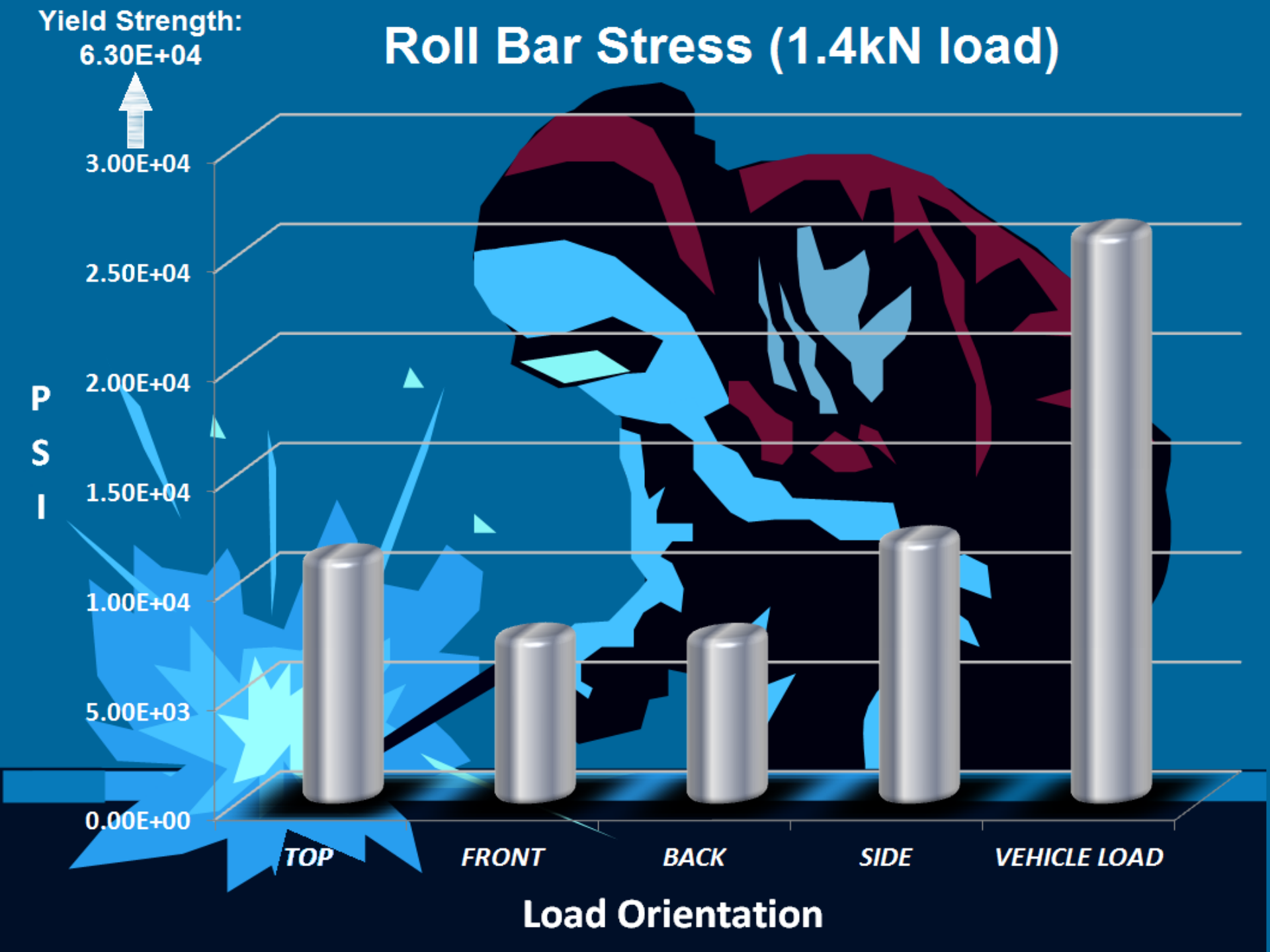
STRESS TESTS

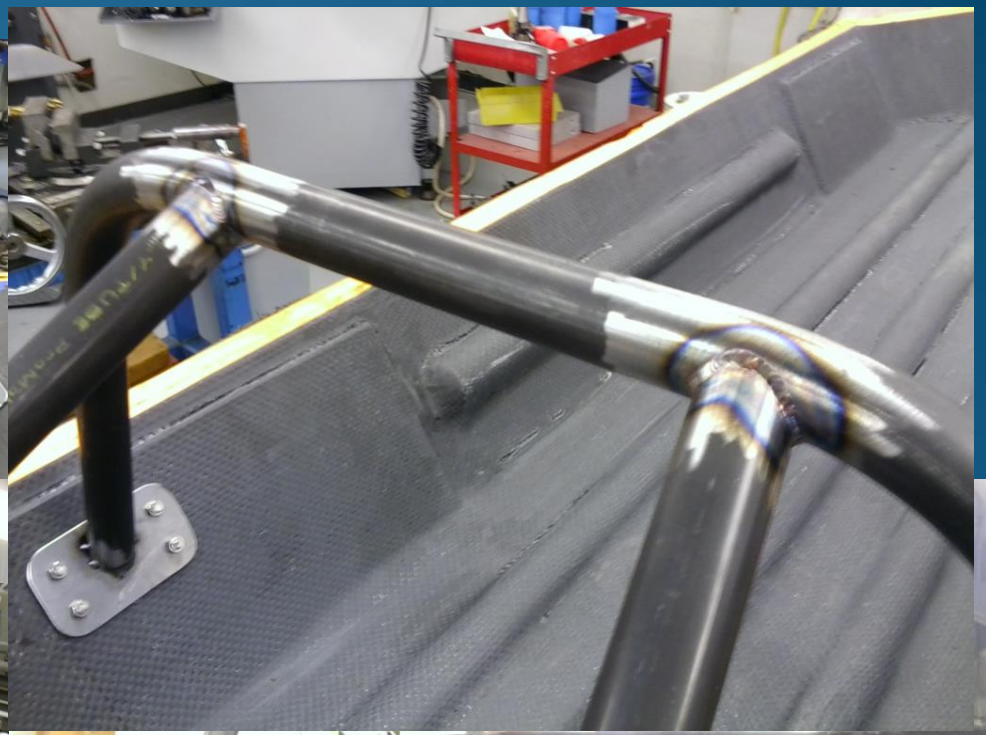
Daniel Green





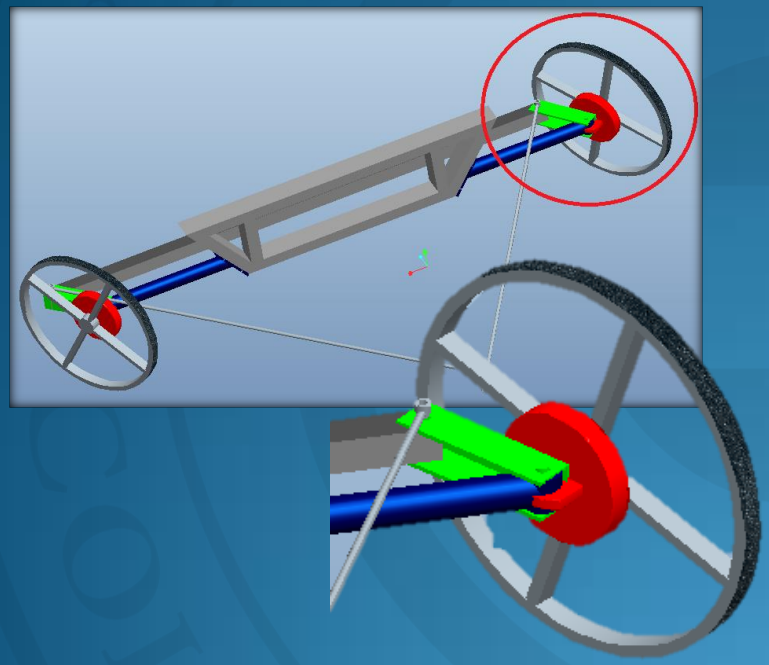


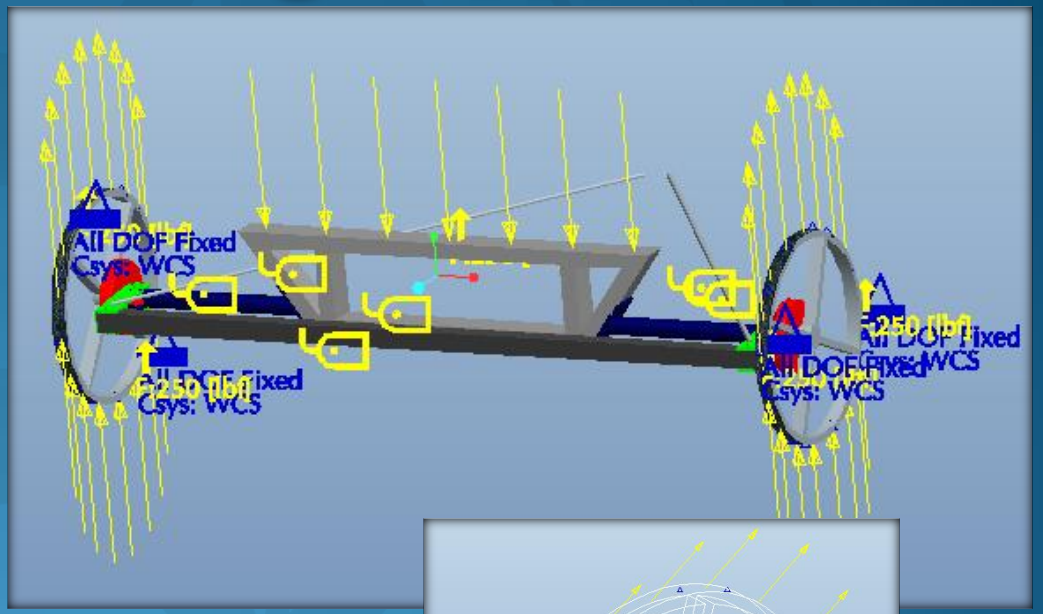

Yield Strength:
6.30E+04
Roll Bar Stress (1.4kN load)
3.00E+04
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
P
S
I
TOP
FRONT
BACK
SIDE
VEHICLE LOAD
Load Orientation

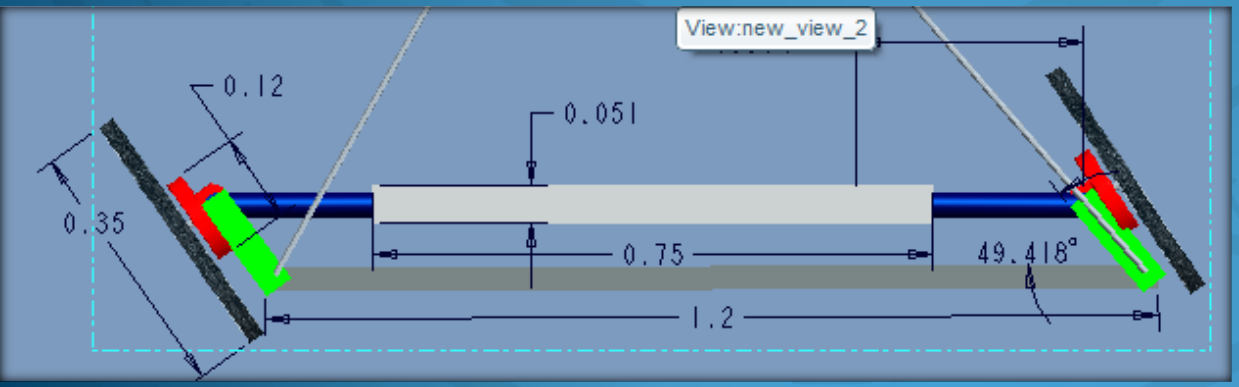


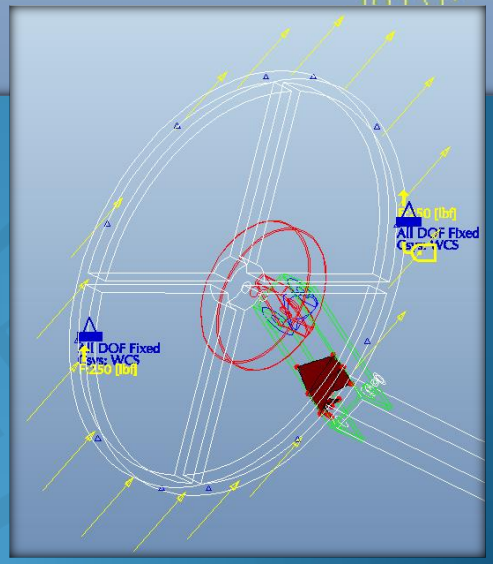
Joseph Petit-Homme, Jr.

Steering



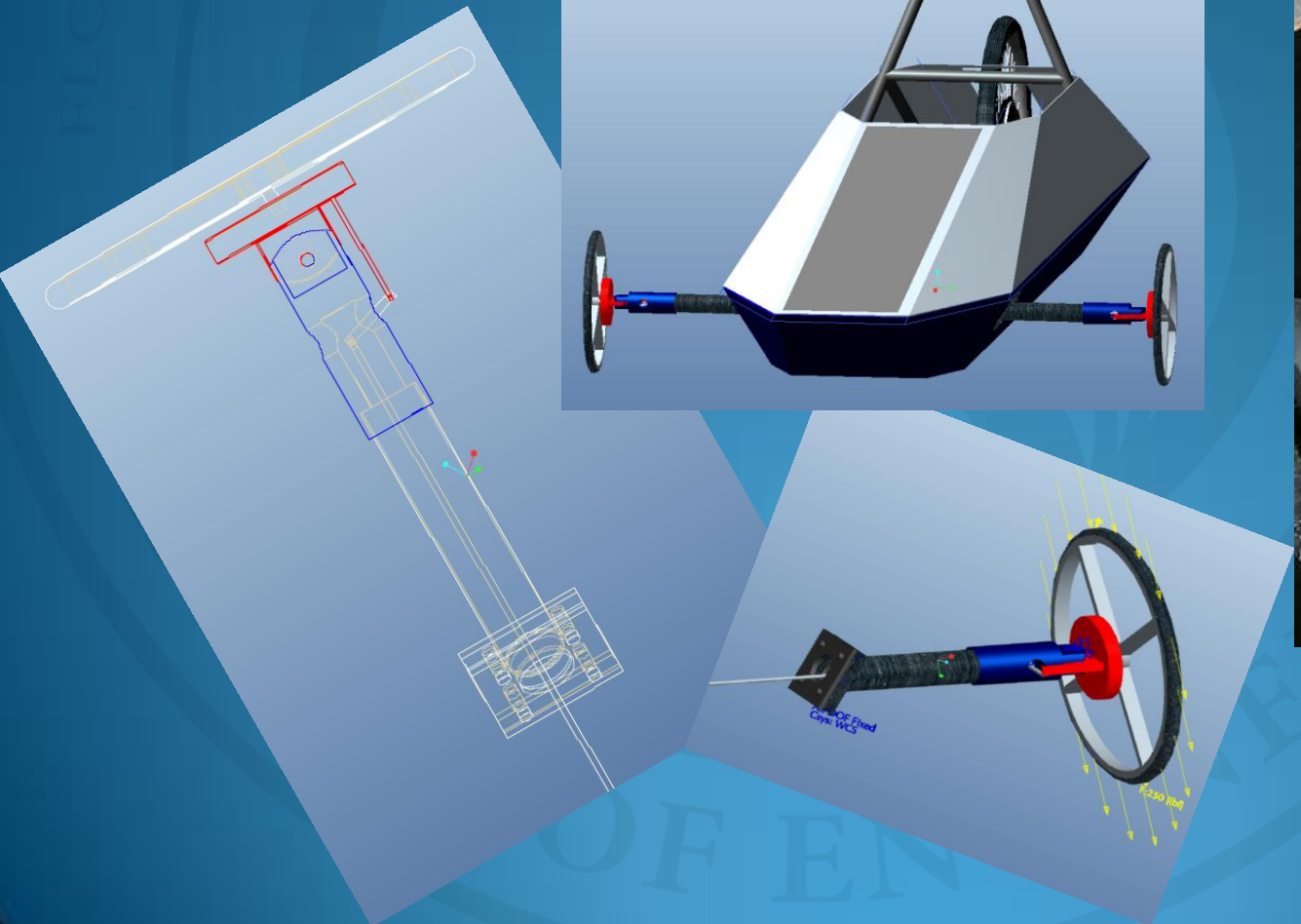






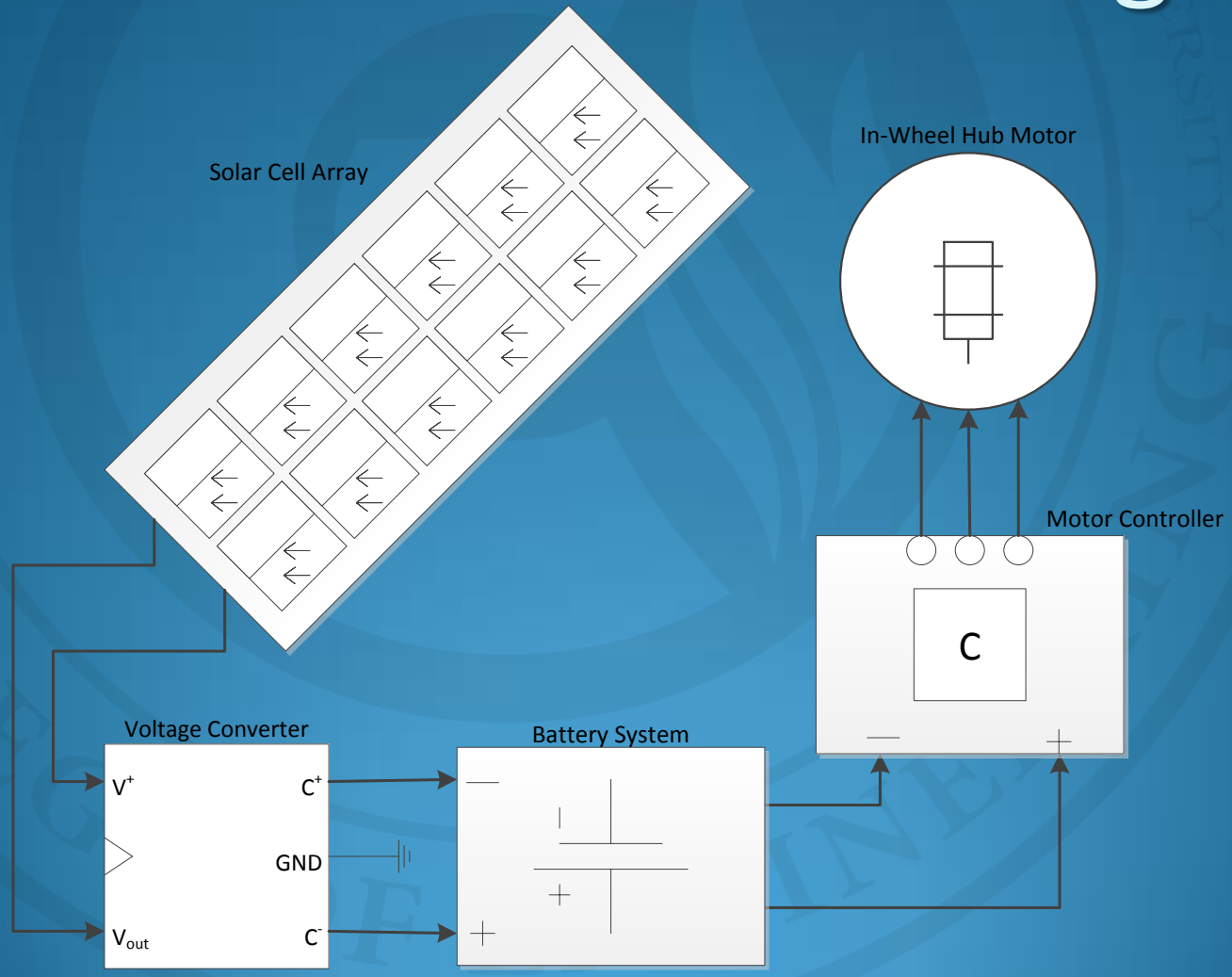
Joseph Petit-Homme, Jr.

New Steering Design



Electrical Sub Design

Electrical Overall Design



Solar Array

Rated Operation

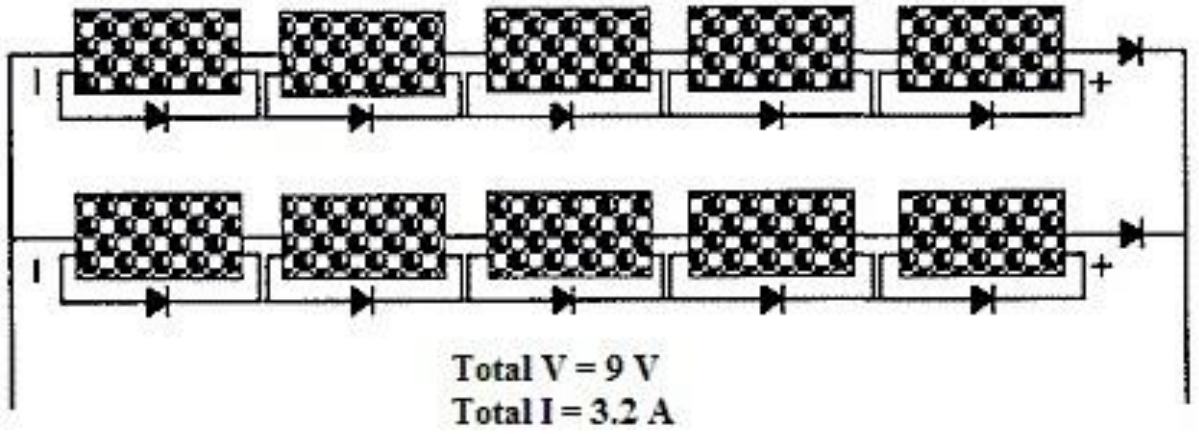
Voltage: 8.2 V

Current: 3 A

Array Size: 0.156 m^2

Allowed Size: 0.17 m^2

Available Size: 0.5 m^2



Ahmad Farhat

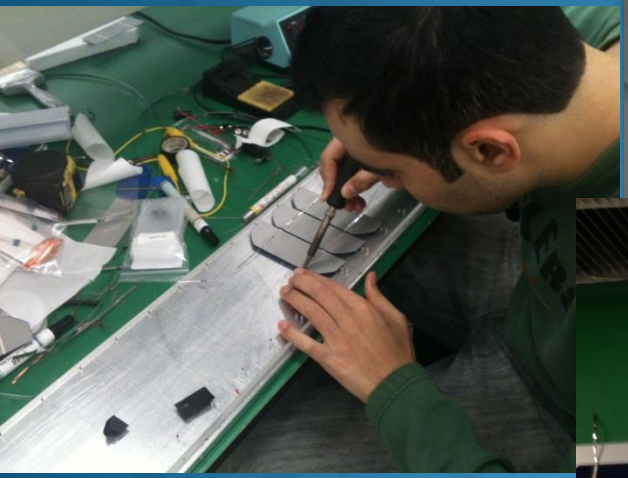
Cell Manufacturing and Encapsulation

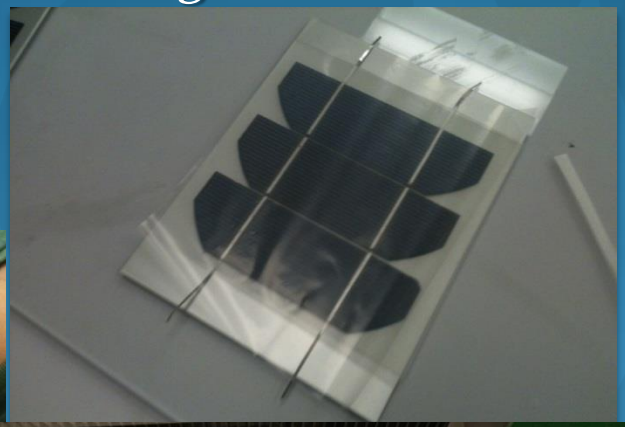
Single Cell Soldering

3 Cells Module Soldered Together

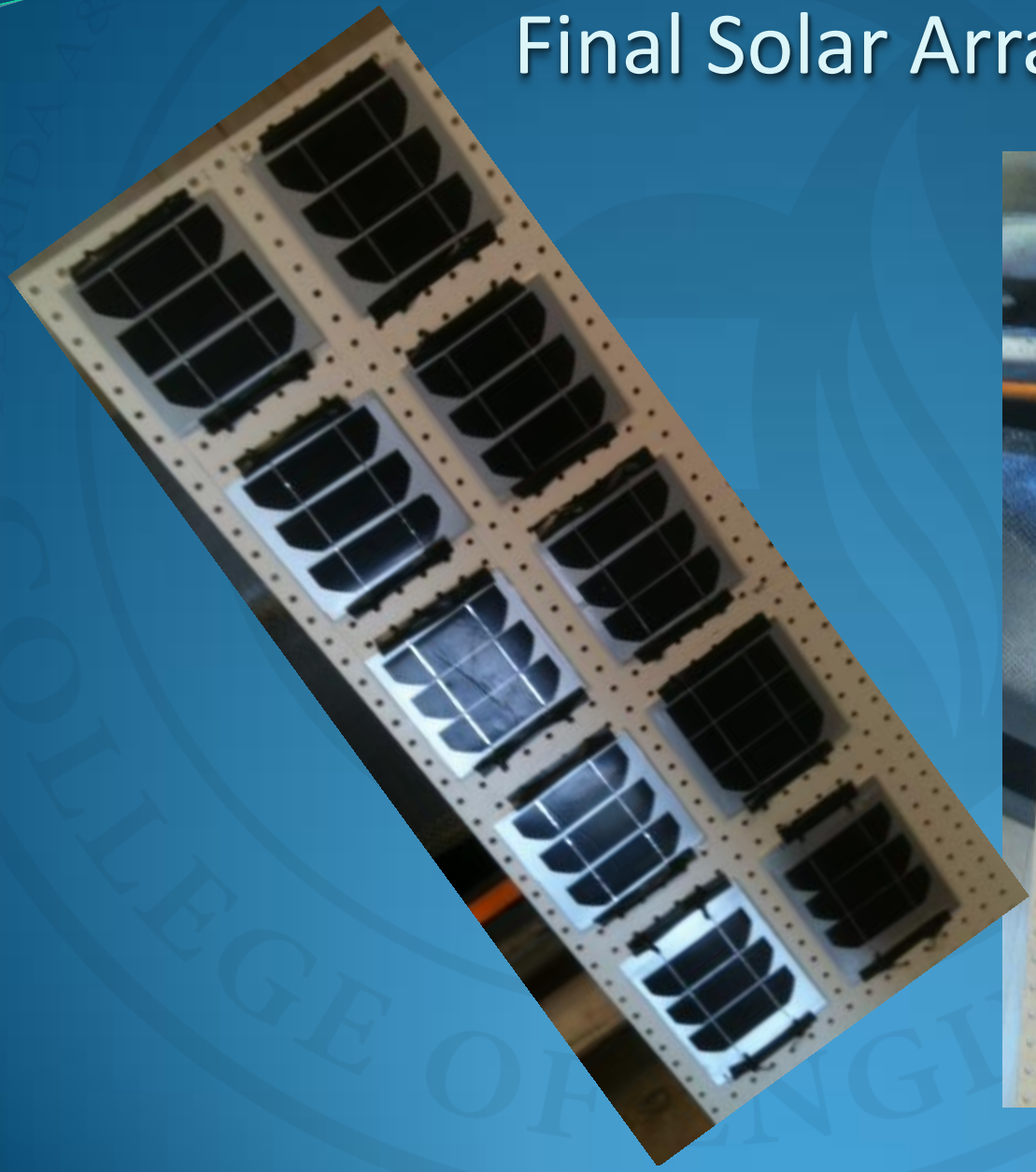
Total number of single Cells 51

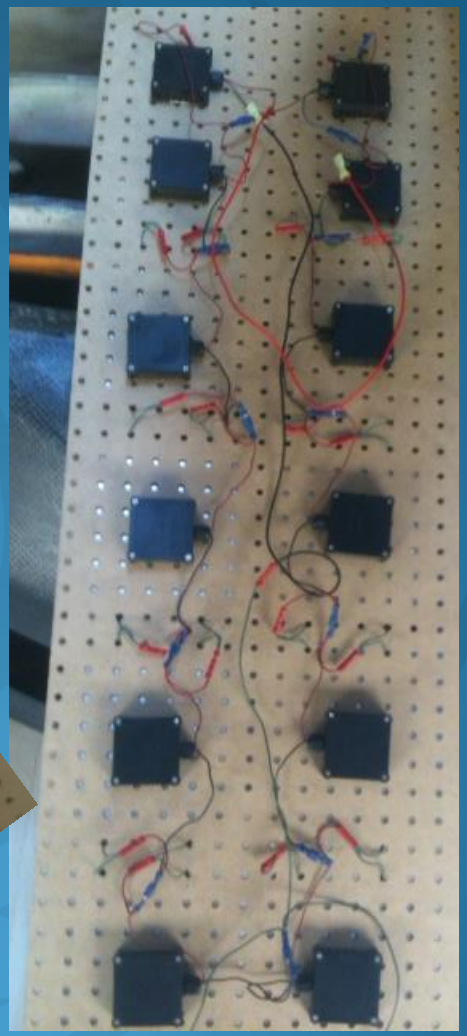
Total number of Modules 17



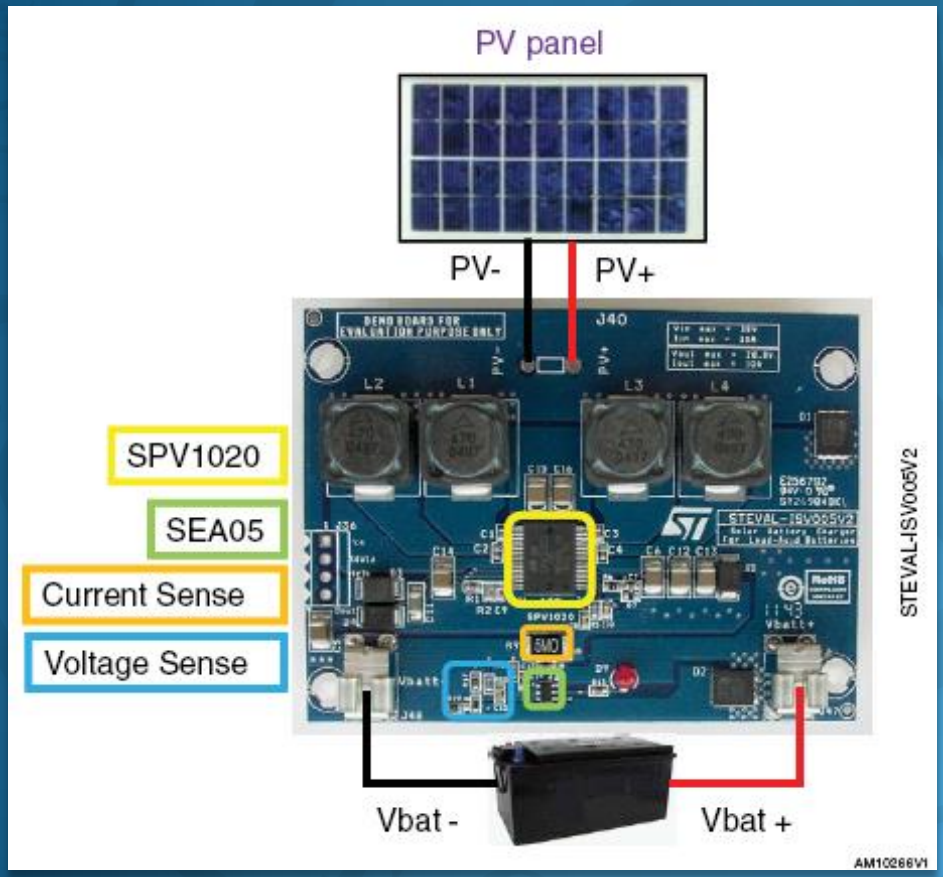


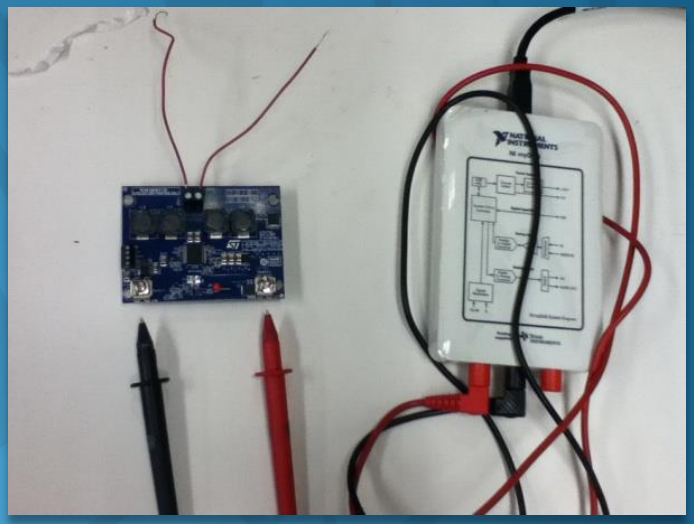
Final Solar Array





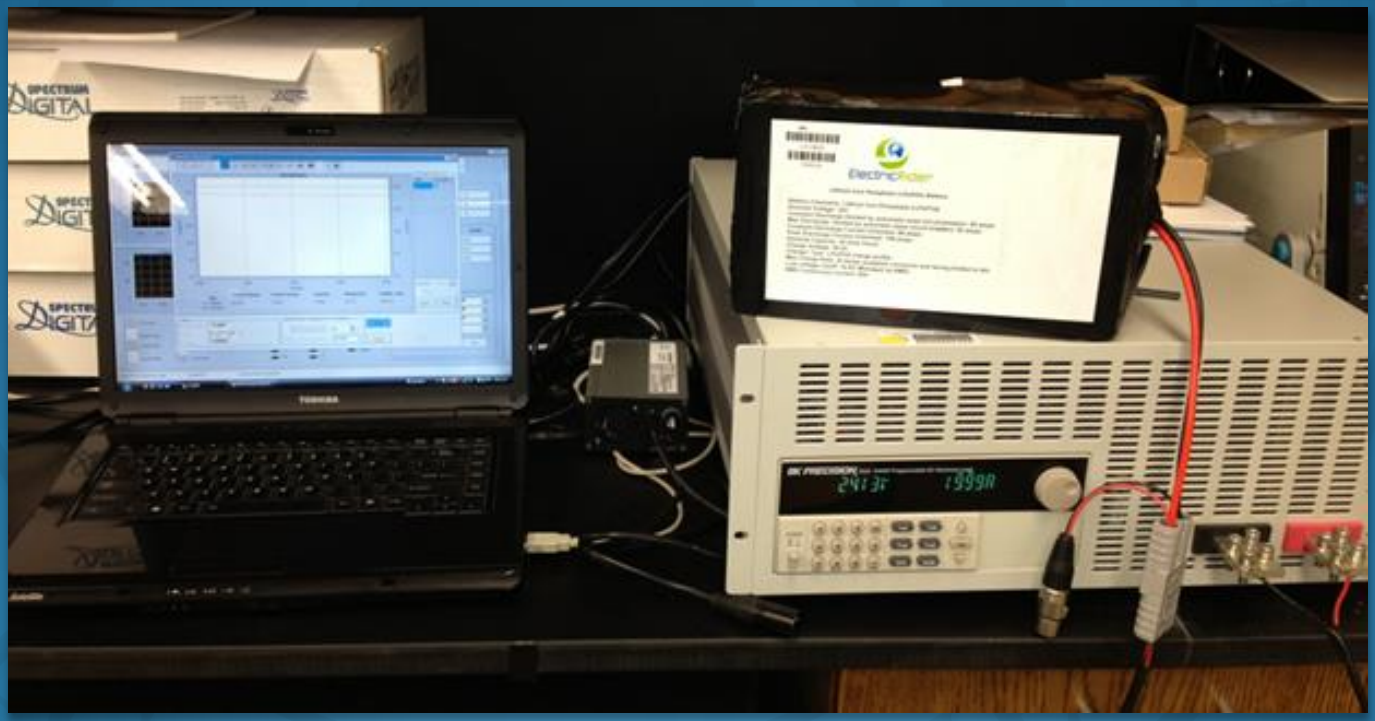
Energy Conversion



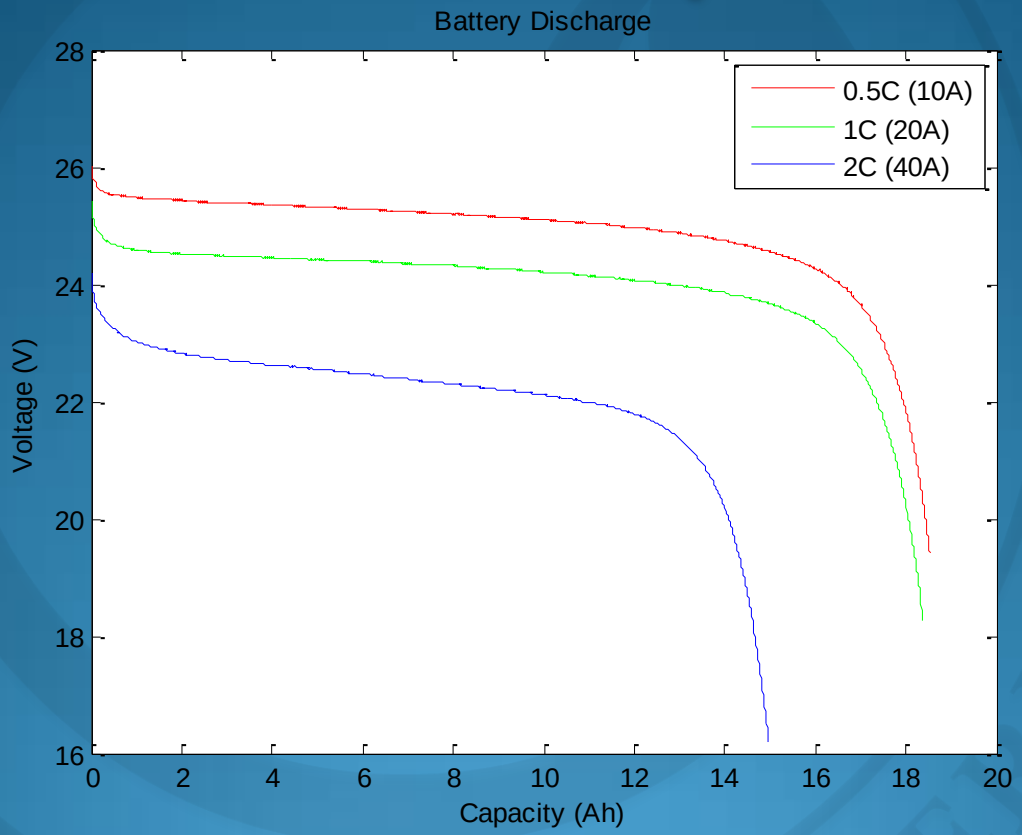


Christopher Dresner

Battery



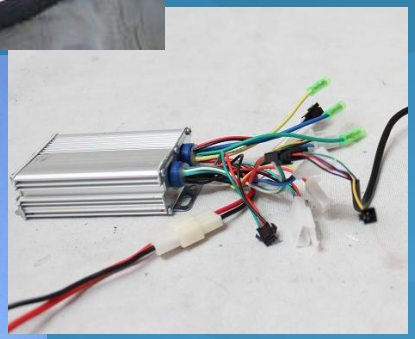
Battery



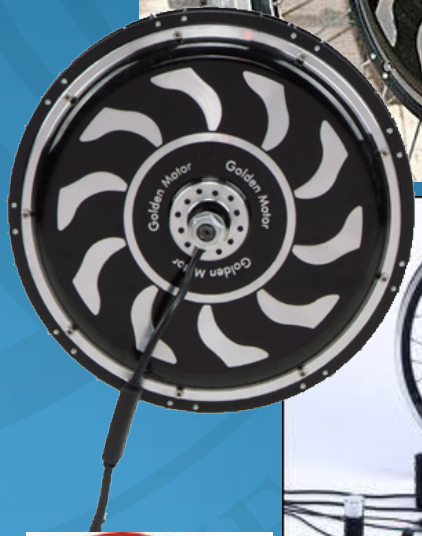
	0.5C (10A)	1C (20A)	2C (40A)
Start Voltage	26.03 V	26.88 V	24.19 V
End Voltage	19.43 V	18.28 V	16.18 V
Capacity	18.5297 Ah	18.3863 Ah	14.9716 Ah
Time	1:51:29	54:32	22:31

Motor

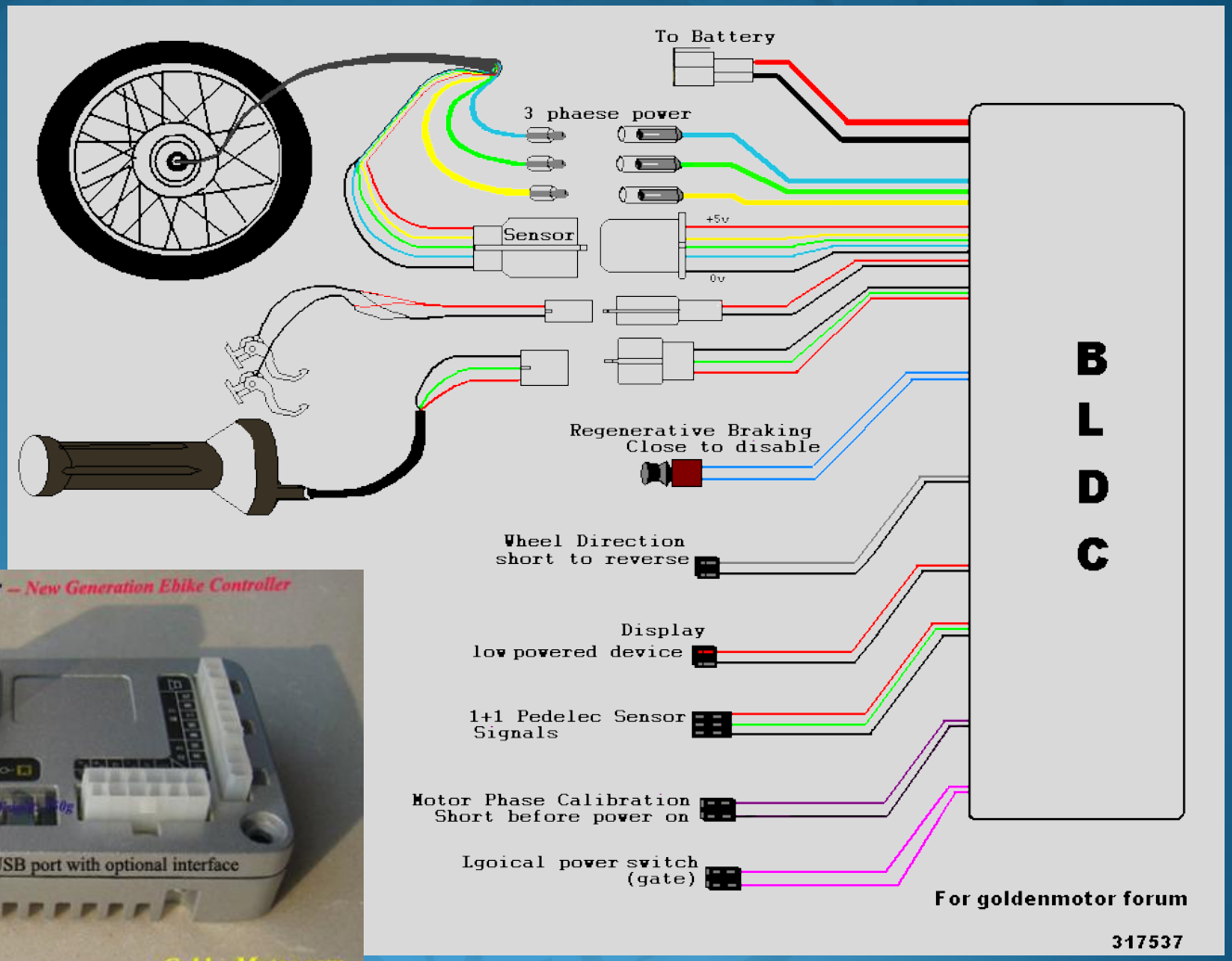
Old Motor: Defective



New Motor



Motor Controller



Matthew Bosworth

Budget

Part	Cost
Chassis Materials and Manufacturing	$1000.00
Steering Materials	$0.00
Roll Bar Materials and Manufacturing	$500.00
Latching/Locking Mechanism	$0.00
Solar Cells*	$0.00
Solar Array Manufacturing*	$0.00
Solar Junction Box (x2)	$65.00
Boost Converter*	$0.00
MPPT Controller*	$0.00
Battery System including BMS	$480.00
Old Hub Motor plus shipping	$265.00
KBS24101,40A,12-24V, Mini Brushless DC Controller	$119.00
Motor Control Box(KBS)	$39.00
Throttle/Brake Pedal (x2)	$138.00
Meter LED 24Volt State of Charge	$19.00
Amperemeter with a free diode	$29.00
Main Contactor CZ 24VDC Coils 100Amps	$29.00
New Hub Motor Kit plus shipping	$495.00
Miscellaneous Production Materials	$400.00
TOTAL	$3578.00

Special Thanks

- HPMI and specifically Jerry Horne and Chip Young for their help on constructing the Solar Car
- Reichhold for their donation of resin
- Jeremy for helping fabricate the roll bar
- Ian Winger for donating and encapsulation of solar panels (SunnyLandSolar)

Questions/Discussion?