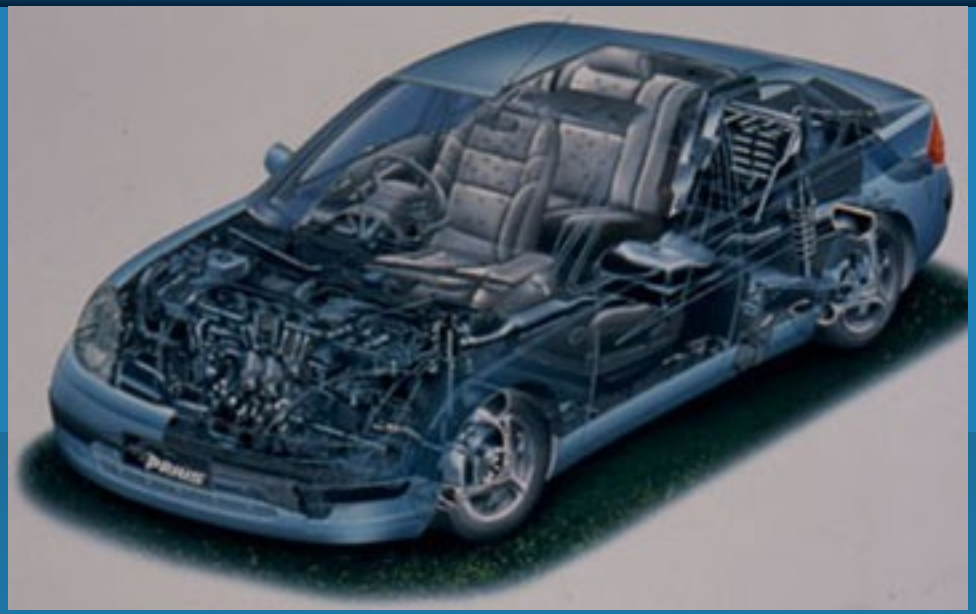
# Hybrid Cars with UltraCapacitor Augmentation



•Toyota Prius

# Introduction

- More efficient hybrid vehicles
- Researched:
  - Ultra-Capacitors


  - Batteries

# Overview

- Problems with regular battery life
- Benefits of Lithium Ion Batteries
- Benefits of Ultra-Capacitors
- Combination of batteries and Ultra-Capacitors

# Circuit Design

- Various circuits developed for model

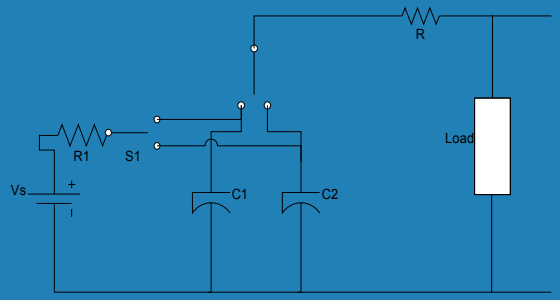



Figure 1

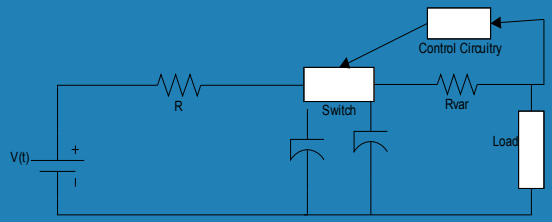



Figure 2

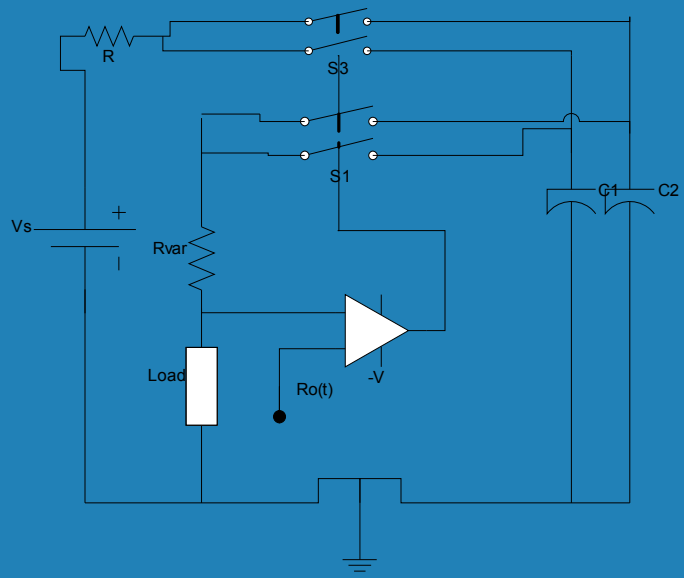



Figure 3

# DC Converters


# Specifications of DC to DC Converter

| DC-100-2 converter specifications | |
|---|---|
| Input voltage range | 0.5 – 1.6 V |
| Working input voltage | 1.2 V |
| Output voltage range | 9 – 24 V |
| Average working output voltage | 12 V |
| Maximum Input Power | 12 W |
| Average efficiency | 90% |
| Acceptable ambient temperature | -30 to +50 ° C |
| Dimensions | 12 x 7 x 3.5 cm or<br>4.7 x 2.8 x 1.4 in |

| DC-100 basic unit specifications | |
|---|---|
| Input voltage range | 0.3 – 0.9 V |
| Working input voltage | 0.5 V |
| Output voltage range | 3 – 18 V |
| Average working output voltage | 6 V |
| Maximum Input Power | 5 W |
| Average efficiency | 85% |
| Acceptable ambient temperature | -30 to +50 ° C |
| Dimensions | 12 x 7 x 3.5 cm or<br>4.7 x 2.8 x 1.4 in |

# Specifications of Relays

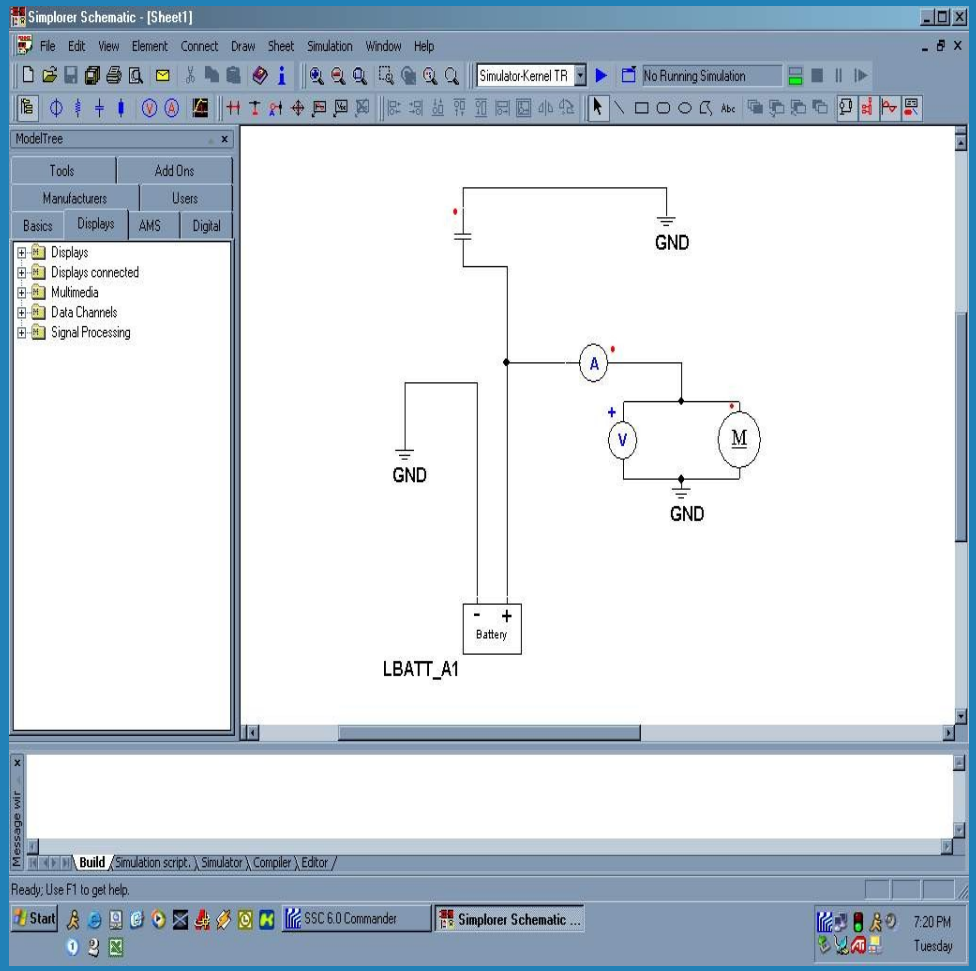
**Physical specifications**

- Size: 1.75” x 2.50” x 1.25”
- Weight: 4 oz.

- Supply voltage: 4.1 – 5.5 Vdc.
- Supply current: 20ma stand-by, 220ma when relay energized.
- Load rating: relay is rated for non-welding contact up to 24 amps at 30 volts DC.
- Switching time: 8.0 milliseconds typical.

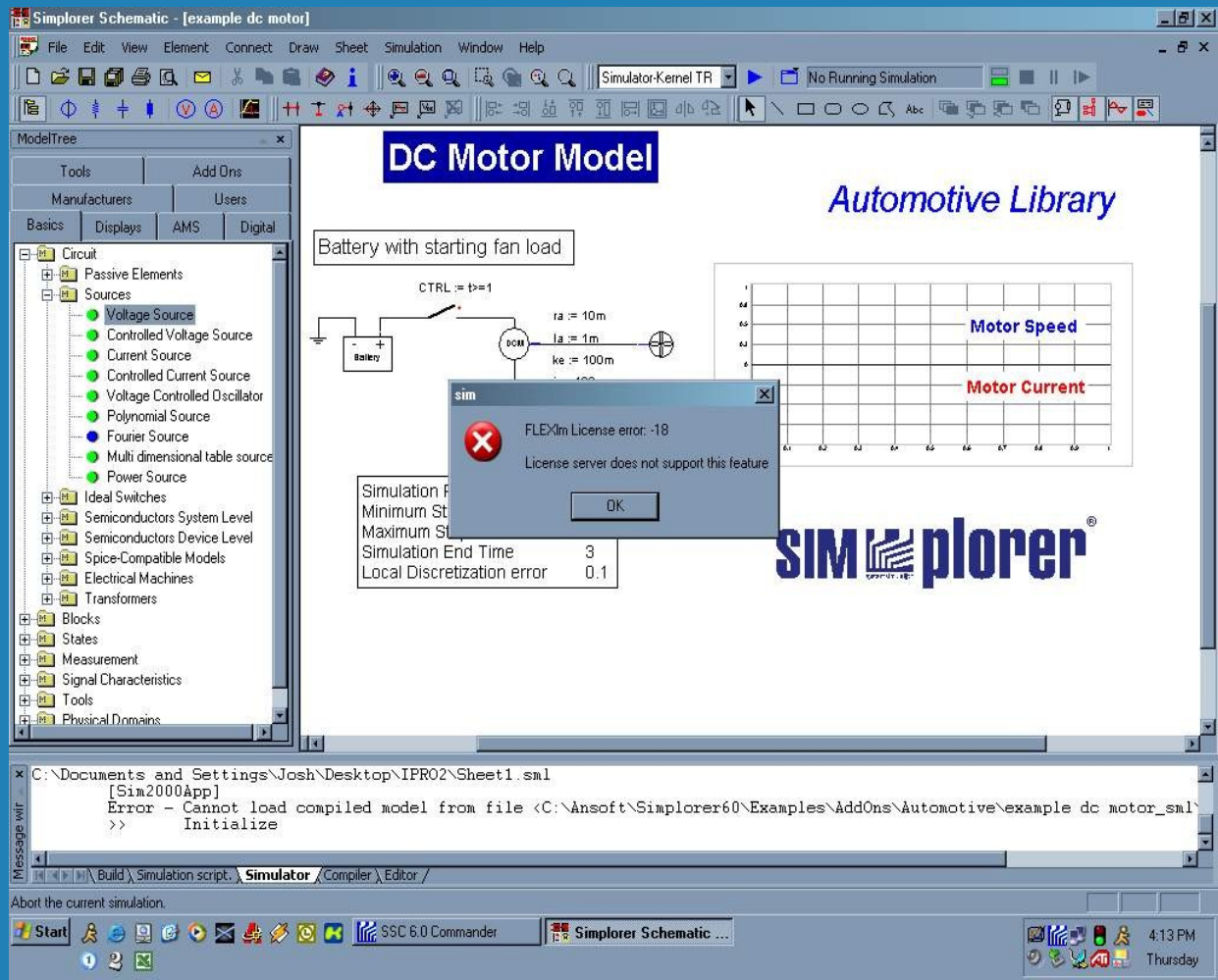
# Simplorer

- Simplorer Goals
- Brief overview of the circuit simulations



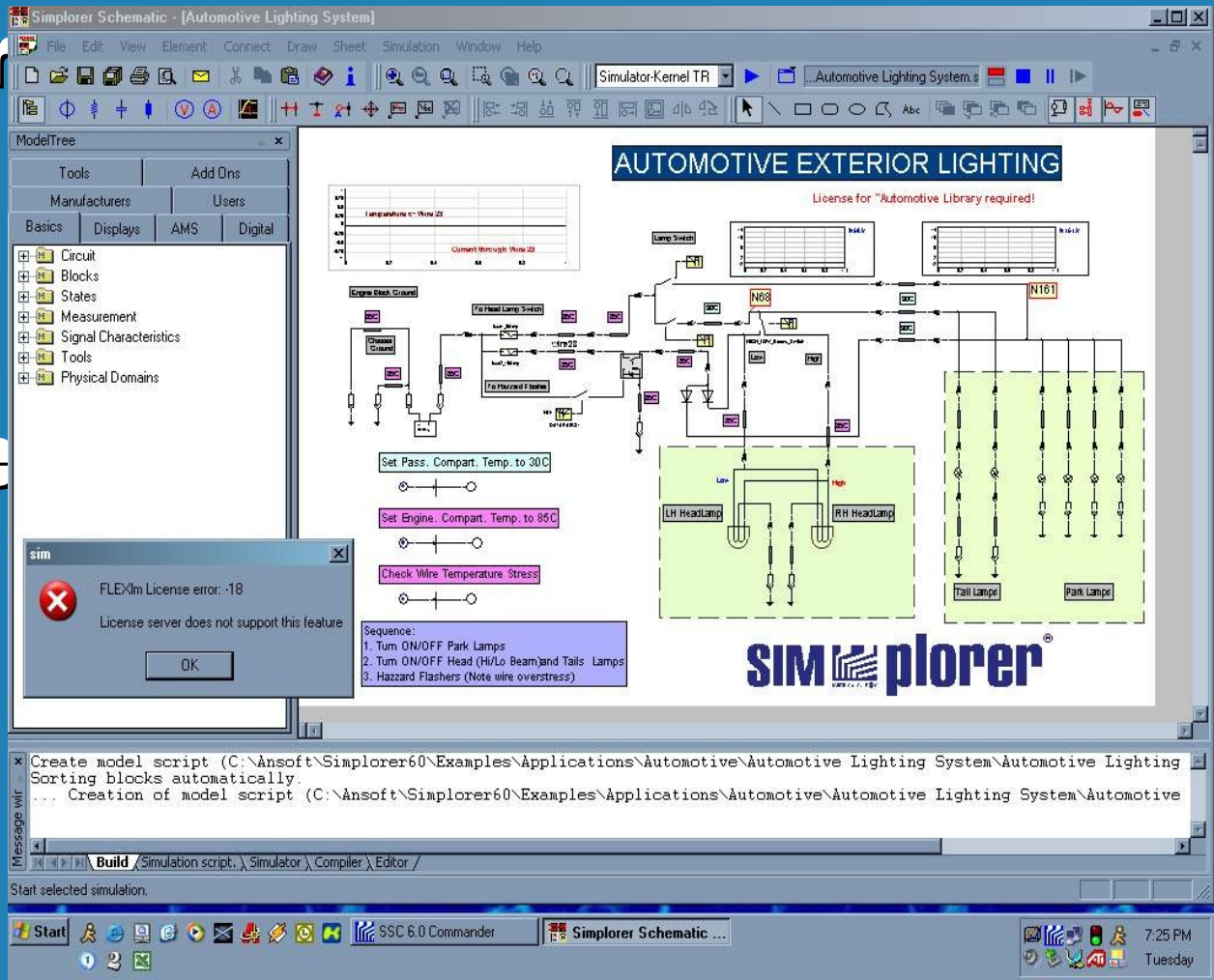
# Simplorer

- Simplorer Problems

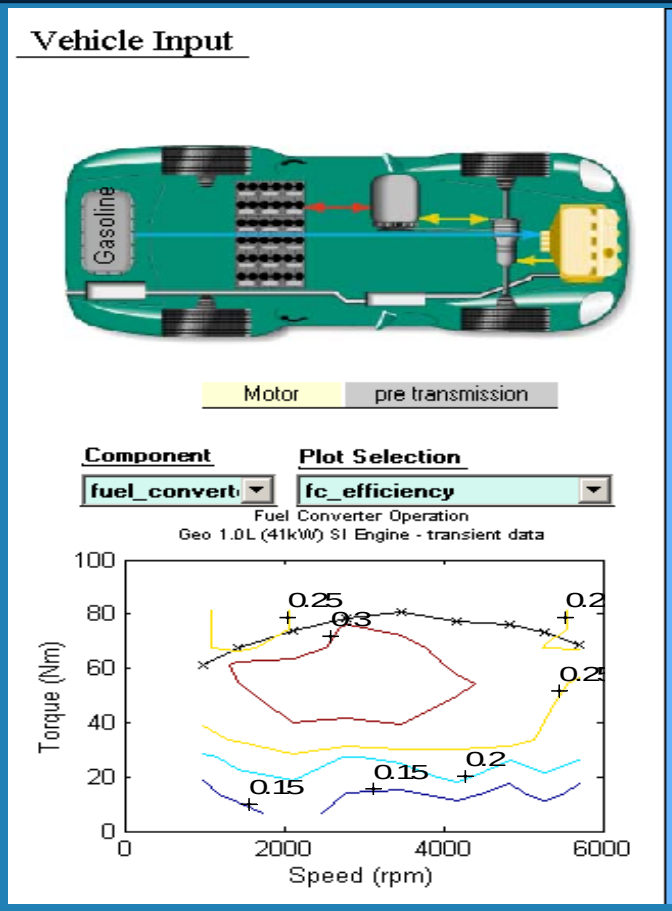


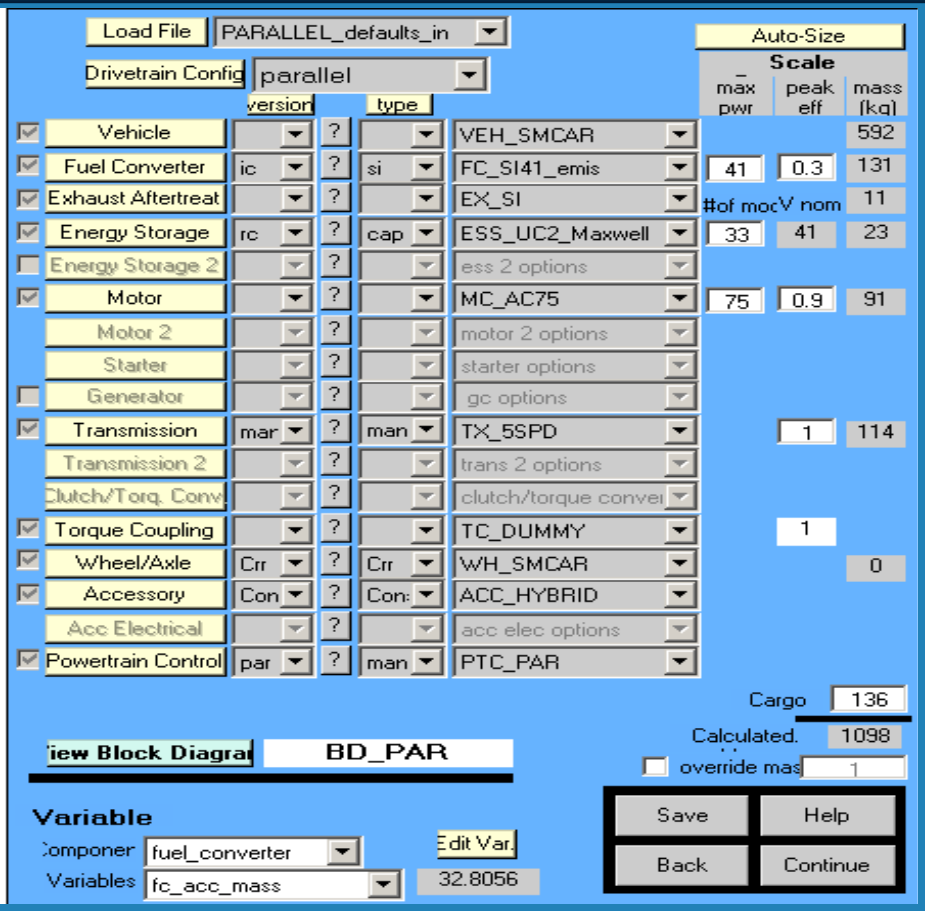
# Simplorer

- Simplorer Benefits
- The future Simplorer



# Advisor

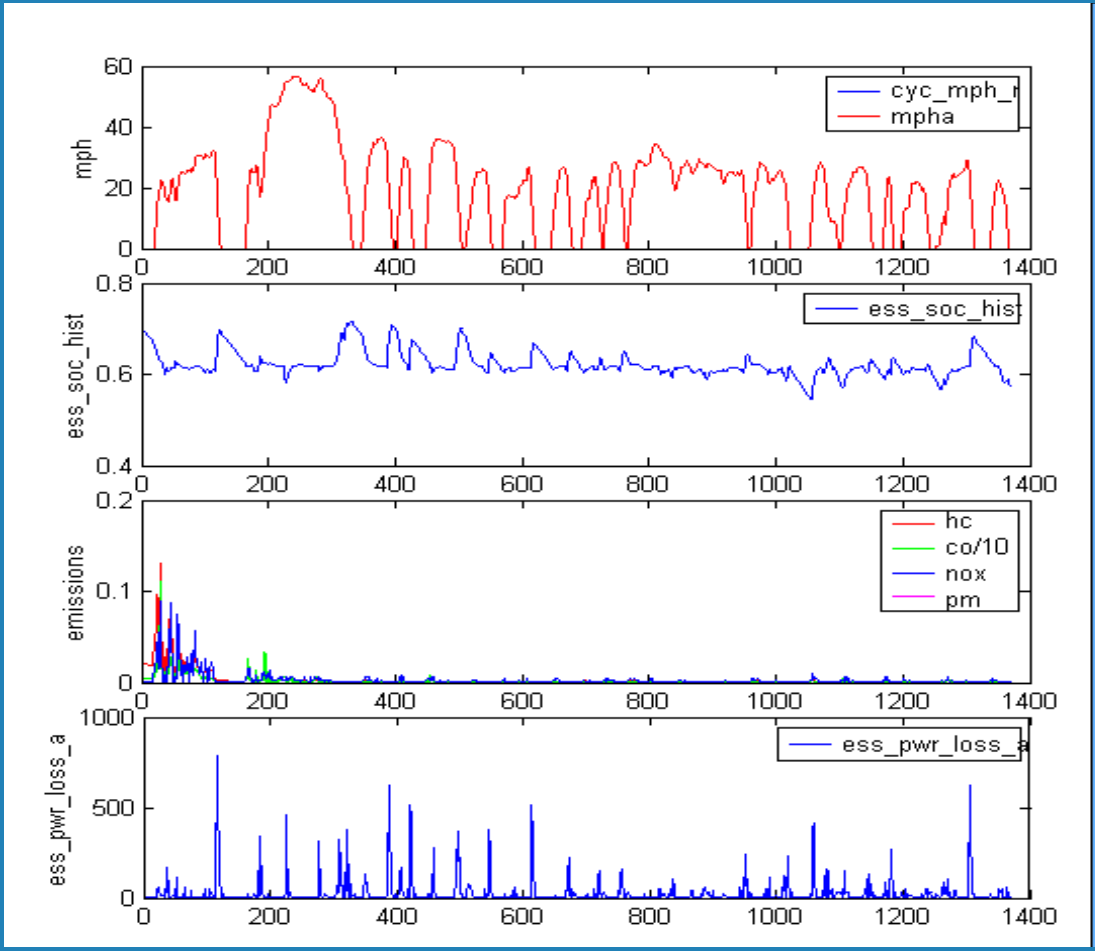

Vehicle Input
Gasoline
Motor
pre transmission
Component
Plot Selection
fuel_convert
fc_efficiency
Fuel Converter Operation
Geo 1.0L (41kW) SI Engine - transient data
Torque (Nm)
Speed (rpm)
0
20
40
60
80
100
0
2000
4000
6000
0.25
0.3
0.2
0.25
0.2
0.15
0.15

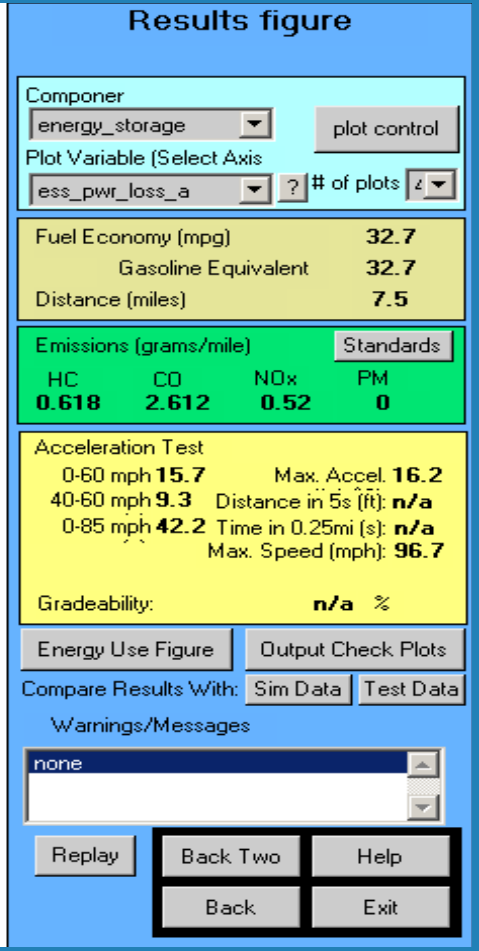

Load File
PARALLEL_defaults_in
Auto-Size
Drivetrain Config
parallel
Scale
version
type
max pwr
peak eff
mass (kg)
Vehicle
VEH_SMCAR
592
Fuel Converter
ic
si
FC_SI41_emis
41
0.3
131
Exhaust Aftertreat
EX_SI
#of mod
V nom
11
Energy Storage
rc
cap
ESS_UC2_Maxwell
33
41
23
Energy Storage 2
ess 2 options
Motor
MC_AC75
75
0.9
91
Motor 2
motor 2 options
Starter
starter options
Generator
gc options
Transmission
man
TX_5SPD
1
114
Transmission 2
trans 2 options
Clutch/Torq. Conv
clutch/torque conver
Torque Coupling
TC_DUMMY
1
Wheel/Axle
Crr
WH_SMCAR
0
Accessory
ACC_HYBRID
Acc Electrical
acc elec options
Powertrain Control
par
PTC_PAR
Cargo
136
Calculated.
1098
override mas
BD_PAR
Variable
Edit Var.
fuel_converter
fc_acc_mass
32.8056
Save
Help
Back
Continue

# Advisor Overview

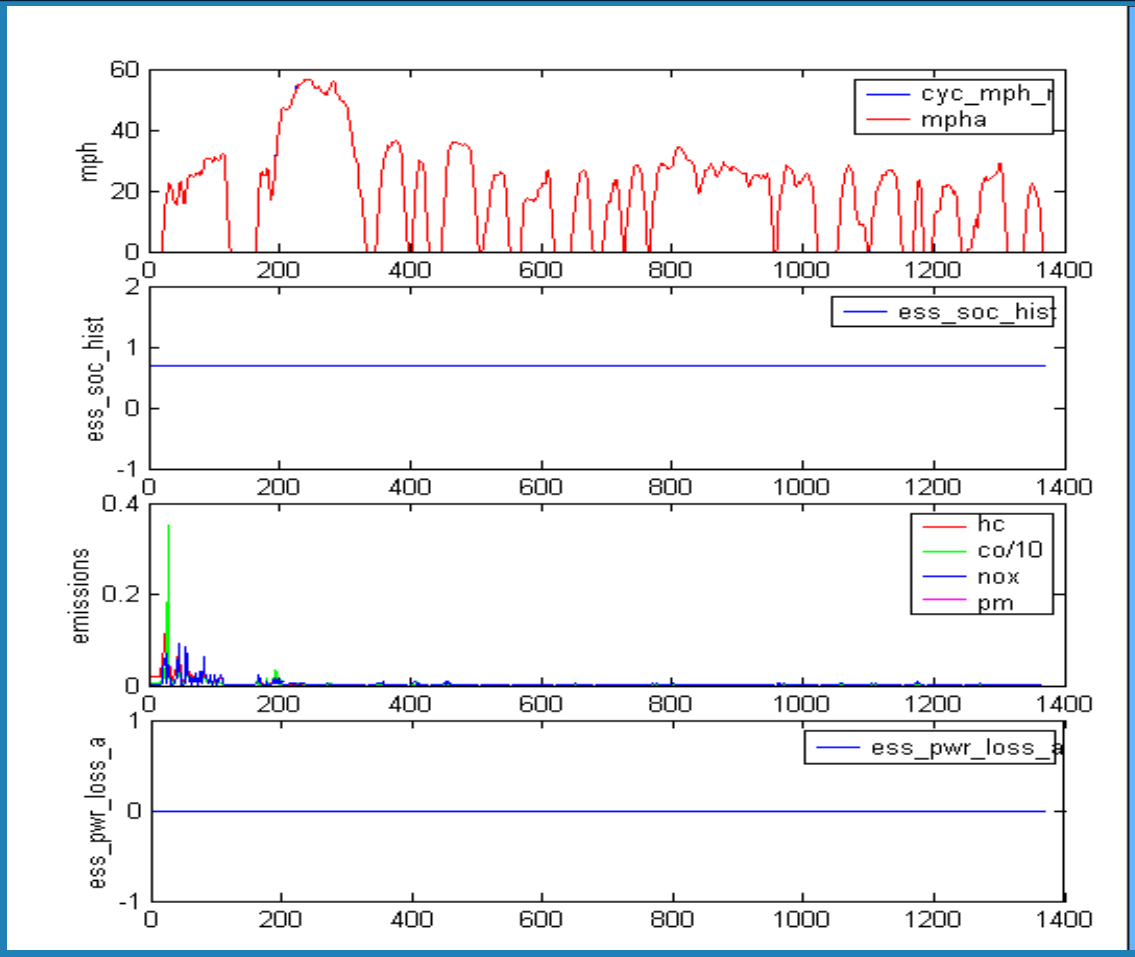
- Powered by Matlab and Simulink, Designed for simulation of:
  - Fuel economy-
    - Conventional cars
    - Electrical cars
    - Hybrid cars
  - Drivetrain components
  - Vehicle data and algorithms

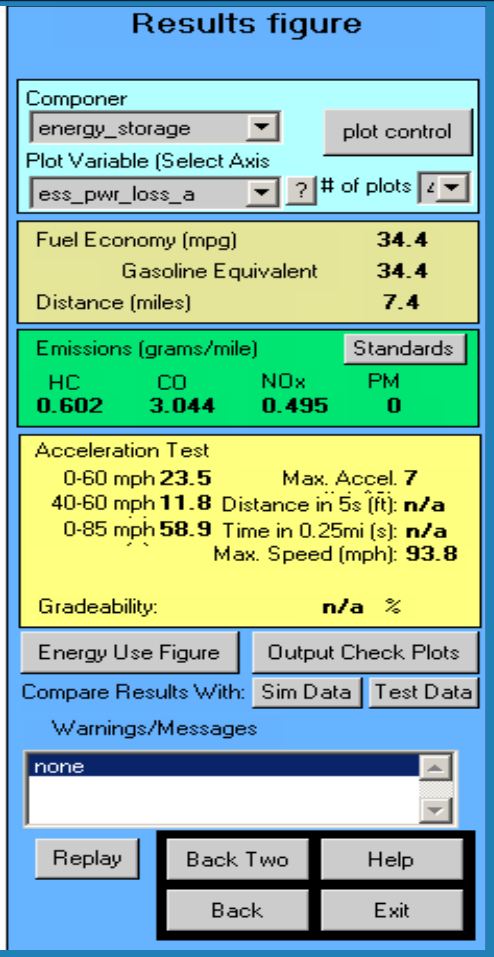
# Ultracapacitor Simulation



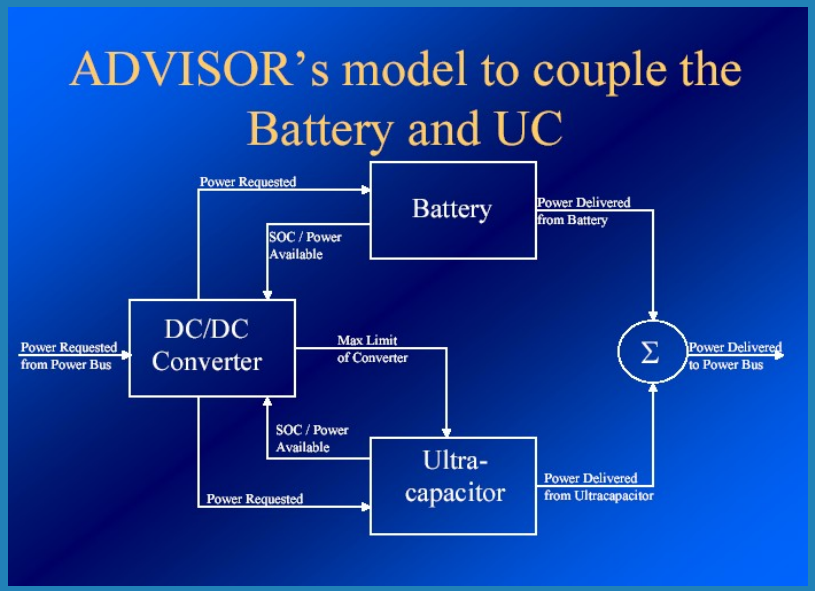



# Lead Acid Battery Simulation



# Advisor Model



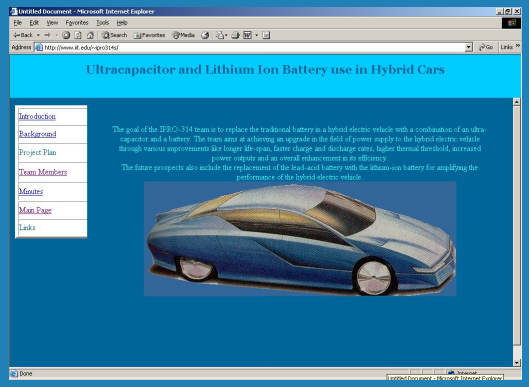

## Problems

Unable to implement correct model

- Correct model which connects the lead acid battery to the ultra-capacitor

# Webpage

- Updated weekly with current progress and information




- Visit us at http://www.iit.edu/~ipro314s/

# Acknowledgements


- Ellen Allston - Manager, University Program Ansoft Corporation
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- http://www.ctts.nrel.gov/analysis/advisor_doc/advisor_ch1.htm
- http://www.ansoft.com/products/em/simplorer/
- http://www.maxwell.com
- http://www.teamdelta.com/pdf/rce210r2.pdf

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- Benito Lugo
- Luke Radwanski
- Jeffery Stano
- Karen Stone
- Rafael Tudor
- Ima Ufot

# Summary and Q/A

- Any questions?