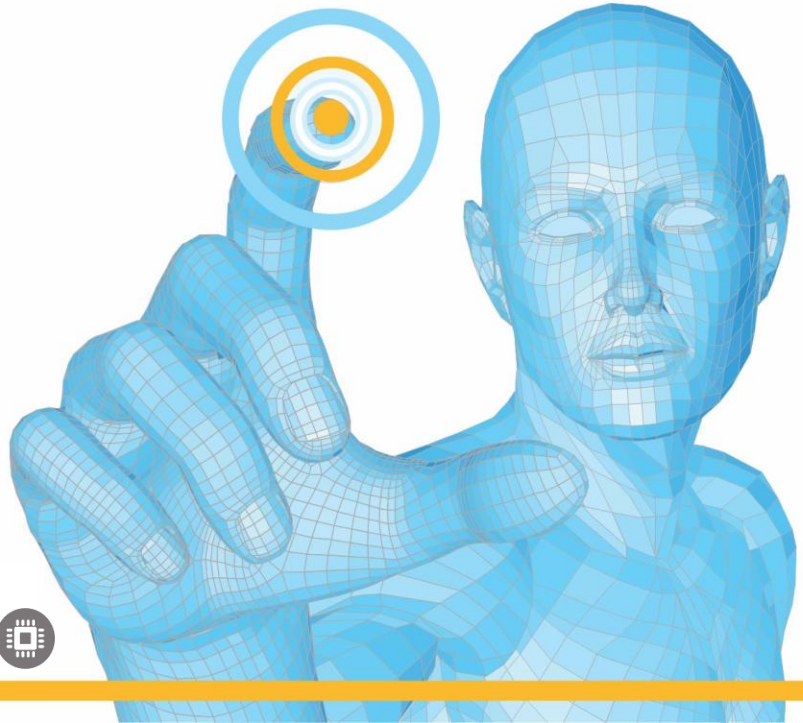
DEP

Smarter Solutions. Realized.

KEY ELEMENTS OF ELECTRIC VEHICLE DESIGN & DEVELOPMENT:



Powered by

DEP MeshWorks

Key Elements of the design and development of Electric vehicles :

- Design
- Systems Model and Engineering
- Structural Engineering and Dynamics
- Battery, Electrical and Electronics
- Competitive Benchmarking

DESIGN :

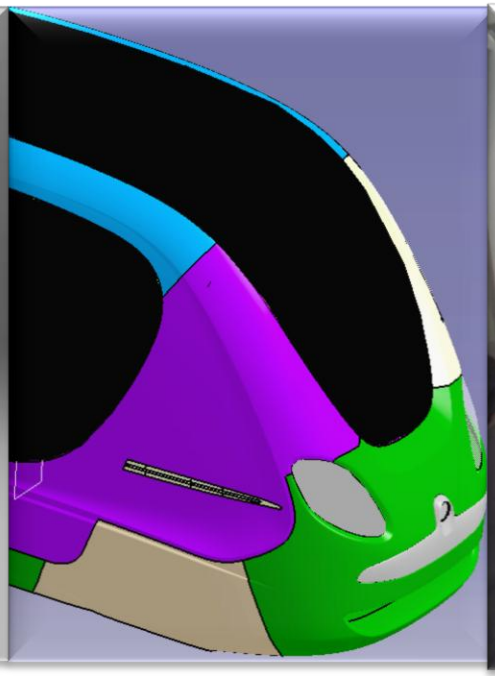
Overall Product design process:

Advanced Research	Advanced Development	Product Development	Production

Concept Initiation	Product Planning	Styling Development	Product/Process Development	Process Validation	Continuous Improvement

Concept Styling to Full vehicle build

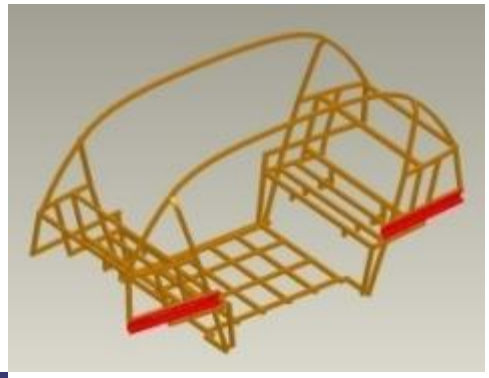
Concept Rendering

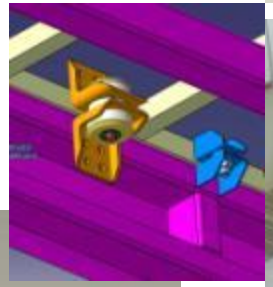


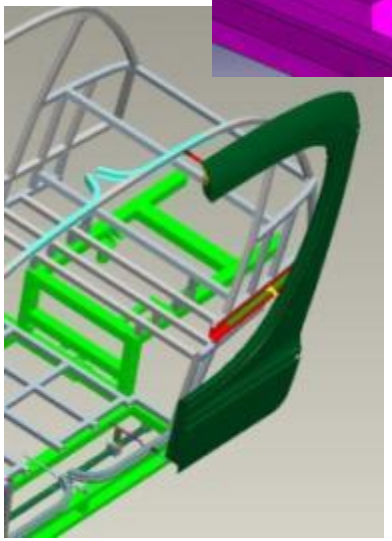
CAE & CAD Model

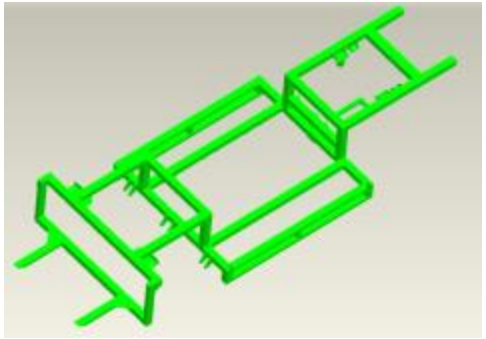
Body Shell build

Final vehicle









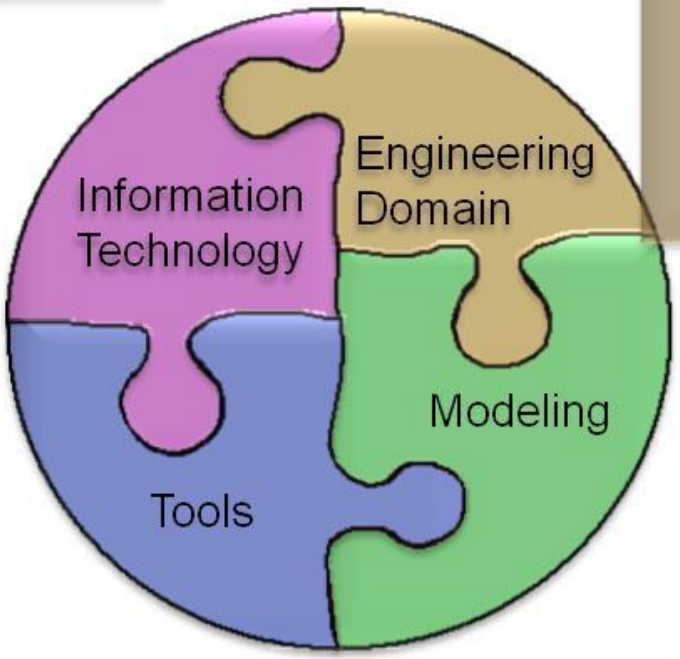

Outer Top Rail
Outer Door Panel
Existing Inner Top Rail Panel
Proposed Inner Top Rail Panel
Inner Door Panel
Door Glass
Section At Top Rail Door Side

SYSTEMS MODEL AND ENGINEERING:

Systems Model and Engineering

Software Engineering
Software Development
Information Management

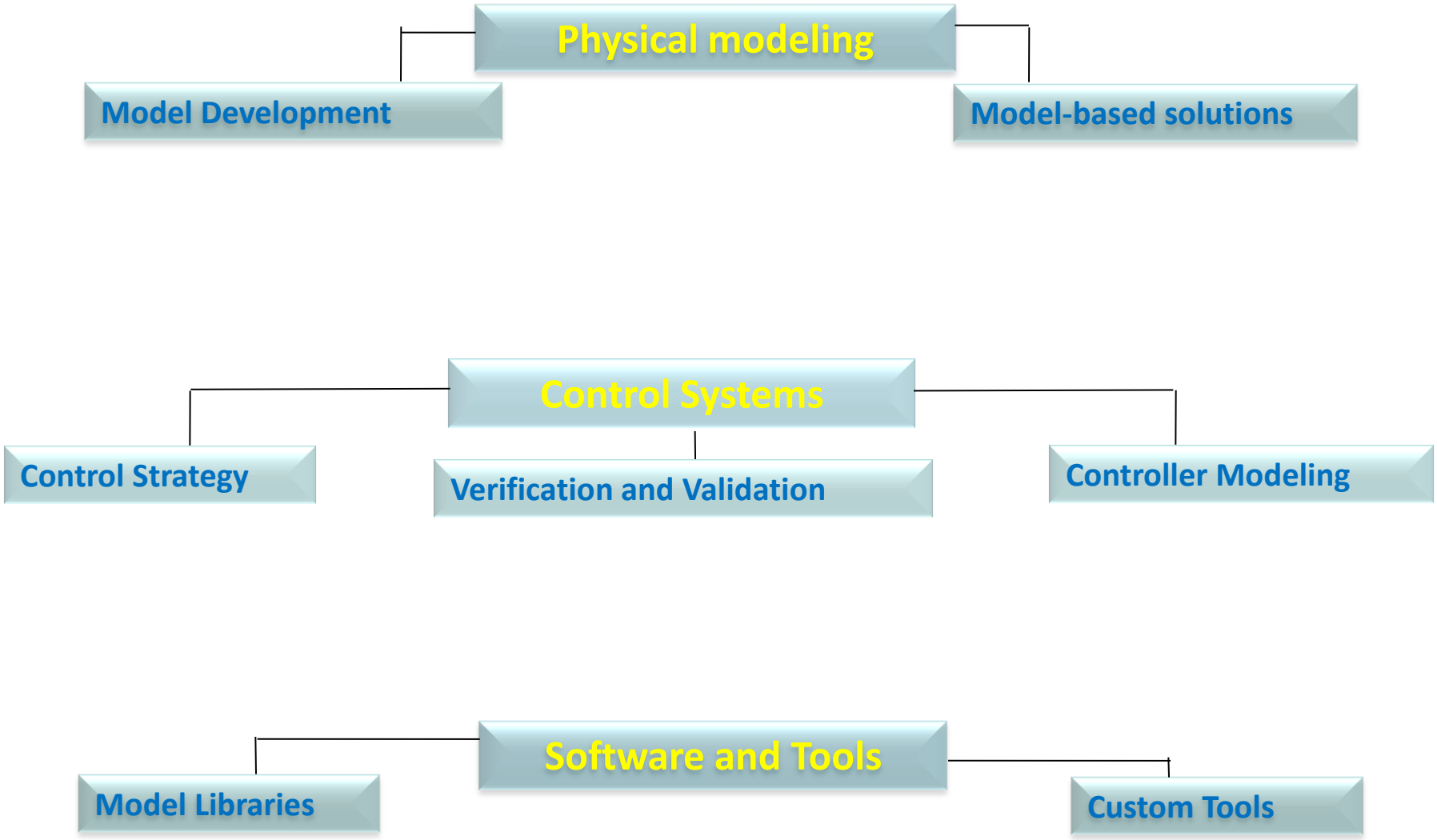
Vehicle & Subsystems
Engine
Transmission
Motor
HEV
Fuel Cell
Battery
Wind Energy
Sensors
Actuators



Ansoft
dSPACE
Dynasim
Engineous
ETAS
Maplesoft
MathWorks
National Instruments
Opal-RT
Reactive Systems

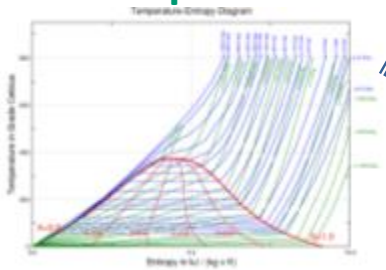
Hydraulics, Thermal, Kinematics, Dynamics
Electrical, Chemical, Computer Science
Control System Models
Embedded SW, Fixed Point, Floating Point

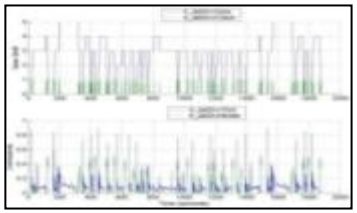
Systems Model and Engineering

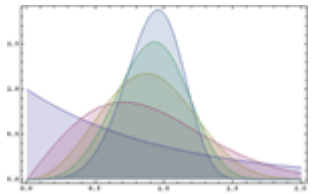


System Modelling – Electric Vehicle Climate Control System

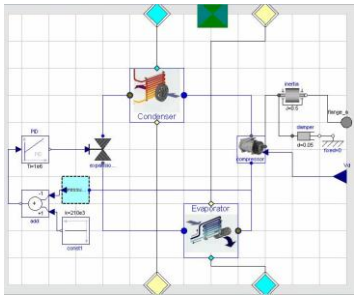
Inputs







Plant Model

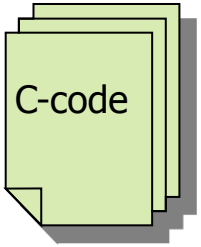


HVAC

Vehicle

Controls Implementations

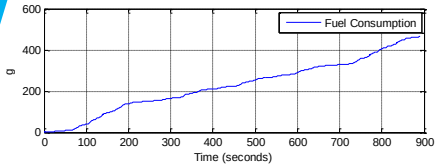
MIL

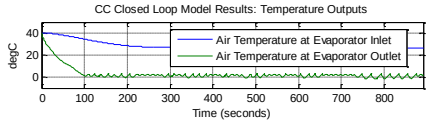


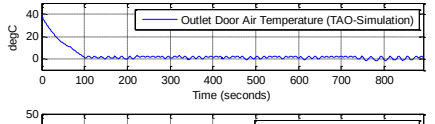
SIL

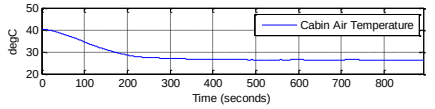
HIL

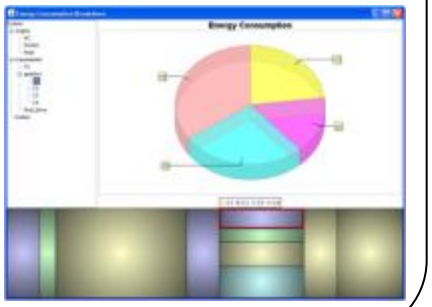
System Performance



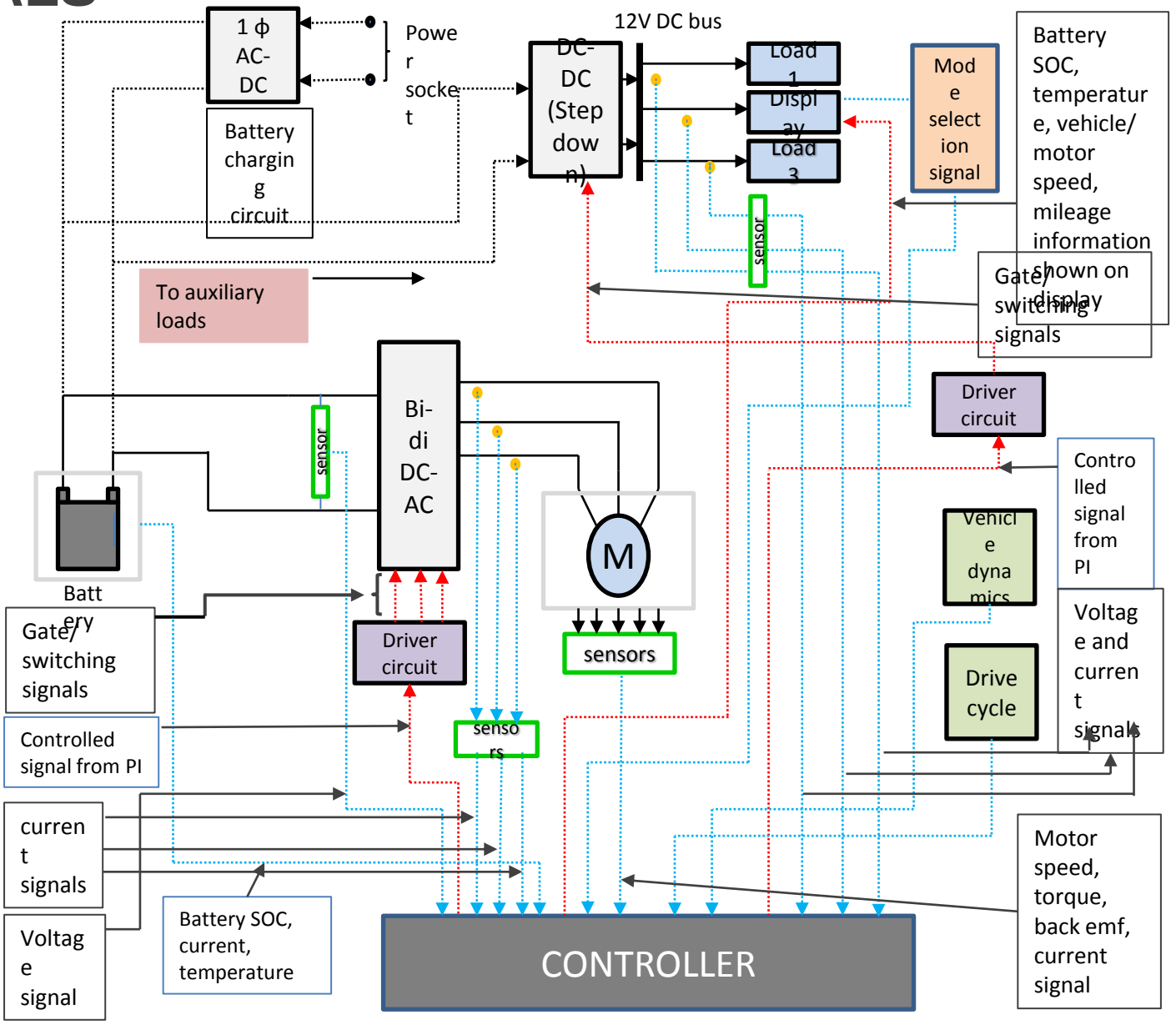






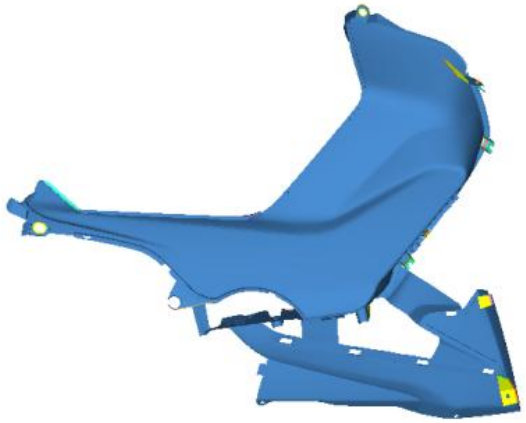


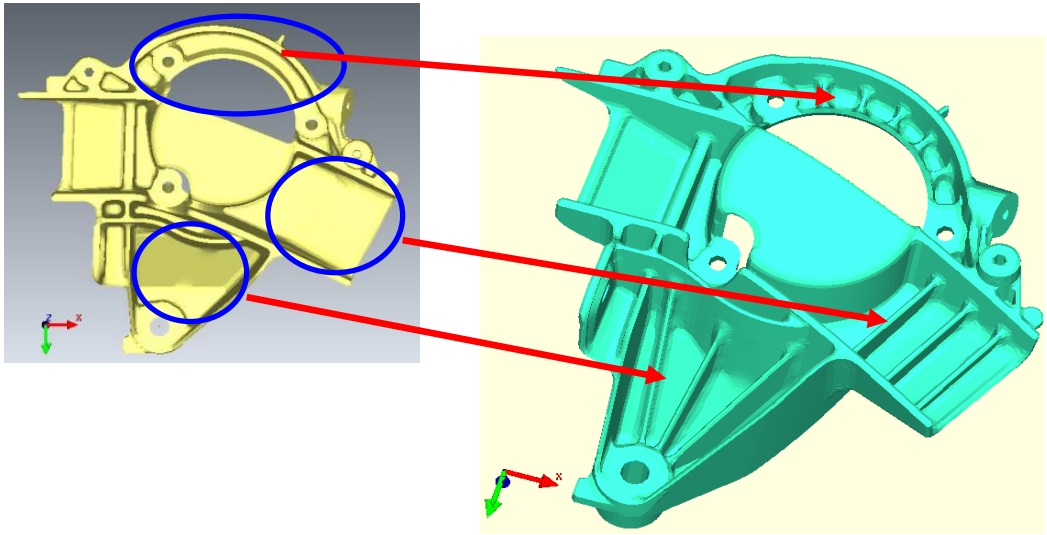
PLANT BLOCK DIAGRAM WITH CONTROL SIGNALS

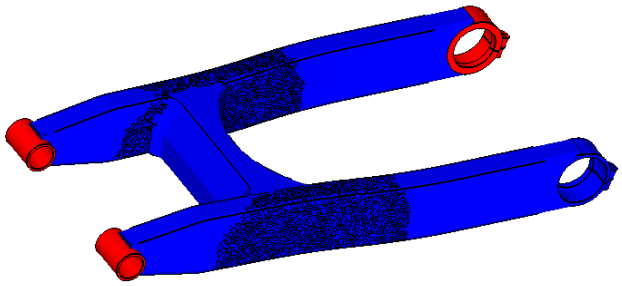


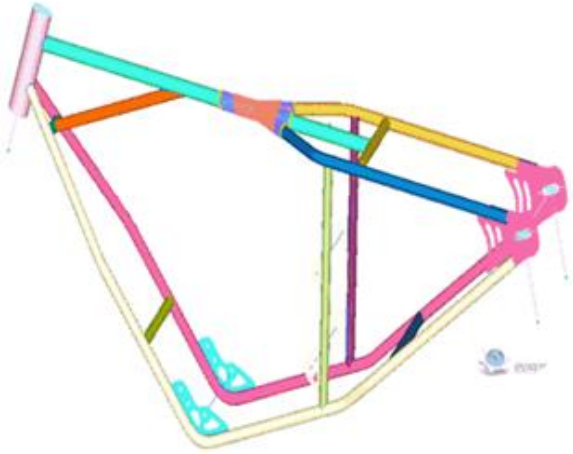
STRUCTURAL ENGINEERING AND DYNAMICS:

Structural Engineering and Dynamics

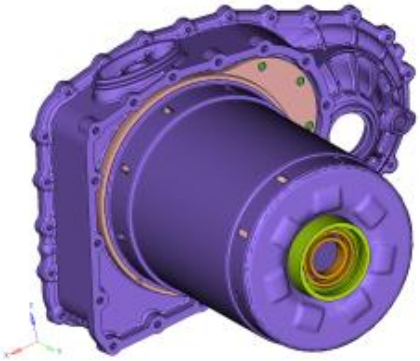




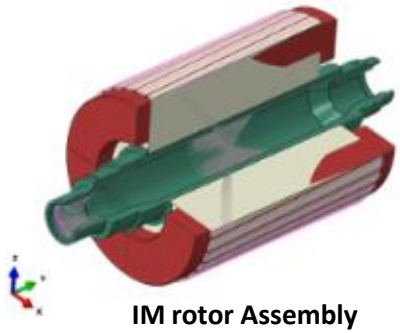




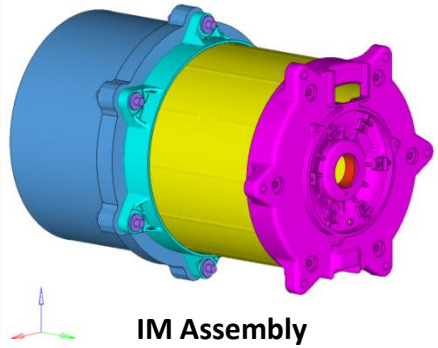
E-Motor Durability Analysis



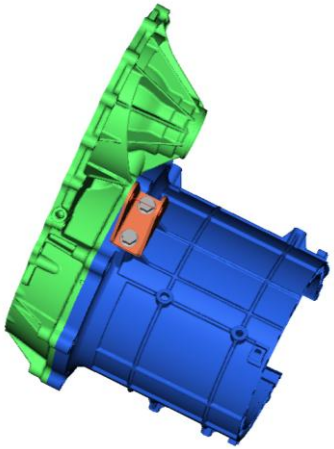
Induction motor with gear box



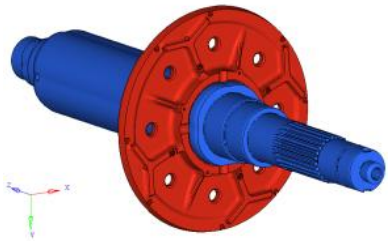
IM rotor Assembly



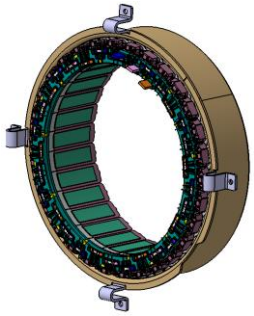
IM Assembly



Motor and transmission assembly

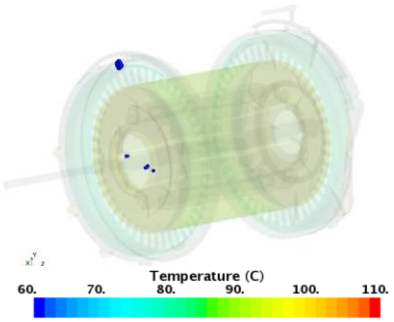


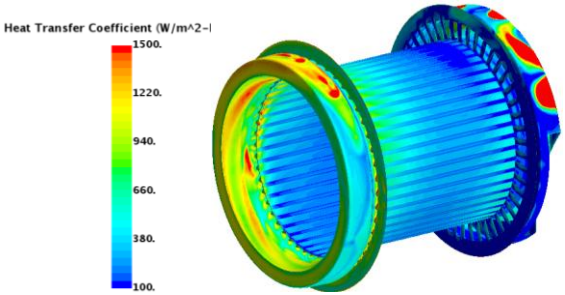
balancing disc & shaft

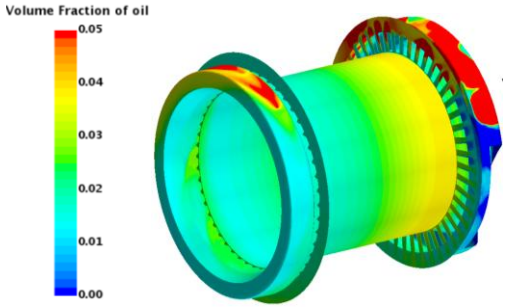


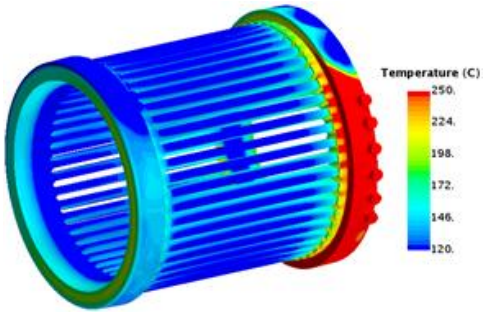
stator & housing assembly

Motors thermal analysis: *Full Hybrid/EV's Traction (PM) motor*



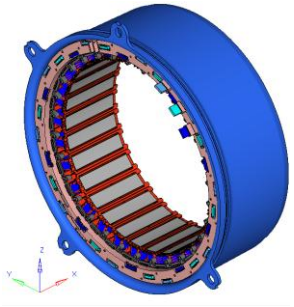


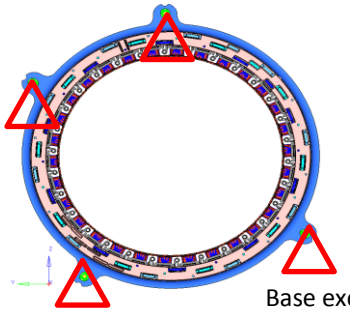




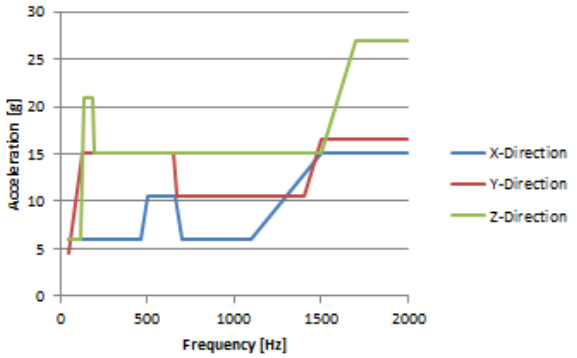
Thermal distribution on stator windings at 2000 rpm

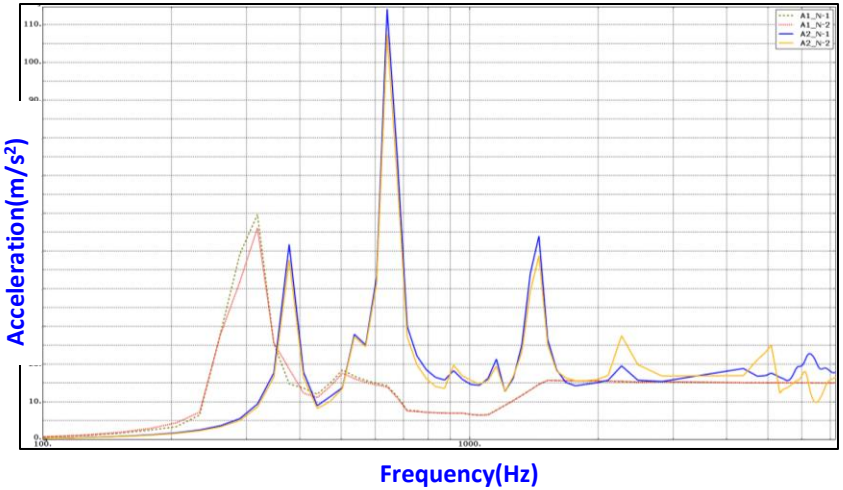
NVH - Forced Response Analysis



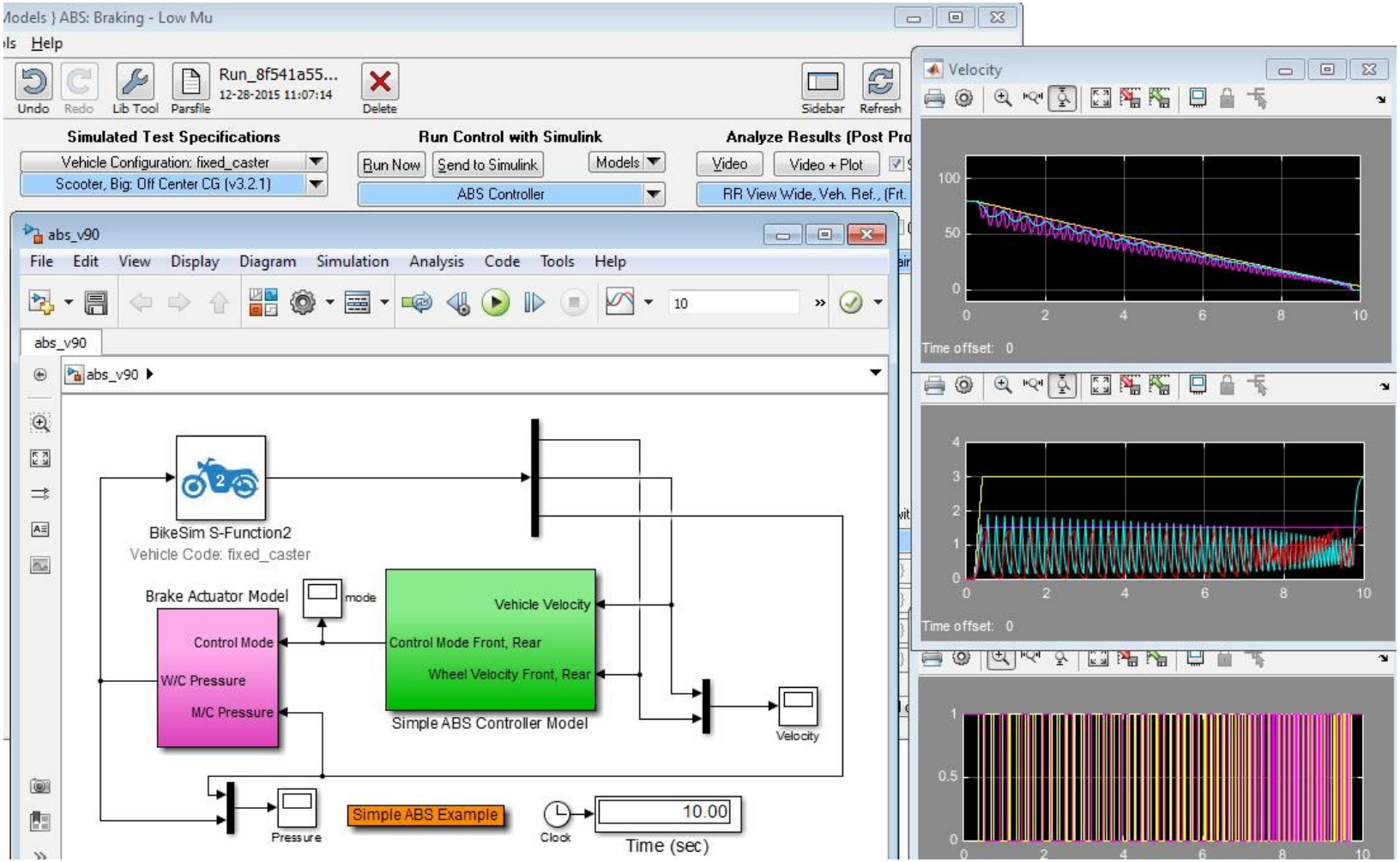


Base excitation



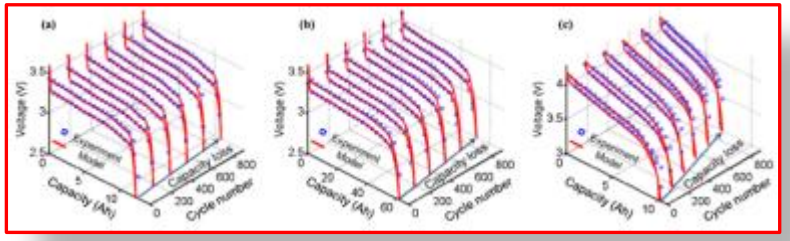


Dynamics:

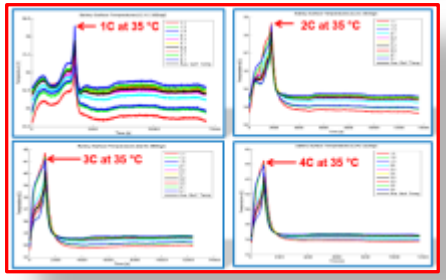

Models } ABS: Braking - Low Mu
Help
Undo
Redo
Lib Tool
Parsfile
Run_8f541a55...
12-28-2015 11:07:14
Delete
Sidebar
Refresh
Simulated Test Specifications
Vehicle Configuration: fixed_caster
Scooter, Big: Off Center CG (v3.2.1)
Run Control with Simulink
Run Now
Send to Simulink
Models
ABS Controller
Analyze Results (Post Pro
Video
Video + Plot
RR View Wide, Veh. Ref., (Frt.
abs_v90
File
Edit
View
Display
Diagram
Simulation
Analysis
Code
Tools
Help
10
abs_v90
abs_v90
BikeSim S-Function2
Vehicle Code: fixed_caster
Brake Actuator Model
mode
Control Mode
W/C Pressure
M/C Pressure
Vehicle Velocity
Control Mode Front, Rear
Wheel Velocity Front, Rear
Simple ABS Controller Model
Velocity
Pressure
Simple ABS Example
Clock
10.00
Time (sec)
Velocity
Time offset: 0
Time offset: 0

BATTERY, ELECTRICAL AND ELECTRONICS:

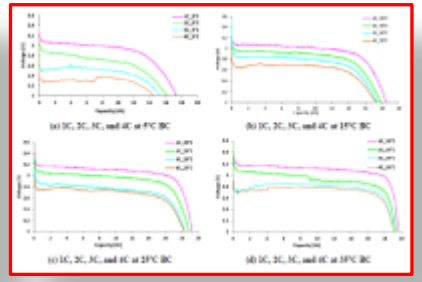
Thermal Characterization of Battery



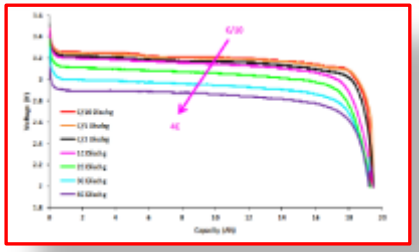
Voltage vs Capacity loss vs number of cycles



Surface temperatures thru TCs

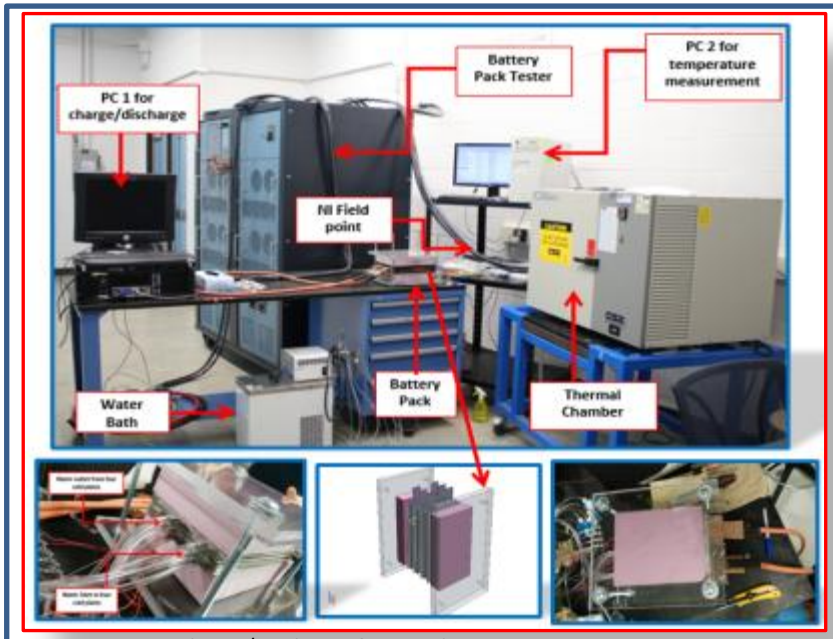


Voltage distribution for pack

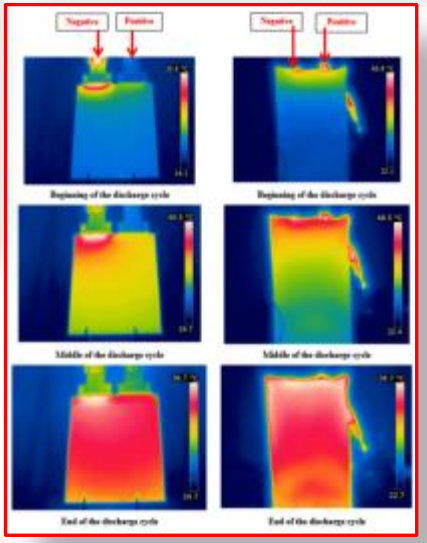


Voltage vs Capacity characteristics

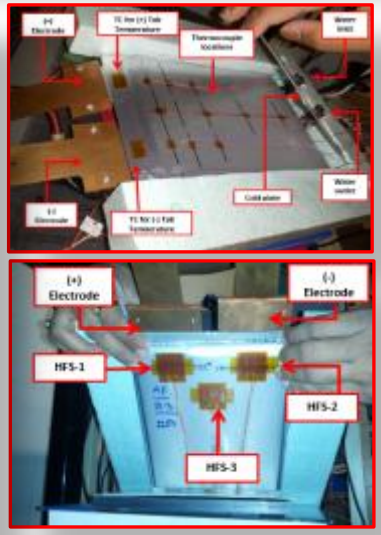
IR Imaging set-up



Charge/Discharge & Degradation test set-up

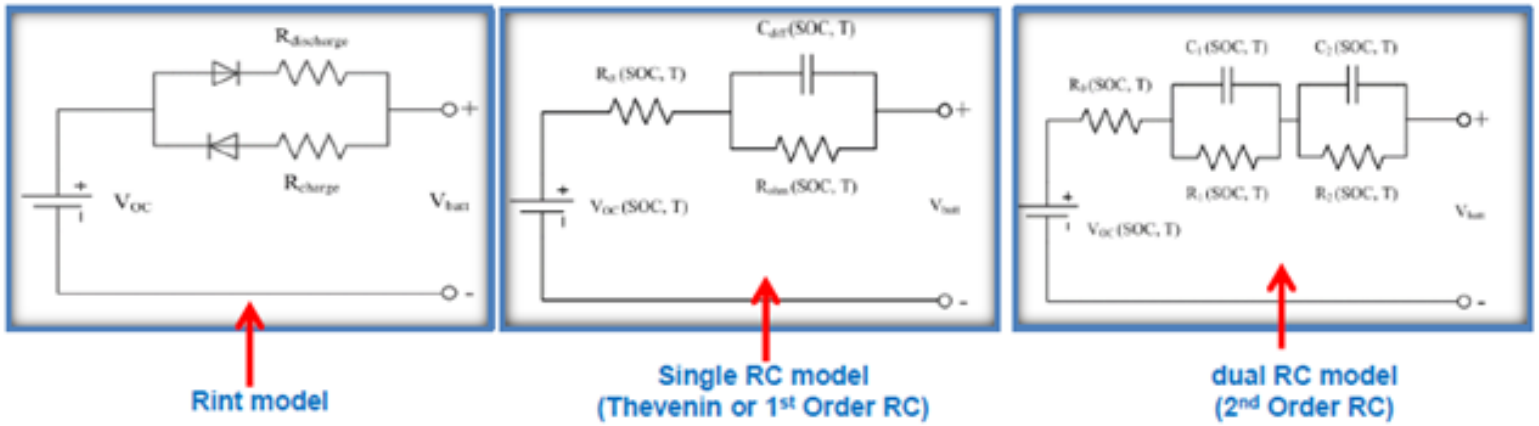


Temp. disbn. Through IR imaging

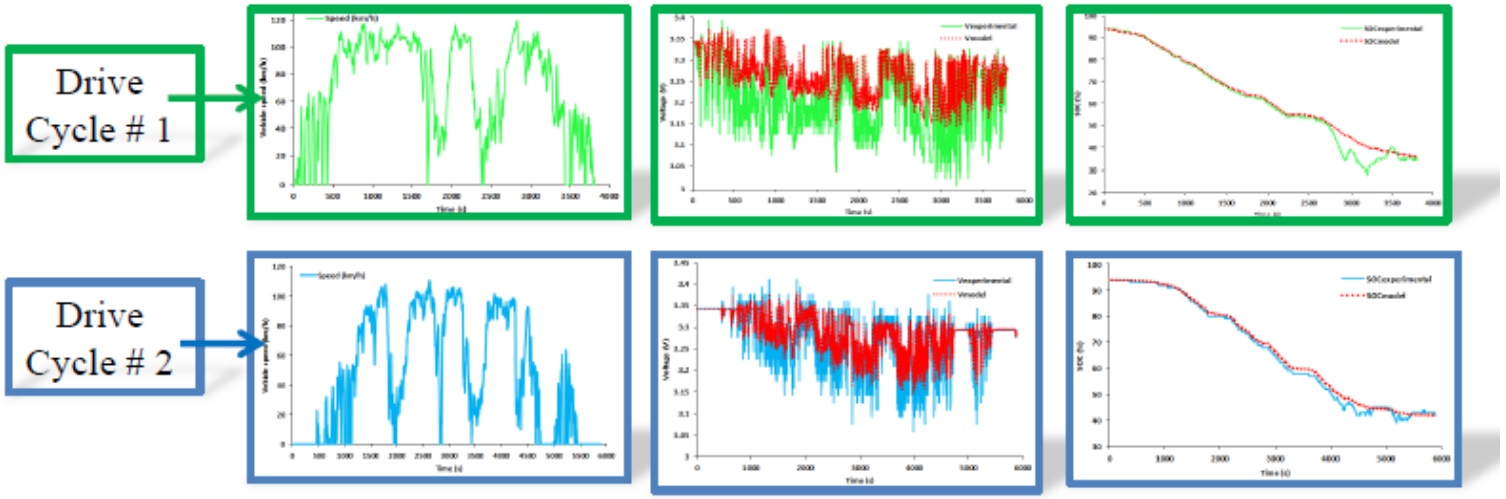


Thermocouples and heat flux sensors locations

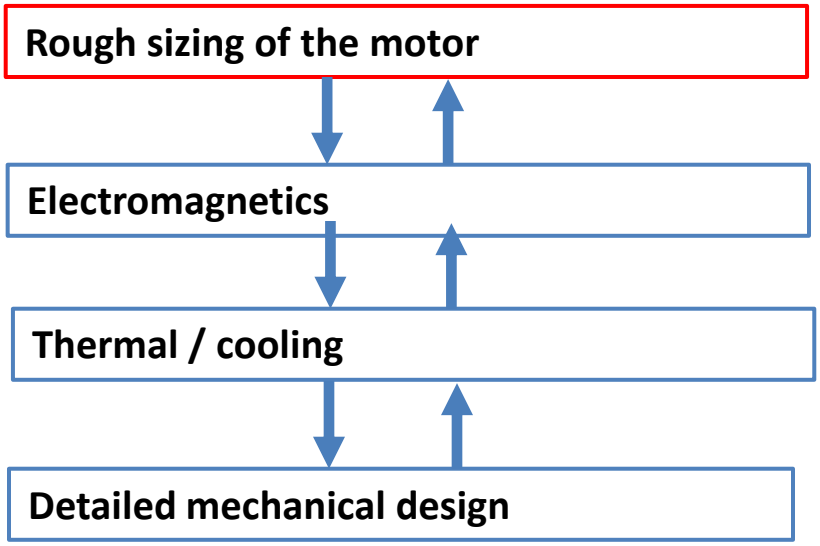
Electro Chemical Modeling - Battery

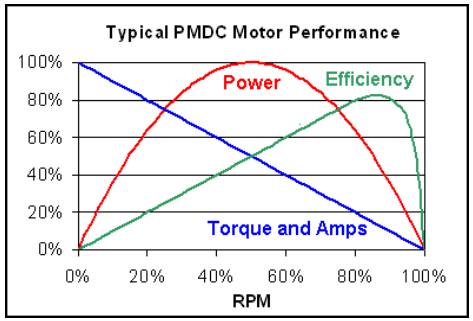


Battery degradation modeling - Battery



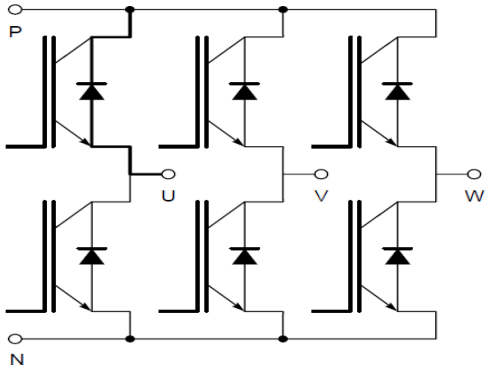
Electric Motor Design Flow:





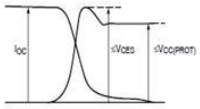
IGBT, MOSFET REVERSE ENGINEERING

Power Circuit Configuration



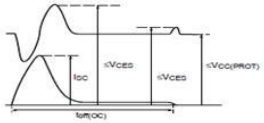
Safe Operation Area (SOA)

Switching(Turn off) SOA

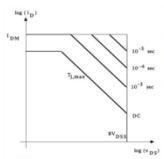


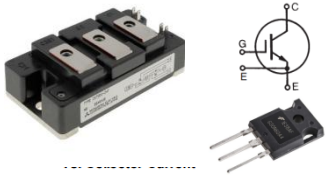
- Maximum allowable simultaneous voltage & current during repetitive turn of switching operations

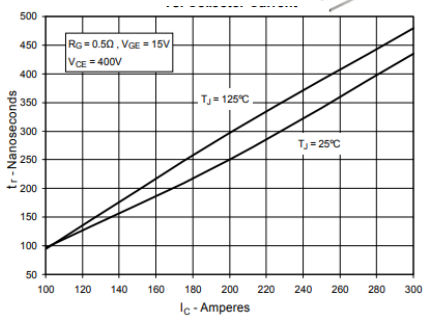
Short circuit SOA



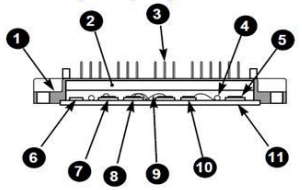
- standard test condition uses a minimum impedance short circuit which causes the maximum short circuit current to flow in the device



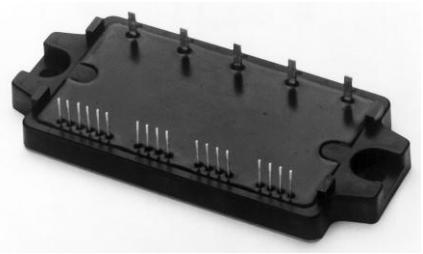




Multi-Layer Epoxy Construction type

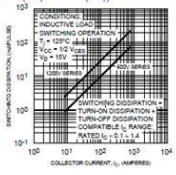


1. Case
2. Epoxy Resin
3. Input Signal Terminal
4. SMT Resistor
5. Gate Control IC
6. SMT Capacitor
7. IGBT Chip
8. Free-wheel Diode Chip
9. Bond Wire
10. Copper Block
11. Baseplate with Epoxy Based Isolation

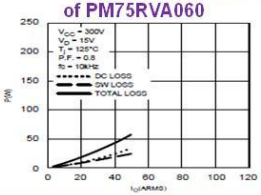


- Modules constructed using this technique are **low profile packages**

Total switching energy ($E_{SW(on)}$,$E_{SW(off)}$) versus I_C



Simulation Power Loss of PM75RVA060



$$P_{(Loss)} = P_{(con)} + P_{(swi)}$$

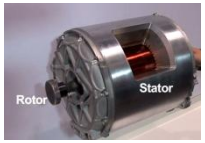
$$P_{(con)} = V_{ce} * I_c = (V_{ceo} * I_c + R_c * I_c^2)$$

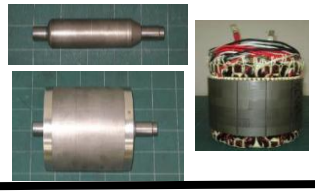
$$P_{(swi)} = V_D * I_D = (V_{Do} * I_d + R_d * I_D^2)$$

COMPETITVE BENCHMARKING:

Reverse Engineering of Electric Power train

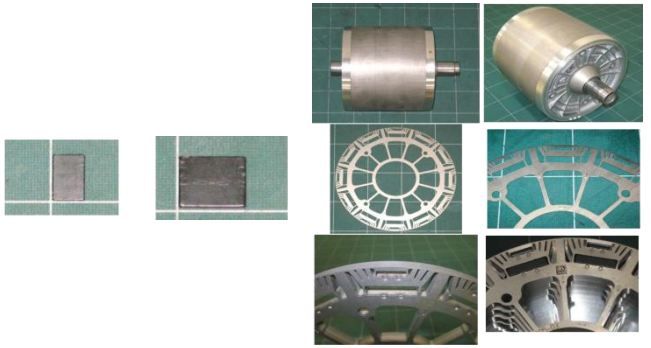
Electric Motor



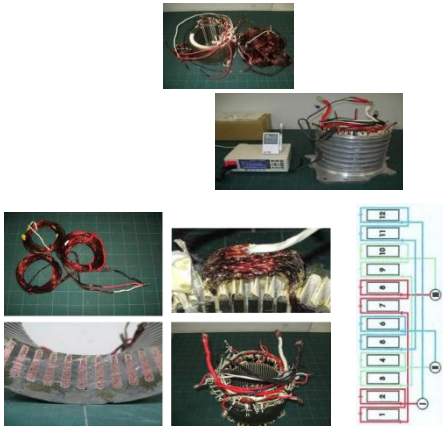


Stator

Rotor

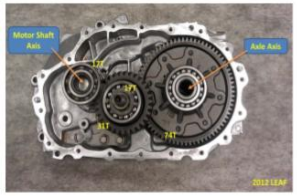


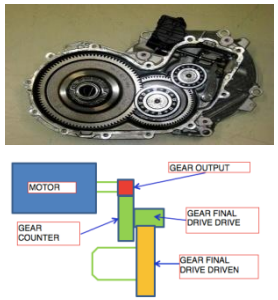
Winding

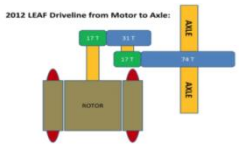


Outer case

Reducer





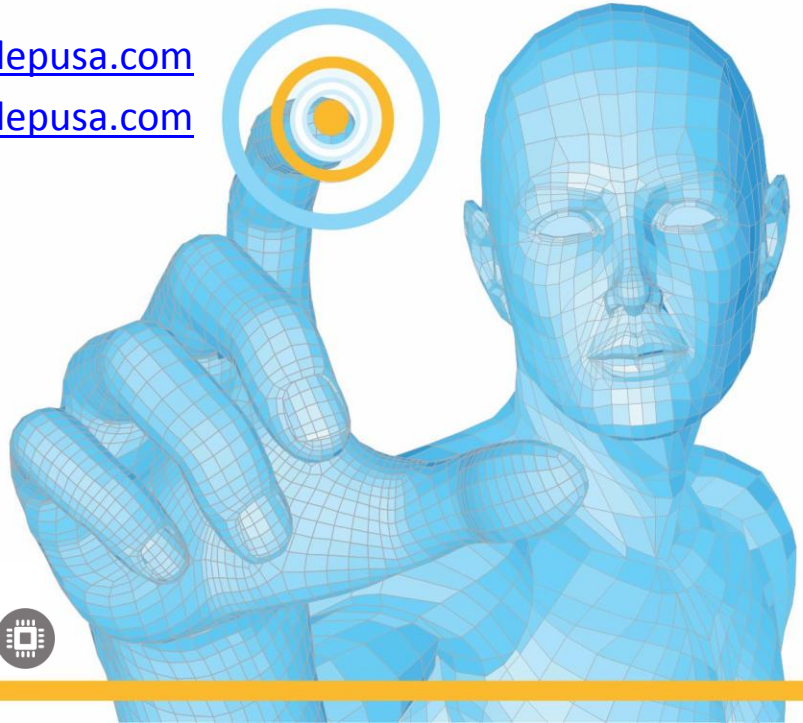


Smarter Solutions. Realized.

Thank you. Have a great day!

Visit our website: www.depusa.com

Write to us: email@depusa.com



Powered by DEP MeshWorks