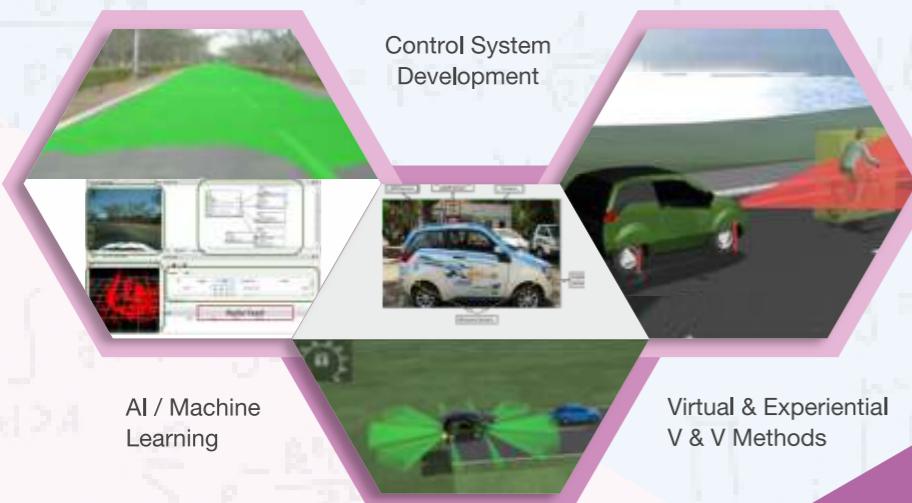


TECHNOLOGY GROUP

Endeavour to Engineer Solutions



INTELLIGENT VEHICLE PROGRAM

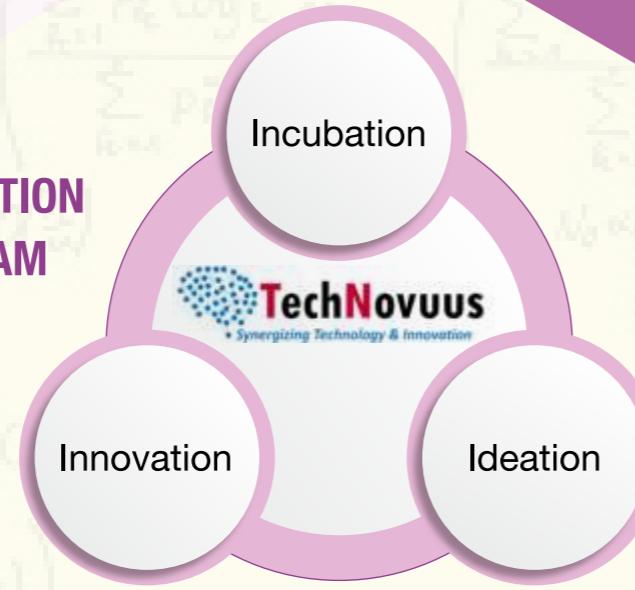


LIGHT WEIGHTING PROGRAM

- Rightweight Product Design by ICME
- Aluminum Superstructure
- Multi-disciplinary Optimization
- Multi-Material Design



INNOVATION PROGRAM



TECHNOLOGY FOCUS AREAS



3W Electric Driveline



x EV PROGRAM

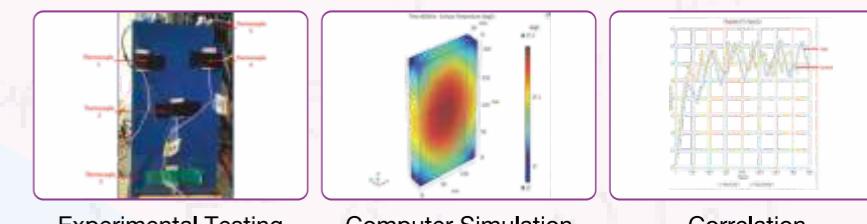


BATTERY ENGINEERING PROGRAM



Re-chargeable Energy Storage System

- Battery Packaging,
- Battery Thermal Management Solution
- LV to HV BMS Development
- R3 and Life cycle Analysis of energy storage systems
- Material based studies for energy storage systems



ADAPTRONICS & IOT PROGRAM

Functional Safety & Engineering



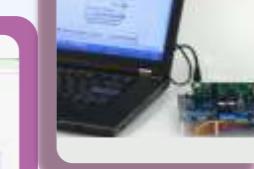
ISO 26262

Model based Development



Automotive Cyber
Security

Verification & Validation



Rapid Prototyping

Verification & Validation



TECHNOLOGY SPECTRUM



Intelligent Vehicle Program

- Drive- By-Wire Platform for AD deployment
- India Specific annotated data set generation
 - Synthetic scenario generation for V & V of ADAS & Autonomous Drive
- Simulation based ADAS & AD Verification & Validation

Battery Engineering

- iMES- Modular/portable Energy Storage Solution
- eMi4 – Battery Management System
- Hybrid Energy Storage Systems

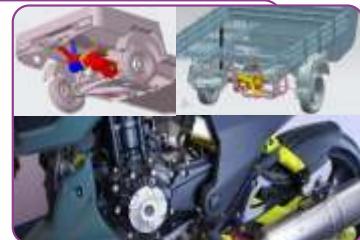


Simulation based Validation

- Hybrid Electric Real Time Simulator
 - BMS, MCU and VCU validation on HIL
- Off-line and Real-Time Simulator for xEV systems

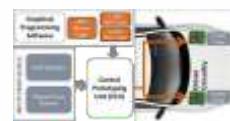
eFFix

- 3 Wheeler Electric Driveline
- DVI – Hybrid 2 Wheeler
- Parallel Hybrid LCV
- iVCON- Intelligent Vehicle Supervisory Controller



Chassis System

- Electric Power Assist System
- Adaptive Front Lighting System
- Anti-lock Braking System and Electronic Stability Program
- Semi- Active Suspension



Powertrain Control Systems

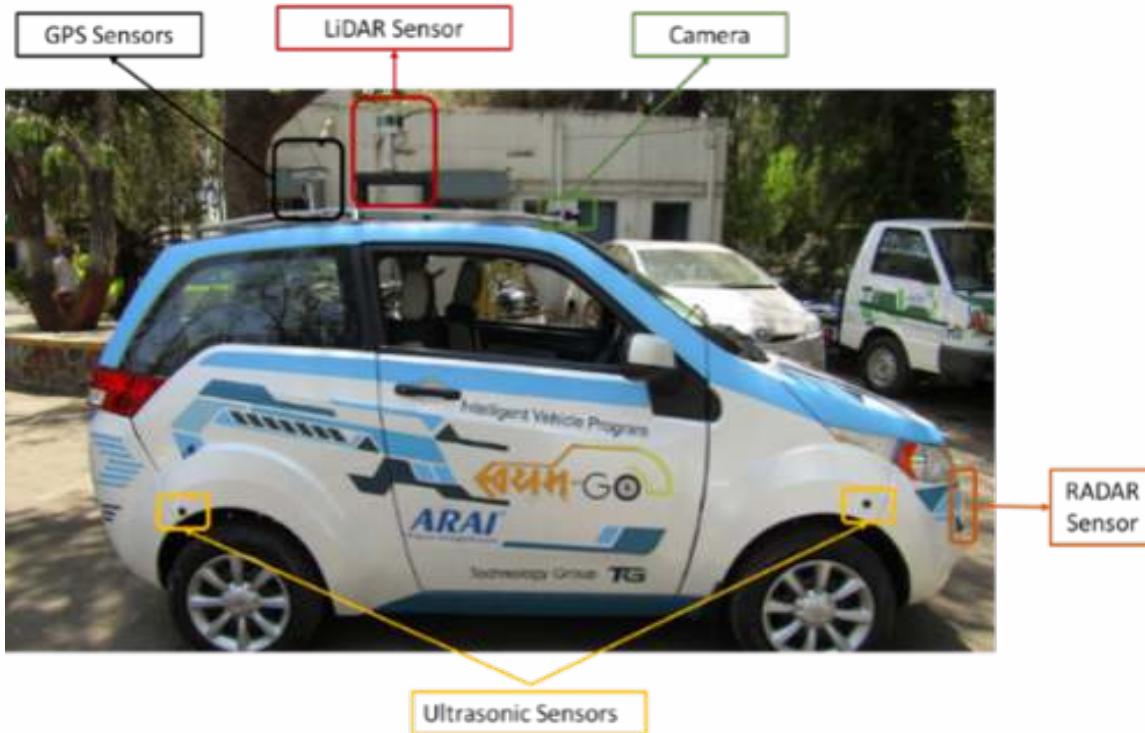
- Dual Fuel – Diesel CNG
- On- Board Diagnostics
- 2 Wheeler Fuel Injection System
- MPFI and GDI Controls
- Automated Manual Transmission Controls

Light-weighting concept

- Aluminum Superstructure
- Multi-disciplinary Optimization
- Multi-Material Design



Drive-by-Wire Platform



The ARAI Drive-by-wire solution provides a comprehensive solution for converting a production vehicle into an Autonomous Ready Vehicle. This includes electronic control of

- Steering
- Accelerator
- Auxiliaries like wiper, head lamps, indicators
- Brake
- Transmission



Features

- Selective Autonomous – Manual Mode
- Fall back safety mechanism
- Emergency stop
- Easy Deployments
- Geo-fencing algorithms
- Precise control of pedal positions, steering angles, vehicle speed, acceleration & deceleration
- CAN/Ethernet based communication with on-board Autonomous Controller
- Easy Troubleshooting mechanism

Advantages

- Quick deployment of ADAS/AD control algorithms on vehicle
 - Vehicle Feedback signals available on network
 - Seamless transition from Auto to Manual Mode and vice versa
 - Additional Algorithm support for LKA, Parking Assist, ACC controls



State of the art HIL facility for validation of xEV controls inclusive of

- Battery Management Systems
- Motor and Inverter Control Units
- Vehicle Controller
- Multi-simulation of xEV Control Systems

The HERTS System comprises of

- NI PXI based Processor
- FPGA I/O cards for motor control simulation.
- I/O's for Engine Management System inclusive of Injection, ignition channels, Lambda probes
- Auxiliary I/O's for emulation of Transmission Control Units, Body Control Modules, supervisory controls
- Dedicated Failure Insertion modules for failure simulation of various ECU's including BMS
- Battery Cell Simulator

Advantages of HERTS

- Reduce Cost
- Reduced Development time
- Perform Abuse Conditions
- Reduced dependency on physical plant
- Continuous V&V at all development phases
- I/O expansion capability
- Early bug detection
- Save costs and reduce risks



Fully integrated hybrid powertrain in a compact vehicle Technology Readiness Level: 6 (System model/ demonstrator tested in relevant environment)

DVI' (द्वि), Sanskrit for the number 2, is a fully integrated mild hybrid powertrain in a compact vehicle. DVI' signifies a number of characteristics of the concept;

- P1 Parallel Coupling
- 2 drive sources
- 2-wheeler (and 3 wheeler) application
- 2 times the bottom end torque,
- twice a typical city drive cycle efficiency

Features

- Innovative integration solution
- Uses an instant response high torque electric motor
- Replaces starting system of existing vehicles
- Packaged within existing vehicles space in an innovative manner
- Simultaneous jerk free shifting between the two drives (engine and motor)
- Operating features include:
 - Start-Stop
 - E-ride
 - EV only crawl
 - Boost
 - Assisted engine braking
 - Launch Control
 - Regeneration
 - Hill start
- Higher low end torque for enhanced low speed performance
- Higher fuel efficiency
- Lower emissions and reduced after-treatment hardware requirement