Tools and Skills

- Software: MATLAB/Simulink/Stateflow, C-Programming, NXP/TI/Raptor MBDT, DaVinci Configurator
- Testing: Simulink Test Manager (MIL/SIL/PIL), RCP
- Systems Engineering: Simulink Requirements Manager, Polarion, System Compser, Magic Draw.
- Hardware: DORLECO Smartcase (NXPS32K1/3xx), New Eagle-Bosch (GCM-196/48) (Infineon TC1793), Cascadia/XPT/Curtis/Sevcon/ASI/Kelly Motor Controllers, Log9/Orion BMS, Amphenol 3in1 units, Bosch Throttle body
- Communication Tools: CANoe, Vector/Kvaser/Peak CAN devices, Kvaser Database Editor, CANKing, Bus Master, CANdb++, CANopen Magic

Projects

As a Lead Vehicle Controls Software Developer:

Vehicle Control Software

1. Electric Vehicle VCU Supervisory Software Development:

- As the product owner for DORLECO's EVcode, I spearheaded the development of critical functions from scratch, including state machines for Startup, Shutdown, and Sleep modes, Drive-Charge-Update-Fault modes, PRND Direction Determination, Torque Arbitration, Cruise Control, AC Compressor Control, Cooling Pumps and Fan Control, Power Steering Control, HVIL and HV Isolation Management, Fault Management (including data saving, DTC trigger, and safety checks), and Vehicle Speed and Odometer Calculation.
- For testing, I designed a vehicle test harness for Model-in-the-Loop (MIL) testing, performed Processor-in-the-Loop (PIL) tests by flashing evaluation boards and DORLECO ECUs, and executed pseudo-Hardware-in-the-Loop (HIL) tests with a plant model on a separate rapid control prototyping (RCP) unit and control logic on the DORLECO ECU.

2. Engineered application-level libraries for efficient processing of CAN, Digital, and Analog (pull up/down) inputs, and output (High/Low side driver) Signals. Furthermore, developed an NVM management library for easy calibration parameter saving and updates using calibration tools.

3. Generated specific VCU software requirements for a client (Indian OEM developing commercial EV), implemented software modifications, and seamlessly integrated the software with the client's vehicle on-site.

5. Developed VCU software for an electric off-road Baja vehicle, supporting a collegiate team in their endeavour.

6. Developed VCU software for an electric boat from a Michigan-based company using a 350-800V battery system and a 450HP motor.

7. Developed VCU software for an electric golf cart and set up a tech bench for rapid prototyping.

8. Developed the requirements and software architecture for a 2-speed transmission used in a California-based OEM’s class-8 EV truck.

9. Developed and calibrated electronic throttle control software using PID and Feed-forward loop. The model was developed using Raptor libraries and tested on a Suzuki SX4 throttle body.

10. Worked on requirements generation, TARA analysis, and DVP generation for CAN message authentication, secure diagnostics, and software signing for System on Chips on Ford's ADAS ECU DAT 3.0 platform.

- *Vehicle Modelling and Simulation*

1. Developed EV sizing software that OEMs can utilize to accurately calculate component sizes for motors, batteries, and other powertrain elements. The software employs estimation techniques, as well as backward-looking and forward-looking vehicle models.

2. Analysed the efficiency improvement achieved by using a two-speed transmission in light commercial electric vehicles.

3. Analysed the best HEV powertrain architectures and supervisory control techniques for converting a commercial diesel pickup truck to an HEV.

5. Developed high-fidelity models serving as tools to conduct performance analysis for various high-speed EVs.

As an Intern:

1. ADAS L-2 Controls:

- Controls software development (PID, Feed-Forward & MPC), and state machine design for AEB, FCW, and ACC features.
- Created a novel control logic for lane-centering systems and published work in SAE.
- Contributed to prediction algorithm optimization, scenario generation, and testing of ADAS features.

2. Motor Controls Development:

- Developed trapezoidal, and field-oriented control algorithms for BLDC and Synchronous Reluctance motors.
- Developed the first principal equation-based motor models and performed parameter estimation and system identification.

3. Vehicle Dynamics Analysis:

- Developed 14-DoF complete equation-based vehicle dynamics model from scratch in Simulink.
- Introduced lateral controls using individual motors (TCS) and brakes (ABS) to control yaw rate, and slip angle and eventually prevent rollover.

As a Professional Trainer:

1. Developed a Simulink model of the Ford Maverick HEV. Researched control strategies that could achieve an economy of 37 mpg by Ford. This was done with a group of 2 students over three months.

2. Trained a group of 4-5 students on how to create control software for automatic and manual transmissions using Stateflow, following the V-cycle in Model-Based Design (MBD).

3. Developed PMSM and synchronous reluctance motor models, as well as DTC control software, with an intern for over 6 months.

4. Developed data-driven models for battery equivalent circuit cell and Battery Management System software using Kalman filters in MATLAB, collaborating with an intern for over 6 months.

5. Developed E-differential and torque vectoring controls software for trainees.

6. Delivered several 10-hour IEEE-certified bootcamps on rapid controls prototyping using Raptor libraries and the GCM196 Bosch VCU.

7. Overall, trained close to 30 students on a comprehensive spectrum of topics including vehicle controls, classical control theory, MBD, MATLAB/Simulink, V-cycle development, vehicle communication, Rapid control prototyping, and automotive systems engineering.

- As a Technical Recruiter:

1. Conducted 30-plus interviews for vehicle controls and electronics engineers and interns.

2. Developed assignments for the technical recruitment process.

3. Played a pivotal role in team-building from ground-up in a small start-up by hiring 8 engineers in 2 years.

Research Papers

1. A Comprehensive Rule-Based Control Strategy for Automated Lane Centering System

- SAE International Journal of Connected and Automated Vehicles
- 18 Apr, 2022

2. A Comparative Study of the Effect of Parallel vs Ackerman Steering on 14 DoF Real-Time Vehicle Simulation Model

- WCX SAE World Congress Experience
- 29 Mar, 2022