Department of
ENERGY TECHNOLOGY
E.T.

AALBORG UNIVERSITY
DENMARK

Vehicle Control Unit

The Vehicle Control Unit (VCU) is the brain of the vehicle and also the interface between the driver and the vehicle. Basically it takes the commands from the driver and converts these into subcommands for the remaining subcomponents.
The VCU prototype is displayed in Fig. 1.

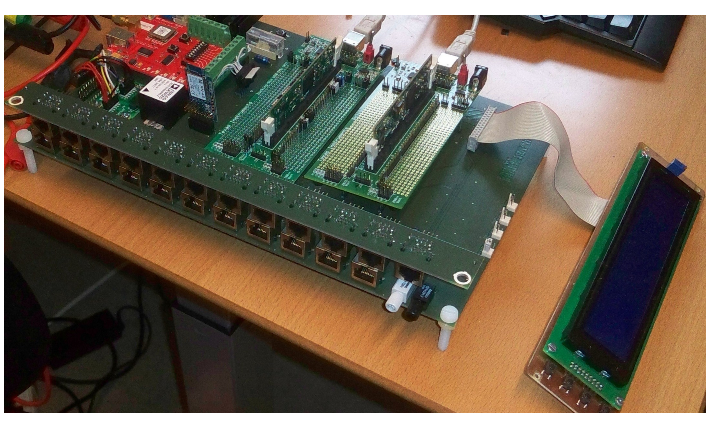


Fig. 1: VCU Prototype.

VCU Components & Signals

A VCU works by gathering data, which is processed and from this a decision is obtained. This might be from the driver, but can also be from one of the sensors. Hence the VCU requires several signals to proper do the required actions. To the right in Fig. 2 the VCU prototype layout and connections are displayed.
Components & signals:

- 1st DSP has the critical tasks of controlling the vehicle systems
- 2nd DSP has the non-critical tasks of containing the Man Machine Interface (MMI), Data logging, etc.
- GPS measures; position and speed.
- Inertial Measurement Unit (IMU) measures; rotation of the vehicle and acceleration in all directions.
- Motor Control Unit (MCU) connection measures motor speed and sends torque references.
- RJ-45 array measures; accelerator & brake pedal, gear lever, Battery Management Unit (BMS) data (State of Charge (SoC), temperature, etc.) and ignition key. And sends control signal to servo pump, cooling pump, battery fans and the original VCU installed in the car by AUDI to make it believe the car is in reverse.

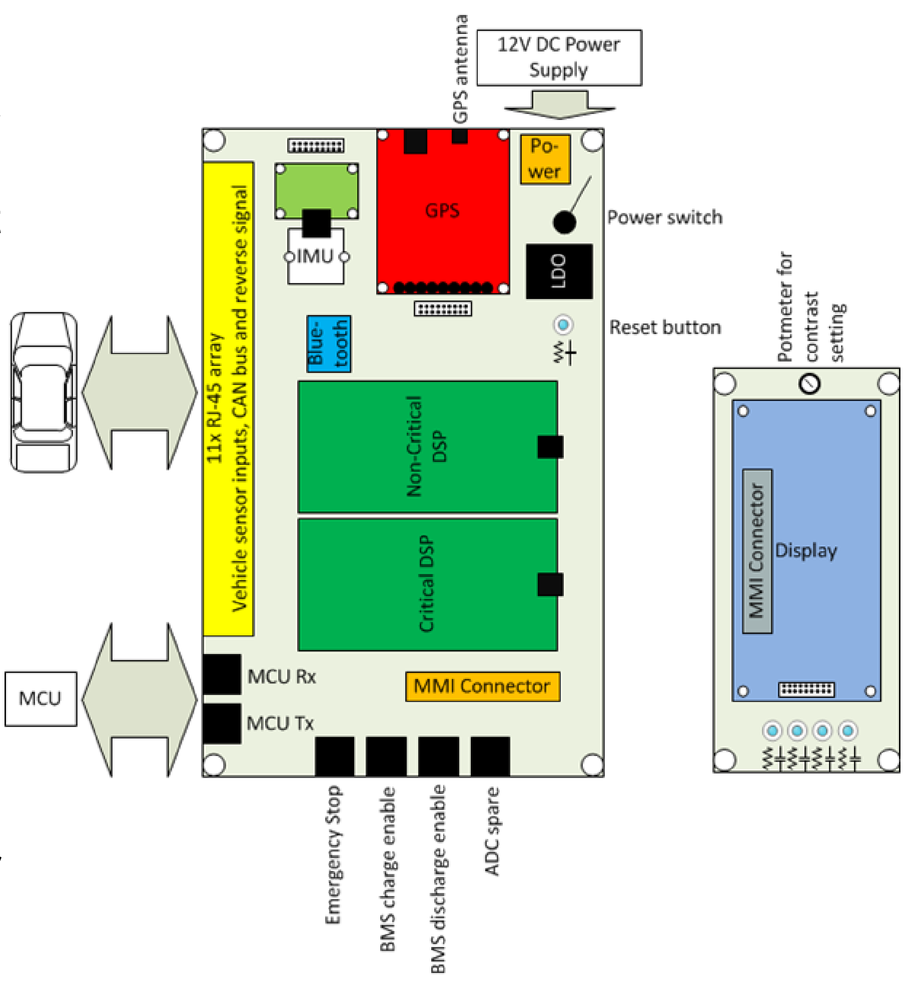


Fig. 2: VCU Prototype Layout.

The VCU-MMI contains:

- Display with: BMS data (SoC, temperature, and errors), power usage, speed, direction and mode
- Bluetooth for transferring data to external data logger or display

Outlook

There are several options for future improvements to the vehicle, which are presented in the following list:

- Electronic Stability Control (ESC) - Individual motor control gives the possibility to use torque vectoring, which is a more precise way of gaining ESC without using rear brakes, as on conventional combustion vehicles.
- Torque steering - With two torque references each to their respective motor, the option exists to control them individually, which through torque vectoring theory aid the vehicle turn. This is illustrated in Fig. 4, where it lowers the size of the red vectors. In Fig. 4, the green arrows are the resulting force on the vehicle from the motor torque. Red arrows are forces from the tires on the vehicle. The black/white mark is Center of Mass and the blue/white is Center of Rotation. Orange is a possible drive path for the vehicle.
- Dynamic brake energy recovery system - Integration of brake force with energy recovery has interesting options as they can be combined with the two other options presented above.

These options will be tested on a RC test platform illustrated in Fig. 3.

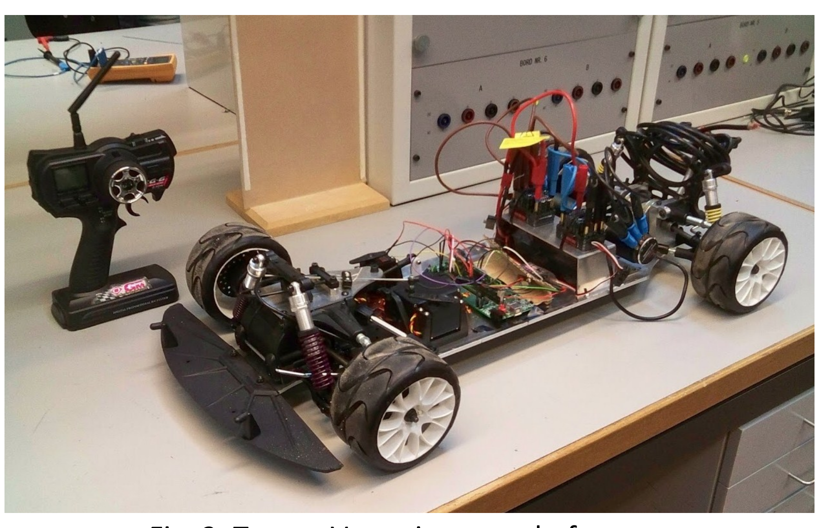


Fig. 3: Torque Vectoring test platform.

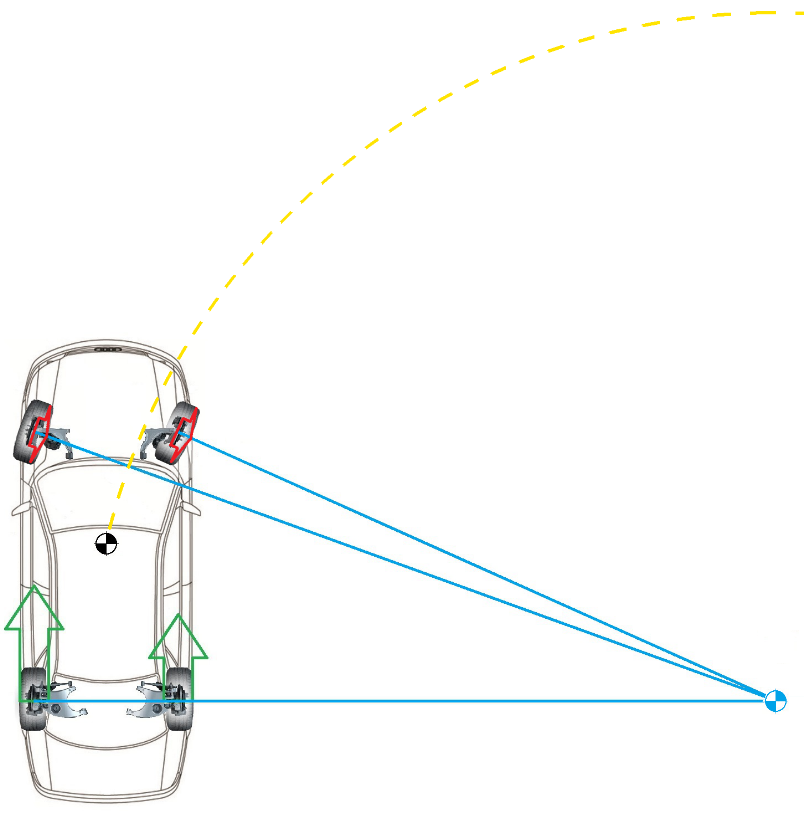
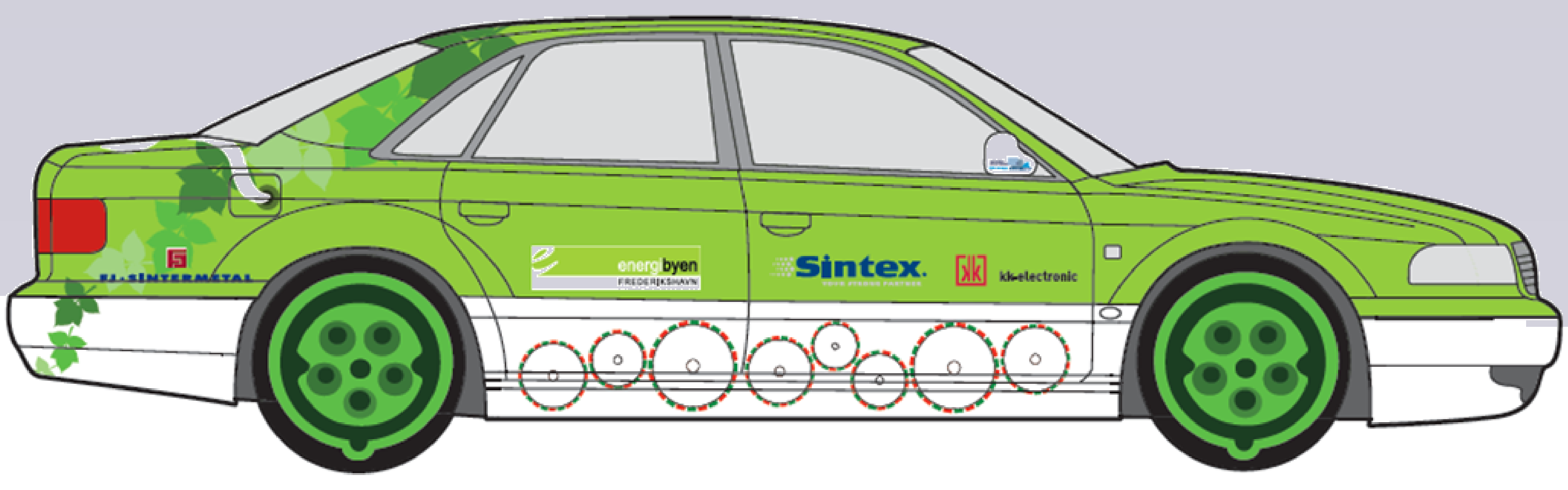


Fig. 4: Example of Torque Vectoring during cornering to obtain torque steering.



Sintex
LiTHIUM BALANCE
kk-electronic a/s
NEFORS
energibyen FREDERIKSHAVN
Danfoss
NEAS ENERGY
SBE
Sertenergy The Power of Simplicity
FJ-SINTERMETAL
Elektro-Isola
DONG energy
GRUNDFOS
AUTO COLLEGE AALBORG
NEOGRID TECHNOLOGIES

Department of
ENERGY TECHNOLOGY
E.T.

DEN EUROPÆISKE UNION
Den Europæiske Fond for Regionaludvikling
Vi investerer i din fremtid